Erosion Potential in the Ski Town of Sun Valley, Idaho

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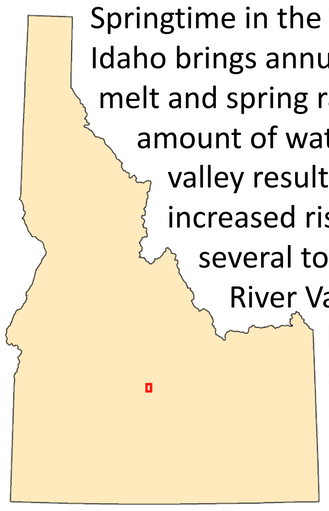
Introduction



Springtime in the Wood River Valley of Idaho brings annual floods from snow melt and spring rains. The incredible amount of water passing through the valley results in flooding and an increased risk of erosion. The several towns lining the Wood River Valley floor face hazardous conditions each year from this threat. Here, the ski village of Sun Valley undergoes large erosional events and flooding due to the still partially frozen soil which fails to absorb excess water. The primary goal of this investigation is to identify the contributing factors and create a visual representation of areas most at risk. In the future, the slope's erosion potentials may be implemented in erosion remediation and prevention.

Methods

This investigation combined several inputs to calculate the erosion potential of the Sun Valley region. A simplified version of the RUSLE (Universal Soil Loss Equation) model was used to evaluate this parameter which was then standardized. Only three of six total factors were considered however. The K factor considers the soil erodibility, L is the length of slopes based on a 22.1 m distance, and the S factor shows slope. Factors C, cover management, and P, support practice were not included due to the lack of data present. Rainfall erosivity (R), was omitted due to snow melt playing a major role in water drainage. To assemble this data a USGS 30 meter digital elevation map (DEM) performed a number of functions in the ArcMap Spatial Analyst tool. Once slope and flow accumulation had been calculated, the LS factor could be determined.

$$LS = Power\left((flow\ accumulation) * \frac{DEM\ resolution}{22.1, 0.4}\right) * Power\left(\sin\left(\frac{slope}{0.9, 1.4}\right)\right) * 1.4$$

Next, soil data from SSURGO's Web Soil Survey gives soil erodibility based on sediment type and whole rock composition. After applying K factor values for differing soil types, the erosion potential was finally calculated. This data was then standardized on a scale of 1 to 10 with higher values experiencing greater erosion potential. A final visual was created using land cover database maps from USGS. This provides a categorical representation of terrain and land usage.

Analysis Maps

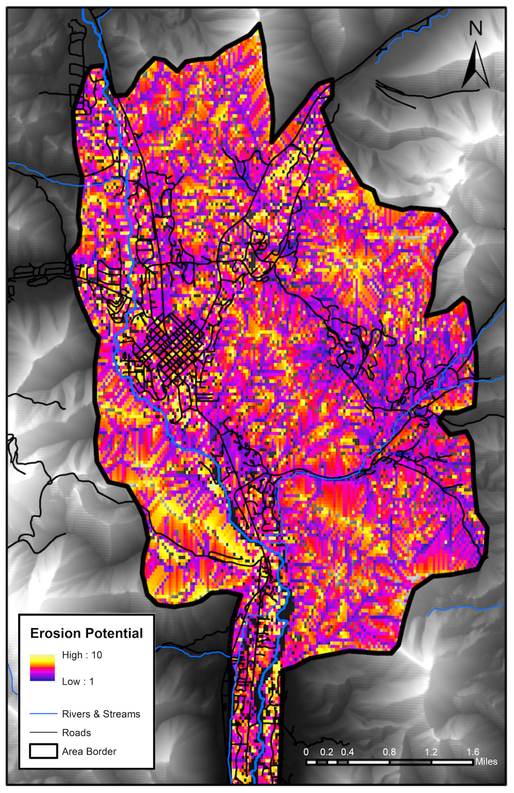


Figure 1: Erosion potential map with highest erosion potential at 10. Created with LS and K factor maps.

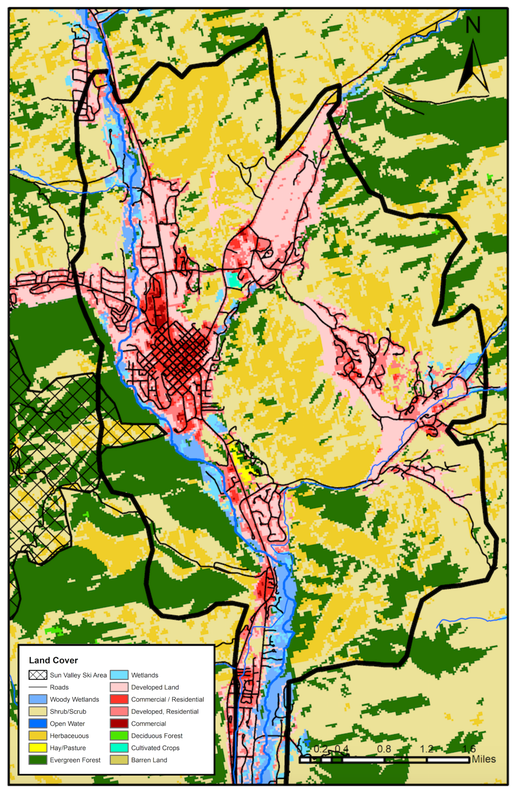


Figure 2: Map of land cover, Sun Valley ski resort seen with 10% hatching.

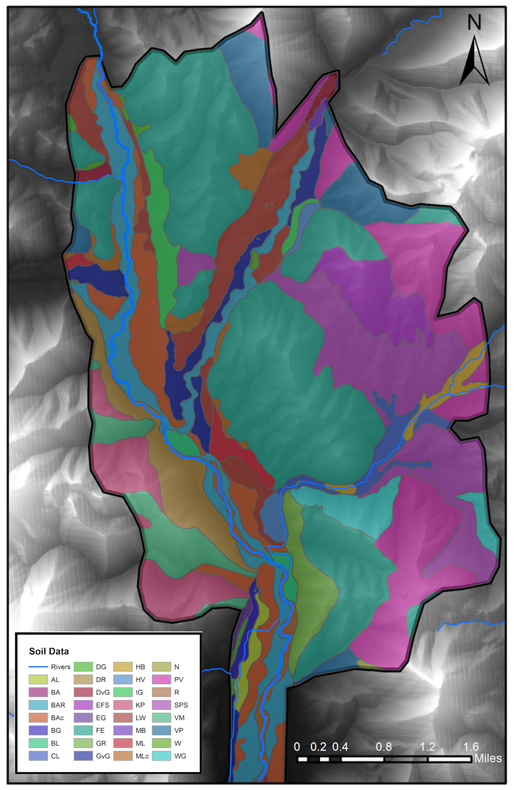


Figure 3: Map of soil data, codes sourced from USDA Web Soil Survey Map, K factor dependent on soil type.

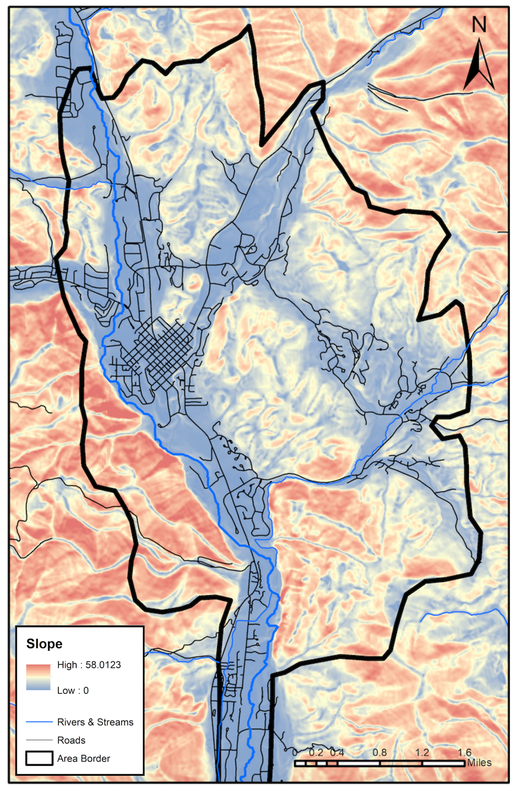


Figure 4: Map of slope in degrees. Deep reds signify steepest parts of mountain slopes.

Results

The resulting erosion potential map highlights areas in this small region most at risk. Low to medium scores dominated the majority of the map with most high risk areas residing on the steeper sloped mountainsides as seen when comparing figures 1 and 4. The mean erosion potential for this region was 3.9. Less than 1% of the mapped area scored above 7.5, with only a handful of spots that exceeded this threshold. The high pixelization of this map could have skewed this data as steeper slopes occupy less space on a 2 dimensional map.

Discussion

This data provides a starting point for identifying erosion risks in Sun Valley, Idaho. Erosion affects the entire Wood River Valley so case studies of the towns Bellevue and Hailey further down the valley could provide increased knowledge of potential erosion risks for the area. Unfortunately, a 30 meter DEM in an area less than 2 miles in diameter at some points results in a highly pixelated map. A larger scale evaluation of the Wood River Valley had been planned however soil data did not extend past the city limits. To map data outside of this region for erosion potential, an LS factor map would be all that is applicable in this model resulting in less than accurate data due to lacking whole rock and fine sediment soil data. For a more accurate erosion prediction, a higher resolution dataset could be implemented as well as more soil data. Also, other parameters in the RUSLE model could be included, however the large accumulation of snow from winters would need to be considered in further models.

References

[1] U.S. Geological Survey, 20141010, NLCD 2011 Land Cover
[2] U.S. Geological Survey, 2013, USGS NED n44w115 1/3 arc-second
[3] USDA, 2013, Web Soil Survey, NRCS ID680
[4] Ashiagbor et Al., Modeling soil erosion using RUSLE and GIS tools
[5] FEMA, Blaine County, Land Use Data

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