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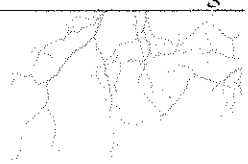

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Peer Review of the Report:
Viticultural Potential of the Soils on the Lake Luciana Golf Course.
November 12, 2007, by Alfred Cass & Associates

Introduction

The objective of this report is to provide a professional peer review of the report: Viticultural Potential of the Soils on the Lake Luciana Golf Course (dated: Nov. 12, 2007) that was produced by Alfred Cass and Associates.

This peer review will discuss: (1) the methods and findings of the field work; (2) the interpretation of the findings regarding inconsistencies with the Napa County Soil Survey; and (3) conclusions regarding the suitability of the soils for premium winegrape production.

Review of Fieldwork and Findings

The methodology used by Cass follow those of Schoeneberger (et. al. 1998) that have been adapted primarily to reduce the time in the field with the understanding that the soil analysis is for a commercial or agricultural endeavor and not an academic process. Consequently, horizons with only very minor differences in color, texture, structure, or hardness are lumped together, rather than differentiated. This process frequently reduces the number of horizons described per profile evaluated.

The methods employed by Cass are widely accepted for the evaluation of agricultural soils for viticultural production.

The Napa County Soil Survey (NCSS) was used as the preliminary reference document for determining the major soil types within the study area. The NCSS provides map units that are named after a soil phase, which is a sub-unit of the soil series. A soil series consist of characteristics that identify a soil by thickness of horizons, texture, structure, hardness, rock content, and a few chemical properties.

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The soil phase identifies a soil by more exact properties within a series. The principal distinction is changes in the surface soil texture, gravel, and slope. Within each map unit (area drawn on the map) smaller areas of other soil phases are permitted. If an area of land has two or three primary soil phases that are not easily mapable at the scale of the survey the soils may be classified as a complex. For example, one of the soil map units found on the Luciana Golf Course is the Bressa-Dibble-complex.

The soil map units for the study area for the Cass report are:

Bressa-Dibble complex, 5-15% slopes
Bressa-Dibble complex, 15-30% slopes
Bressa-Dibble complex, 30-50% slopes
Contra Costa gravelly loam 5-15% slopes
Maxwell clay 2-9% slopes
Millsholm loam, 15-30% slopes

The Bressa Dibble complex is quite common in the Pope Valley Area. The two soils are generally differentiated by their amount of silt and clay with the Bressa having a surface texture of silt loam and subsoil of silty clay loam and the Dibble having a surface of silty clay loam and the subsoil of silty clay or clay. Both soils are relatively shallow 24" to 40" over weathered fractured shale or very fine-grained sandstone.

Cass added the Millsholm loam to the Bressa-Dibble complex as a means to lump similar soils. The Millsholm loam is generally quite different from the Bressa-Dibble soils in that it is has a very thin loam surface horizon over a very shallow clay loam upper subsoil. The depth to 80-95% fractured sandstone is typically only 12"-18". Although these soils are morphologically different, all three are considered highly suited to high quality winegrape production. Therefore, the lumping of these three soils into one group within the confines of the report limits the distinctions in soil quality that could be made. However, since all three are all identified as highly suitable, it does not restrict the total area that would be considered suitable for premium winegrape production.

Cass is correct in his assessment of criteria that are important in determining the relative suitability of soil for premium winegrape production. Rating systems such as the California Agricultural Land Evaluation and Site Assessment Model (LESA) or the Stori Index do not provide sufficient specific criteria and do not properly evaluate the specific needs of winegrapes compared to other agricultural crops.

The profile logs of each site provided by Cass were reviewed for morphological characteristics. It is assumed that the data collected by Cass in the field (texture, structure, rock type and content, etc.) is correct. There is no way to determine their accuracy without re-opening the pits and re-assessing the profiles. Considering the

vast experience of Cass, a re-assessment of the actual field work was deemed un-necessary.

A review of each of the 66 profiles profile found only two major discrepancies regarding the profile's morphological characteristics the grouping of the soils by Cass.

- Site 286 is identified by Cass as a Contra Costa loam, but its morphological characteristics indicate it would be better identified as a Henneke. The location of the site near the T-Box of hole 6 and in the middle of the open and relatively flat alluvial plain is unlikely for the Henneke, which is typically a hillside soil. However, the profile has the brown to reddish brown surface and upper subsoils over fractured serpentine, which is quite characteristic of the Henneke.

- Site 308 is identified by Cass as being Maxwell clay but its morphological characteristics indicate it would be better identified as Group 10 Alluvium over Maxwell clay. There are two alluvial layers of clay loam and coarse sandy loam over the clay in the subsoil.

- There are many sites that are not clearly distinguishable between the Bressa-Dibble and the Contra Costa. Cass appears to have used the surface and upper subsoil texture to distinguish these groups, with the Bressa-Dibble requiring at least two horizons of silt loam or silty clay loam. If only clay loam was present the soil was classified as the Contra Costa. This division between morphological groups is appropriate.

Map Units of the Golf Course Site

The revised soil map presented by Cass is similar to that of the Napa County Soil Survey (NCSS), but with several major modifications. The NCSS has Maxwell clay mapped only at the tees, faraways, and greens for hole 2 though 7 which occupy the southeastern third of the total area. Profile data indicates that the Maxwell clay extends much father north into the central basin (holes 1, 8, 10, 11, 17 and 18) and along the edges of the major stream beds that feed water into Lake Luciana in the northwest portion of the study are. This data is consistent with the geomorphological processes that could have lead to the deposition and formation of Maxwell clay from serpentine rock found to the east and north of the golf coarse area. The Maxwell clay is an alluvial soil formed from the deposition of montmorillonitic clays derived from serpentine. The Henneke soils are residual soils formed directly on the serpentinic rock material on the eastern and northern hillsides. Differences between the soil survey map units and the actual soils found on the landscape are quite common and should be expected. As stated earlier in this report, a soil map unit may

have upwards of 20-30% of its area consist of soils that are different from the soil used in the map unit name.

The revised soil map presented by Cass is generally in agreement with the soil profile groups that he identified. There are a few soil profiles that exhibit characteristics of one soil type isolated and completely surrounded by other soil types. Considering the density of the soil profile sites (one pit per 2.8 acres), there is still a high degree of internal consistency in the mapping units proposed by Cass. For example the Contra Costa loam is a residual (formed in place) soil generally found on lower elevations next to alluvial soils. There are four major areas that are mapped as Contra Costa loam. Two of these areas (Sites 313, 343, and 344; and 305, 306, 315, and 336) are on moderately sloping uplands at the edge of alluvial basins. The other two are slightly elevated ridges that are essentially islands surrounded by Maxwell clay (301, 316, and 332; and 286, 292, 300, and 328). As was noted earlier, it appears that 286 would be more likely identified as Henneke loam, but was classified by Cass as a Contra Costa loam. The Henneke map unit that dominates the north and eastern hills appears to be the source for much of the alluvium that is now the Maxwell clay found in the open central basin designated for the golf course. The differences in the NCSS soil map and the map proposed by Cass is consistent with the scope and scale of the NCSS mapping procedures and the soil evaluation conducted by Cass.

Soil Suitability Assessment

Cass used the morphological and chemical data generated from each profile site to determine a relative suitability rating for each soil group. This rating system was constructed only for the soils within the Luciana Golf Course area and assigned the best soils with a rating of 1 and the worse with a rating of 10. This concept of best and worse is based on an assessment solely for the production of high quality winegrapes. This assessment is not necessarily appropriate for judging the suitability of the soils for golf greens, faraways, or any other agricultural endeavor. The criteria for this suitability assessment are derived from limited published scientific literature and professional experience. Qualitative ratings of wine and the soil on which they grow is frequently fraught with unsubstantiated conclusions. However, most of those proposed by Cass are generally widely accepted and relate to soil water availability, water drainage and soil aeration, and soil chemical composition. Since Cass and a handful of other professional soil scientist are on the cutting edge of the state of the art in soil assessment for vineyard design, there are some criteria that he believes critical and that other evaluators might assess as relatively unimportant and visa versa. However, after several years of in-depth assessment of the criteria used by Cass and others, I believe his criteria are valid.

The major criteria used by Cass are related to the interaction of the morphological characteristics to develop soil structure, hardness, and the effective rooting depth. These properties then determine the availability of water to the vines and the potential of the vines to penetrate the soil to sufficient depths to retrieve the water from a rather broad soil pore size distribution. The model proposed by Cass assumes that vines can have access to insufficient as well as over abundant water during a season, and the optimal amount of water for premium winegrape production is between these extremes.

The second major criterion is related to the chemical constituents of the soil and their impact on soil structure and vine nutrition. The primary soil chemical properties of importance are the concentrations of magnesium, sodium, and boron, and the total amount of soluble salts. All of these constituents have severe negative impact of winegrape quality if they are too high, and they are moderately to quite difficult to rectify.

Cass then assessed each soil group in relation to that group's situation related to the each physical and chemical property and the impact of a proposed modification to a property. Based on applying the assessment criteria form each of the major soil properties to each soil group Cass then placed each group into the relative rating scheme as follows:

Rank 1 - Deep Bressa-Dibble-Millsholm Complex
Rank 2 - Shallow Bressa-Dibble-Millsholm Complex
Rank 4 – Alluvial Soils
Rank 5 – Contra Costa loams and manufactured soils
Rank 7 – Alluvial soil over Maxwell Clays
Rank 10 – Maxwell clays

Each of the rankings are well justified based on my experience in the viticulture of Pope Valley and Napa County. The Bressa-Dibble soils are among the best in this area for viticulture due to their relatively well balance soil chemistry (many properties at or near the optimal range) and relatively low soil water holding capacity that allows for relatively precise water management throughout the season. The high concentrations of rock in the Bressa and Dibble soils reduces overall soil water holding capacity and upon tillage, the re-distribution of the rock within the tilled-zone moderates the somewhat marginal soil structural, drainage and aeration characteristics. The Millsholm loam is generally so shallow over sandstone, that it behaves significantly differently than the Bressa-Dibble that it should not have been lumped into the Bressa-Dibble group. However, it is also a high quality viticultural soil with a very low total available water holding capacity even after tillage. Irrigation of the Millsholm is generally much more critical than the Bressa-Dibble.

The shallow Bressa-Dibble group has a lower total available water holding capacity at any depth compared to the deeper version because of the higher rock content.

The Alluvial soils assessed in the report were judged to be of good quality, but their distribution is quite limited and dispersed into areas dominated by other groups.

The Contra Costa loams described by Cass are generally more clayey than the typical NCSS soil profile description and have more degraded structure and are harder. This is most likely due to the influence of the neighboring Maxwell clays that have very high clay and magnesium content. These soils will require more inputs, more attentive management and will still pose less than optimal behavior.

The Maxwell clay soils are among the absolute worst viticultural soils. They have very poor physical and chemical characteristics that are not easily managed, especially for high quality fruit production. Cass provided a summary of the major physical problems with the Maxwell clays and why they are considered either marginally suitable or unsuitable for production of high quality of winegrapes. His discussion did not address the chemical properties that are problematic other than the high magnesium content. The Maxwell clays also have problems with the bioavailability of potassium and phosphorus that severely limit their viticultural value.

Conclusions

Alfred Cass and Associates evaluated sixty-six (66) soil pits within the 180 acre area of the proposed Lake Luciana Golf Course. The soil profiles were photographed and the morphological characteristics of the soil profiles were recorded. Soil samples were taken from most of the described horizons and submitted for chemical analysis.

The soils were then evaluated and placed into soil groups based on their similarity to the soils that are mapped for the area in the Napa County Soil Survey. This classification resulted in placing the soils into seven groups. The location of each evaluation site was placed on an aerial photo and a new soil map was created based on the classification of the soil profiles into the groups. This new map was similar to that provided by the Napa County Soil Survey, but had many obvious discrepancies. This level of discrepancy is not uncommon and should be expected as county soil survey map units are evaluated for uniformity and location of soils of similar characteristics.

The classified soil groups were then evaluated in relation to their physical and chemical characteristics that are pertinent to the production of high quality winegrapes. The soil groups were assigned a value of 1 to 10 with a 1 being the best of the groups and 10 being the worst of the groups. This system did not try to compare these soils to other soils of Napa County, but was limited to the relative merits of the soils found on the proposed golf course area.

The rankings were consistent with generally perceived criteria for judging the suitability of soils for viticultural production. Based on the rating system employed the Bressa-Dibble and Millsholm soils were considered most suitable and the Maxwell clay the least suitable for the production of high quality winegrapes. I concur with the Cass assessment and the ranking of the soils relative to their viticultural suitability.

Disclaimer

The conclusions and/or recommendations included in this report are based upon the data and information available to Anamosa Inc. - Vineyard Soil Technologies at the time this report was prepared. All conclusions and recommendations are time and site specific and are directed to the specific and stated needs of the addressed clients only.

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