USLE for Napa County Vineyards

Protocol for Soil Loss Modeling
Developed by Napa County Resource Conservation District (RCD), with assistance from the Napa Field Office of the USDA/Natural Resources Conservation Service
Napa County Planning Building & Environmental Services Department (PBES)
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The Universal Soil Loss Equation 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). A pdf of this publication can be found online at http://topsoil.nserl.purdue.edu/usle/AH_537.pdf And "Guides for Erosion and Sediment Control in California" http://efotg.sc.egov.usda.gov/references/public/CA/ErosionGuides_CA_1977-1996.pdf . An MS Excel spreadsheet for developing a USLE can be downloaded from the RCD website at http://naparcd.org/resources-documents/conservation-practices/ . Click on the tab titled 'For Vineyards and Rural Lands' and then click on 'Managing Erosion from the Vineyard'. 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/

No Net Increase (Best to have county define). The Napa County General Plan requires that vineyard developments (including replants) result in *no net increase* in sediment delivery to waterways. In order to address this requirement, it is necessary to estimate a baseline condition, i.e. the pre-project soil loss and compare it to post-project potential soil loss. Calculations should be derived for each vineyard block and may require multiple transects for each block. The 'No Net Increase' shall be determined by PBES. In general, the 'no net increase' can be assumed to be looked at on a sub-watershed scale.

T - Soil Loss Tolerance.
In the USLE spreadsheet that you can download from the RCD website you will notice 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*.

The online ("Web Soil Survey") defines a **T** value for each soil type. This soils survey can be found at http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm . The **K** value 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 (usually expressed as tons/acre in the U.S.)

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). The website may be found at: http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ca. 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 in Appendix 1, Table 1, in this document or as a tab in the USLE spreadsheet provided on the RCD website. All of Napa County lies within R Zone 1. Sonoma County lies within both R Zones 1 & 2, see map in "Guides for Erosion and Sediment Control in California" (USDA 1996).

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.

LS—Slope Length and Gradient.

The **LS** factor combines consideration of both slope length and slope steepness. Modeling should be based on flow path, usually the longest and steepest transect that can be drawn through each mapped vineyard block. More than one transect may need to be drawn in the proposed vineyard block area to accurately model variations in topography and vegetation types (i.e. cover).

In "Guides for Erosion and Sediment Control in California" Appendix 1, Table 3 may be used to derive the **LS** factor. However, the RCD incorporated this table's algorithms into the Excel spreadsheet that may be found on the RCD's website. In the spreadsheet's appropriate fields enter the slope (in percent) and the slope length of the transect (in feet). The spreadsheet then calculates the LS factor.

In general, transects should be drawn perpendicular to the contours, from the top of proposed vineyard block (including its avenues) to the lower end of the block.

- To model post project conditions, use the same transect location but end the line at the bottom of the block or the point where runoff is diverted into a drop inlet, cross-slope ditch, in-sloped terrace, or French drain, that is flat on contour.
- If ditches or terraces continue to drain downhill, then the transect must follow that flow path to either a drop inlet or to the bottom of the block.

- The transect can be stopped at a diversion ditch that has a design capacity for the peak discharge from a 10-year, 24-hour duration storm (100-year, 24 hour duration storm within domestic water supply areas), where peak flow velocity do not exceeding 1.5 ft./sec., and designed with stable side slopes
- Transect lengths are terminated at drop inlets because it is assumed that no soil loss occurs once flow is piped.
- Slope length with out-sloped terraces should be drawn from top to bottom of block.
- Any adjacent, uphill vineyard block must be included in the modeled transect, unless it is isolated hydrologically by a diversion.

Segmented LS with Complex Slopes: Transects that travel along slopes that are significantly flatter toward the bottom (concave slopes) or significantly steeper toward the bottom (convex slopes) may be calculated by the segmented slope method, and entered manually, to override the spreadsheet's algorithms, which assume uniform gradients within each transect. Subtle variations of slope gradient within transects do not result in significantly different **LS** factors under the segmented slope method, and may be safely ignored.

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 eight out of ten marks fall on plant material (living or dead) the implied percent cover is 80 percent. Appendix 2 provides some images of percent cover.

Evaluating Pre-Project Cover Factors: Planning new vineyards in Napa County requires estimating soil loss or sediment delivery on the site as it exists prior to the proposed development (i.e., pre-project conditions). Seasonal variability can complicate the determination of percent cover considerably; however pre- and post- project cover conditions need to be interpreted as how the site would look after wetting rains have allowed vegetation to germinate. Determining pre-project 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.

Cover values need to be representative of those observed along the general area of the transect. If there is more than one distinct vegetation community or ground cover condition along a transect, then transect should be modeled using a weighted C factor. Some circumstances may warrant modeling a segmented slope if there is a slope break, or non-uniform slopes. If there are two or more distinctive vegetation types within a proposed block area then multiple transects may need to be modeled.

Use Appendix 1 Table 4 for determining **C** factors or see tab associated with RCD Excel spreadsheet. Generating a pre-project **C** factor involves field observation and accurately quantifying the condition of the project site's vegetation community, in relation to its percent canopy, and percent ground cover. An appropriate determination of a pre-project **C** factor requires accurately defining the percentage of "G" and "W" ground cover types, and interpolating between the two types as needed. The footnotes in Table 4 provide definitions for the "G" and "W" ground cover types. Both the RCD and PBES can provide assistance for accurately defining the ground conditions and percent covers. Once an Erosion Control Plan (ECP) has been submitted to PBES, the RCD will request a site visit to field check the submitted pre-project C factor(s). The RCD can provide pre-plan assistance for determining **C** factors, before officially submitting the plan to the County. Any USLE calculations submitted for an ECP should include a detailed description of the vegetation and ground cover conditions used to determine the C value; this will help to speed up the review process of the ECP.

Estimating Post-Project Cover Factors: Post-project **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. Appendix 1 Table 6 or see 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 but is also provided in the RCD spreadsheet.

Estimating Post-project 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 four feet wide in a vineyard with eight-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 post-project percent ground cover. Fall broadcasting of annual grasses and straw mulch may assure an increased level of cover, even after herbicide treatment. Vineyard plan that specified tillage as a practice need to apply straw mulch to all tilled areas to achieve the required % cover. Experience has shown that straw mulch, applied early in the fall, is too frequently lost to strong winds—requiring expensive re-application to avoid exposure to early rains. "Crimping" straw is frequently an effective and (relatively) inexpensive technique for avoiding this problem.

P—Support Practice

In general, the **P** in vineyards correlates to their row direction, relative to slope. See Appendix 1 Table 7 or see tab associated with RCD Excel spreadsheet for a breaks down how to derive an appropriate P value. Vineyard blocks with straight rows (not contoured) but laid out with row directions very close to parallel to contours, may be assigned somewhat lower **P** values, per the table. Undeveloped sites are assigned a **P** value of 1.

Literature Sited

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.

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