Guidelines for Calculating *Annual Soil Loss* Using USLE for LandSmart Vineyard Plans

Developed by Napa County Resource Conservation District (RCD), with assistance from the Napa Field Office of the USDA/Natural Resources Conservation Service
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The Universal Soil Loss Equation (USLE) is an empirical model derived from data compiled—beginning in the 1930's--by the US Department of Agriculture, National Soil Loss Data Center at Purdue University. The purpose of this effort was development of a quick approach to estimating average annual soil loss. For a complete description of the protocols for the use of the USLE please refer to the manuals titled, "Predicting Rainfall Erosion Losses" and associated 1981 errata (USDA 1978) and "Guides for Erosion and Sediment Control in California" .

In order to use the following guidance you should have downloaded the USLE Calculation MS Excel spreadsheet from the RCD's LandSmart webpage. Some of the information required for the USLE equation is geographically specific to the project area. Having the Latitude & Longitude (in decimal degrees) for the site location can be helpful. The following website can be used to determine site location: http://www.findlatitudeandlongitude.com/

T - Soil Loss Tolerance.

In the USLE spreadsheet you will see there is a cell to identify "T". From a sustainability perspective, the USDA assigns a soil loss tolerance(**"T"**) to each soil type. This **T** value may be understood as the level of soil loss that can be sustained on a site to maintain productive capacity, or as the rate at which new soil is regenerated on a site by natural forces. The concept of **T** pertains to the sustainability and productivity of soil resources and is *not a water quality parameter*. **T** is a measurement of tons/acre/year.

The online Web Soil Survey defines a **T** value for each soil type. The **K** value (which will also be needed to run the USLE calculation) will be found using this same method.

1. Click on the green button titled. 'Start WSS' to begin.
2. You can either use the icons in the map view to zoom to the project location or use the index on the left side of the page and type in the Latitude & Longitude.
3. Once you have zoomed into the project location use the 'AOI' icon in the tool bar of the map to draw a polygon around the project area.
4. Once the polygon has been drawn click on the 'Soil Map' tab to see the soil symbol(s).
5. Click on the 'Soil Data Explorer' tab to get data. Within this tab click on 'Soil Properties and Qualities' tab.
6. In the index box on the left side of the page, click on 'Soil Erosion Factors'. To get the **T** and **K** values. You will need to click on the 'View Rating' box for the values to be displayed below the map.

It is not unusual to encounter AOIs that include more than one mapped soil type, each with a different **T** and **K** values. If this is true than run the scenario using the soil with the lowest **T** value to get the most conservative results. Another technique would be to calculate a "weighted" **T** and **K**, based on the proportional acreage of the area of each **T** and **K** value within the AOI.

Soil Survey mapping units at times may have been drawn with a broad brush, therefore, qualified professionals, including NRCS staff or Certified Professional Soil Scientists, may find somewhat different unit boundaries, or even errors in *Soil Survey* mapping. Informed, on-site investigations (borings, soil pits, etc.) may override mapping unit designations, and their corresponding **K** and **T** values.

The Universal Soil Loss Equation

The equation itself is **A=(R) (K) (LS) (C) (P)** where

A=Average annual soil loss (expressed as tons/acre).
and

(R)=Rainfall and runoff
(K)=Soil erodibility
(L)=Slope length
(S)=Slope gradient
(C)=Cover and management
(P)=Support practice

R—Rainfall and Runoff

In California, USLE **R** factors are based on the 2-year/6-hour storm, as estimated by the National Oceanic and Atmospheric Agency NOAA Atlas 14. This website allows users to locate their site by either entering in the latitude & longitude or by zooming in with the map view. The website then generates a table displaying depth estimates of storms with return intervals of between 1 and 1000 years, and durations between 5 minutes and 60 days. Use the median value given for the 2-year/6-hour storm event to determine your **R** value. **R** values can be found as a tab in the USLE spreadsheet. Input the **R** value (not the rainfall total) into the USLE equation. Both the Napa River and Sonoma Creek watersheds lie within **R Zone 1**.

K—Soil Erodibility

As discussed in the **T** values section of this document, the Web Soils Survey will provide **K** value(s) for your project area. Some project areas may encompass different soil types. If the various soils have different **K** values then this may require a 'segmented slope transect' to perform the USLE calculations. See 'Segmented Slope Transect' in the publication "Predicting Rainfall Erosion Losses" for further discussion on how the run USLE in these scenarios.

L—Slope length

More than one transect may need to be drawn in the vineyard block area to accurately model variations in topography or cover types. In general, you should be able to draw just one transect that would represents the average slope steepness, length, and cover of the vineyard area. Transects should be drawn perpendicular to the contours, following the flow path of runoff, starting at the top and ending at the bottom of the vineyard block (including any perimeter avenues). If a cross slope ditch or in-sloped terrace exist, then continue the transect downhill along that pathway to either a drop inlet or to the bottom of the block. Transect lengths are terminated at drop inlets because it is assumed that no soil loss occurs once flow is piped. If the vineyard block has out-sloped terraces then you should be drawn your transect perpendicular to contour from top to bottom of block (i.e. follow the flow path).

S—Slope gradient

Napa County Conservation Regulations (Resolution 94_19), which discusses USLE protocols states, "When the land clearing project involves 30ac or less… the slope is measured from a map with a scale of 1'=200'(max) with contour intervals of 20 feet. When the land clearing project involves greater than 30 acres the slope is measured from a map with a scale of 1"=200'(max) with contour intervals of 5 feet." To determine % slope using Cons Regs methodology take the difference from the top elevation to bottom elevation, along the transect, and divide by the transect length (i.e. rise/run) to get % slope.

If you are using Google Earth, it will give you slope gradients.

LS—Slope Length and Gradient.

The **LS** factor combines consideration of both slope length and slope steepness. Appendix 1, Table 3 in "Guides for Erosion and Sediment Control in California" may be used to derive the LS factor. The RCD has incorporated this table's algorithms into the Excel spreadsheet and the LS will be automatically calculated once you have inputted the **L** and **S** values.

C—Cover and Management.

The USLE's **C** factor, along with the conditions and practices it represents, is the most critical in estimating and controlling soil loss and is reliant upon the concept of "percent cover." The concept of "percent cover" is deceptively simply, 'viewed from above, the plan reviewer looks down on the area to be evaluated'. A USDA protocol calls for laying out on the ground a tape measure or cable marked at designated intervals and counting the number of those intervals that fall on either residue or growing vegetation. If the vineyard has an Erosion Control Plan (Napa County only) that plan may specify the minimum % cover required in those blocks. Seasonal variability can complicate the determination of percent cover considerably. Cover conditions need to be interpreted as how the site would look after wetting rains have allowed vegetation to germinate. Percent cover should include soils within the planted area, as well as the perimeter avenues and averaged together. Determining cover conditions during the winter season is highly recommended. Photo documentation of these conditions may be helpful if the plan cannot be reviewed until dryer months of the year.

In a developed vineyard, **C** factor determinations fall into the land use category of cropland, which includes vineyards. Cropland or vineyard floor management can be separated into tilled and non-tilled systems, and various combinations of the two. Tab associated with RCD Excel spreadsheet assigns **C** factors for various levels of cover in both tilled and non-tilled systems. Hybrid systems like alternate-row tillage may be evaluated through simple interpolation between the tilled and non-tilled values.

Vineyard floor management practices influence the amount of cover that can be anticipated and therefore must be taken into account. Herbicide use in the vinerows needs to be carefully considered when selecting realistic percent cover values. Strip sprays in row, reduce the cover

in the sprayed strip to essentially zero. For example, if the sprayed strip is 4 feet wide in a vineyard with 8-foot vinerow spacing, the *theoretical* maximum cover would be only 50% within the vineyard perimeter. The vineyard avenues around the perimeter are also to be included in determining overall percent ground cover. Fall broadcasting of annual grasses and straw mulch may assure an increased level of cover, even after herbicide treatment. Application of straw mulch can have variable effects on providing cover. Experience has shown that straw mulch, applied early in the fall, is too frequently lost to strong winds—requiring re-application to avoid soil exposure to raindrop impact. If perimeter avenues have been covered with a road-base rock or other materials, then that material can be considered as cover.

P—Support Practice

In general, the **P** in vineyards correlates to their row direction, relative to slope. see tab associated with RCD Excel spreadsheet for appropriate **P** value. Hybrid systems like alternate-row tillage may be evaluated through simple interpolation between the tilled and non-tilled values.

A—Annual Soil Loss

Once you have inputted all the values into the USLE spreadsheet it will provide you with a value for **A**. Compare this value to the **T** value you derived from the Web Soil Survey. If **A** is greater than **T** then your soil loss rate is exceeding what is tolerable as defined by the USDA. In a vineyard setting increasing % cover and/or reduced tillage can be the most cost-effective way to decrease **A**.

Literature Sited

USDA Soil Conservation Service Davis, California 1977-1996. Guides for Erosion and Sediment Control in California.

Wischmeier, W.H., and Smith, D.D. 1978. *Predicting Rainfall Erosion Losses* – *A Guide to Conservation Planning*. U.S. Department of Agriculture, Agriculture Handbook No. 537.