Appendix C: Revised Universal Soil Loss Equation (RUSLE) Modeling

The Revised Universal Soil Loss Equation (RUSLE) was used to model erosion potential. RUSLE computes average annual erosion from field slopes as (Renard, 1997):

\[ A = R*K*L*S*C*P \]

Where:

- \( A \) = computed average annual soil loss in tons/acre/year.
- \( R \) = rainfall-runoff erosivity factor
- \( K \) = soil erodibility factor
- \( L \) = slope length factor
- \( S \) = slope steepness factor
- \( C \) = cover-management factor
- \( P \) = Conservation Practice

The modeling was conducted in the ArcInfo Grid environment using Van Remortel’s (2004) Soil & Landform Metrics program. This is a series of Arc Macro Language (AML) programs and C++ executables that are run sequentially to prepare the data and run the RUSLE model. A 30-meter cell size was used to correspond to the requirements of the program.

All of the required input spatial data layers were converted to the projection required by the program (USGS Albers NAD83) and placed in the appropriate directories. The input data layers include:

- USGS Digital Elevation Model (DEM). The DEM was modified by multiplying it by 100 and converting it to an integer grid as prescribed by the program.
- Master watershed boundary grid (created from USGS DEM).
- National Land Cover Dataset (NLCD) land cover grid.
- Land mask grid for open waters, such as oceans or bays, derived from the NLCD land cover data. No oceans or bays are present in this watershed, so no cells were masked.

The first component AML of the program sets up the ‘master’ soil and landform spatial datasets for the study area. This includes extracting the STATSGO soil map and attributes as well as the \( R \), \( C \), and \( P \) factors, from datasets that come with the program. The \( R \)-factor is rainfall-runoff erosivity, or the potential of rainfall-runoff to cause erosion. The \( C \)-factor considers the type of cover or land management on the land surface. The \( P \)-factor looks at conservation practices, such as conservation tillage.

Additionally, a stream network is delineated from the DEM using a user specified threshold for contributing area. A threshold of 500 30x30 meter cells was specified as the contributing area for stream delineation. This number was chosen based on consultation with the program author. The AML also created the \( K \) factor grid. The \( K \) factor considers how susceptible a soil type is to erosion.

The second component AML sets up additional directory structures for any defined subwatersheds. In this use of the model the entire Upper Gila watershed was done as a single unit.
The third component AML iteratively computes a set of soil parameters derived from the National Resource Conservation Service's State Soil Geographic (STATSGO) Dataset.

The fourth component AML calculates the LS factor according to the RUSLE criteria using DEM-based elevation and flow path. The L and S factors take into account hill slope length and hill slope steepness.

The fifth component AML runs RUSLE and outputs R, K, LS, C, P factor grids and an A value grid that contains the modeled estimate of erosion in tons/acre/year for each cell.

References:


Data Sources*:

U.S. Department of Agriculture, Natural Resources Conservation Service.

http://www.ncgc.nrcs.usda.gov/branch/ssb/products/statsgo/


*Note: Dates for each data set refer to when data was downloaded from the website. Metadata (information about how and when the GIS data were created) is available from the website in most cases. Metadata includes the original source of the data, when it was created, its geographic projection and scale, the name(s) of the contact person and/or organization, and general description of the data.