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GEOG 483: Lesson 7

Agriculture

Lesson Goals

The primary goal of this lesson is to learn various techniques and tools useful in handling raster GIS data, converting vector data to raster layers, and subsequently employing these output layers in a spatial site-selection analysis.

Important actions learned in this lesson include: converting between vector and raster data formats, understanding the difference between discrete and continuous data, creating hillshade and aspect layers from elevation data, employing interpolation techniques to produce surfaces from point data, creating buffers for raster features, performing distance calculations, reclassifying raster data into discrete categories, and performing map algebra.

Project Summary

The goals of this lesson are taught through the utilization of various input raster and vector layers to perform a site selection for a new viticulture business in the Napa Valley, California. The unique soil and climate requirements needed for grape cultivation resulted in the following criteria:

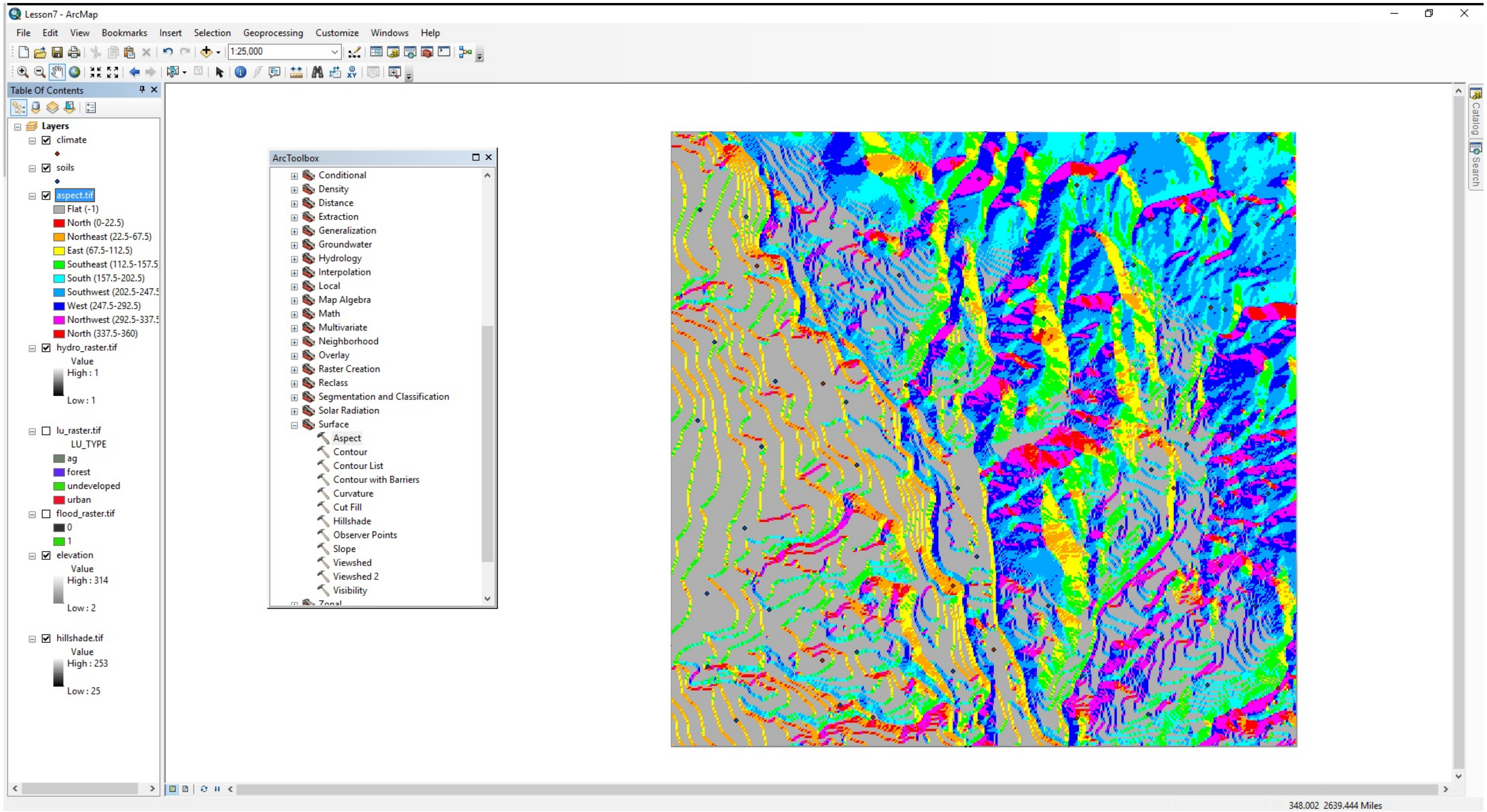
1. Outside of floodplain and greater than 100m from streams
2. Landuse type of agriculture or undeveloped
3. Aspect between 112 -337 degrees or flat land
4. Average wind speed of 25 mph or less
5. Average minimum temperature of greater than 35 degrees F.
6. Soil depth between 31 and 72 in.
7. Medium to highly drained (values 1.5 – 3.0) soils

Input data layers include raster and vector types describing elevation, climate, soil information, landuse type, and hydrography.

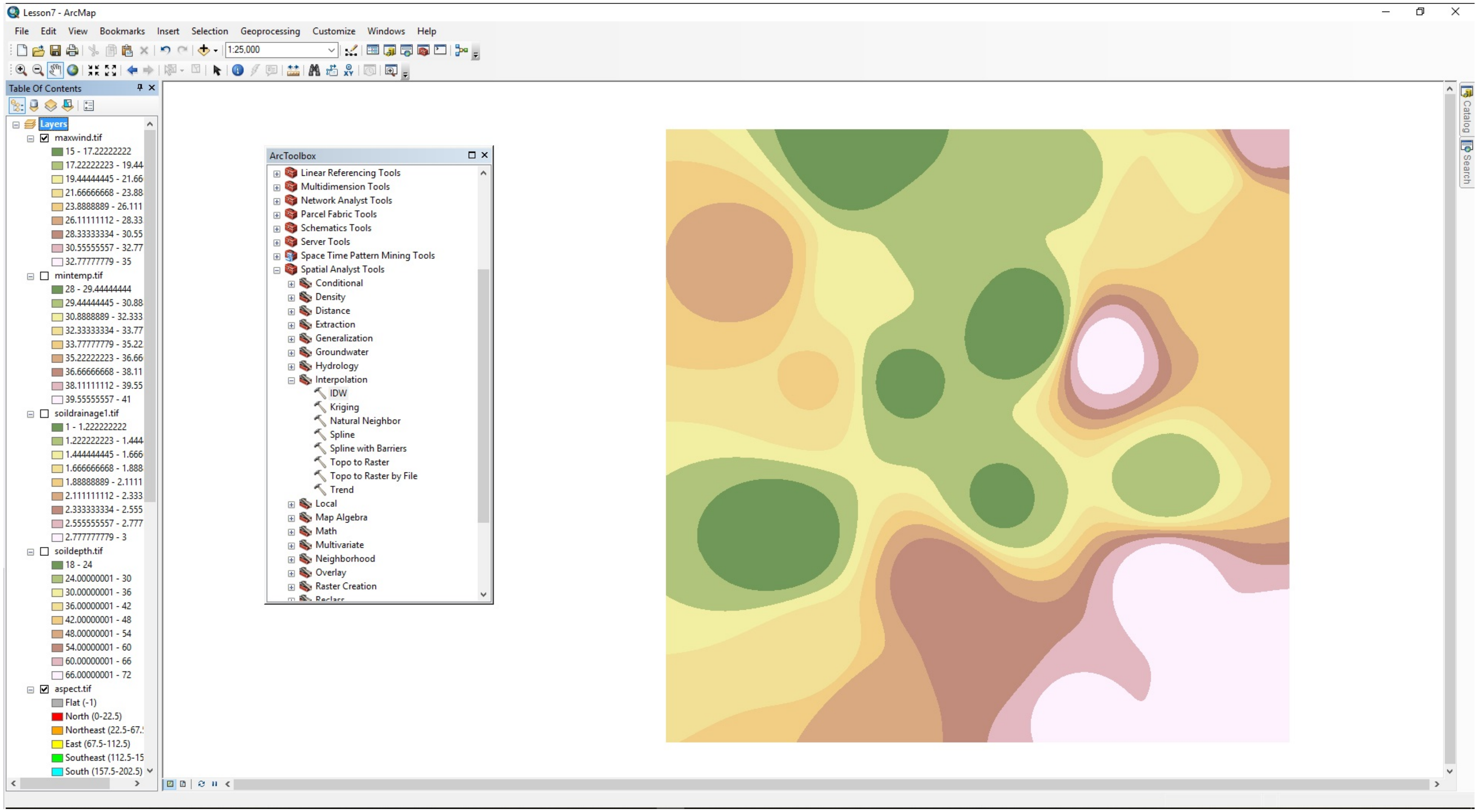
Discussion

The main strategy used to perform this site selection analysis was to convert every input layer involved in the site selection criteria into a raster data layer. Some input layers already existed in raster form while other vector layers were converted using geoprocessing tools. Other techniques such as interpolation were used to create raster layers from vector data points. Once each data type was in raster form, tools were used to reclassify each raster cell with a value of 0 (unacceptable) or 1 (acceptable) depending upon if the cell's original value fell within or outside the predetermined criteria for that data type. Map algebra is then used to multiply all raster data layers together, resulting in an output raster with cells only containing a value of 1 if all raster data inputs had passed all criteria for that cell location.

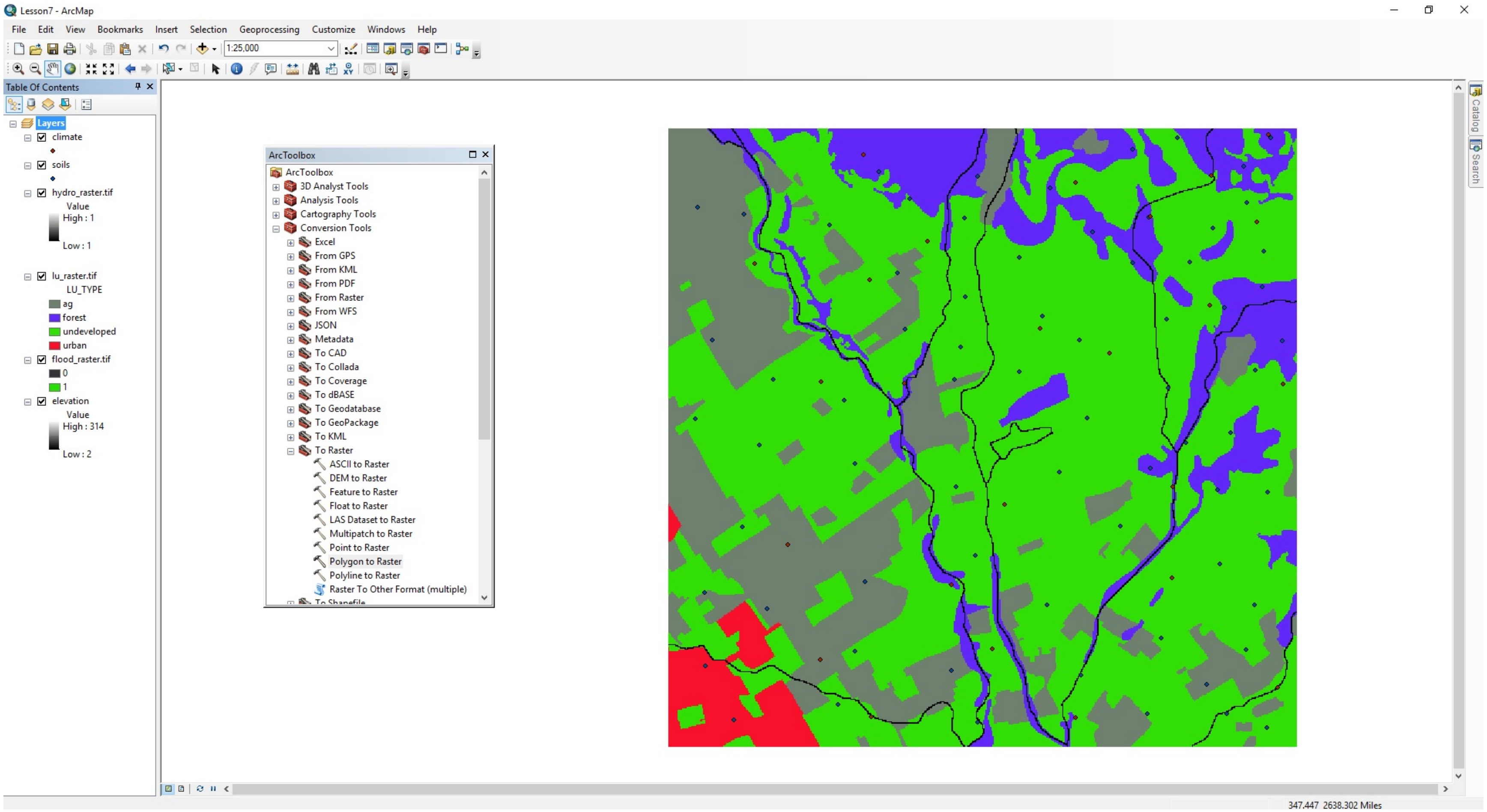
Some screen captures during phases of the described process follow.



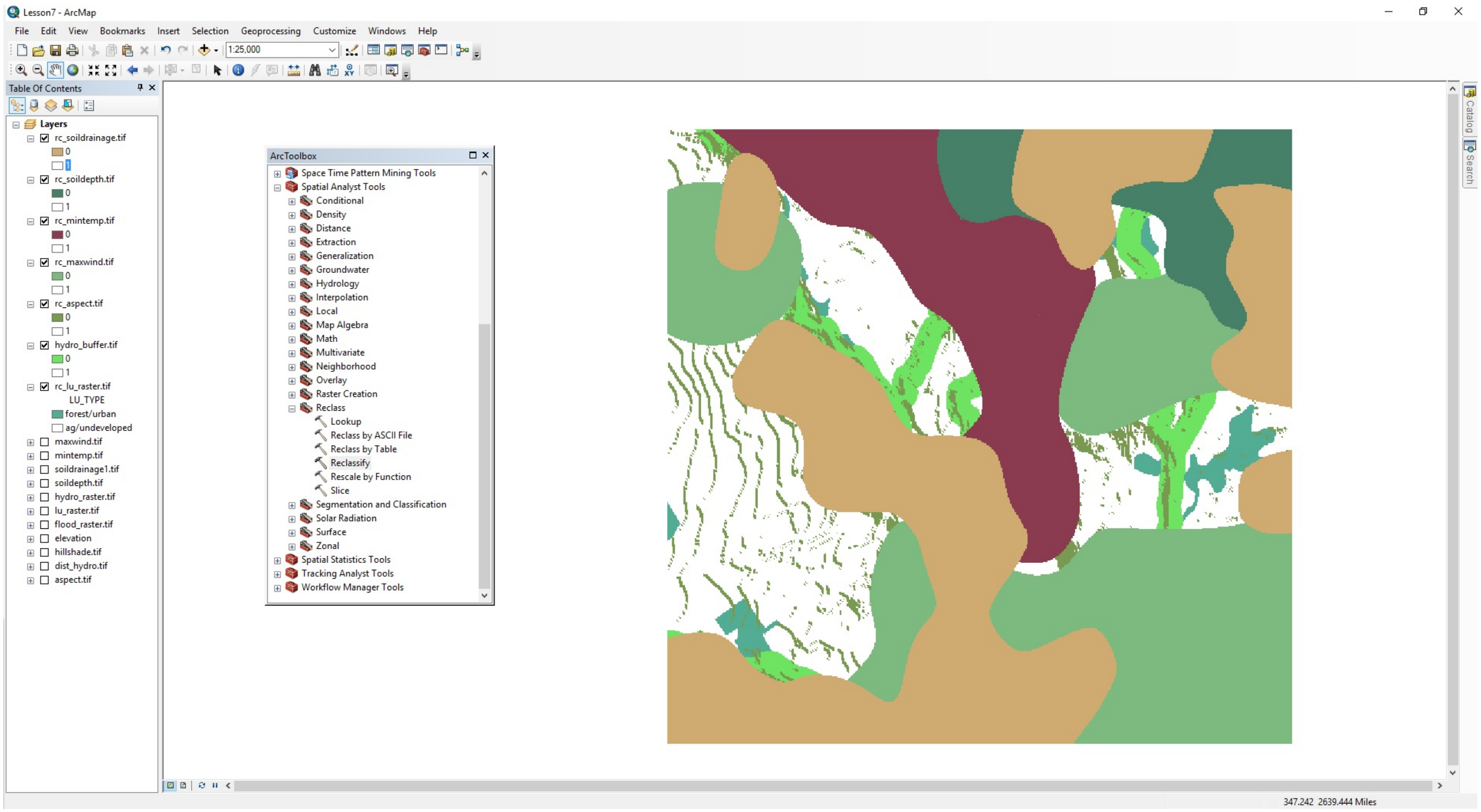
Calculating an aspect raster layer from an elevation aspect layer.



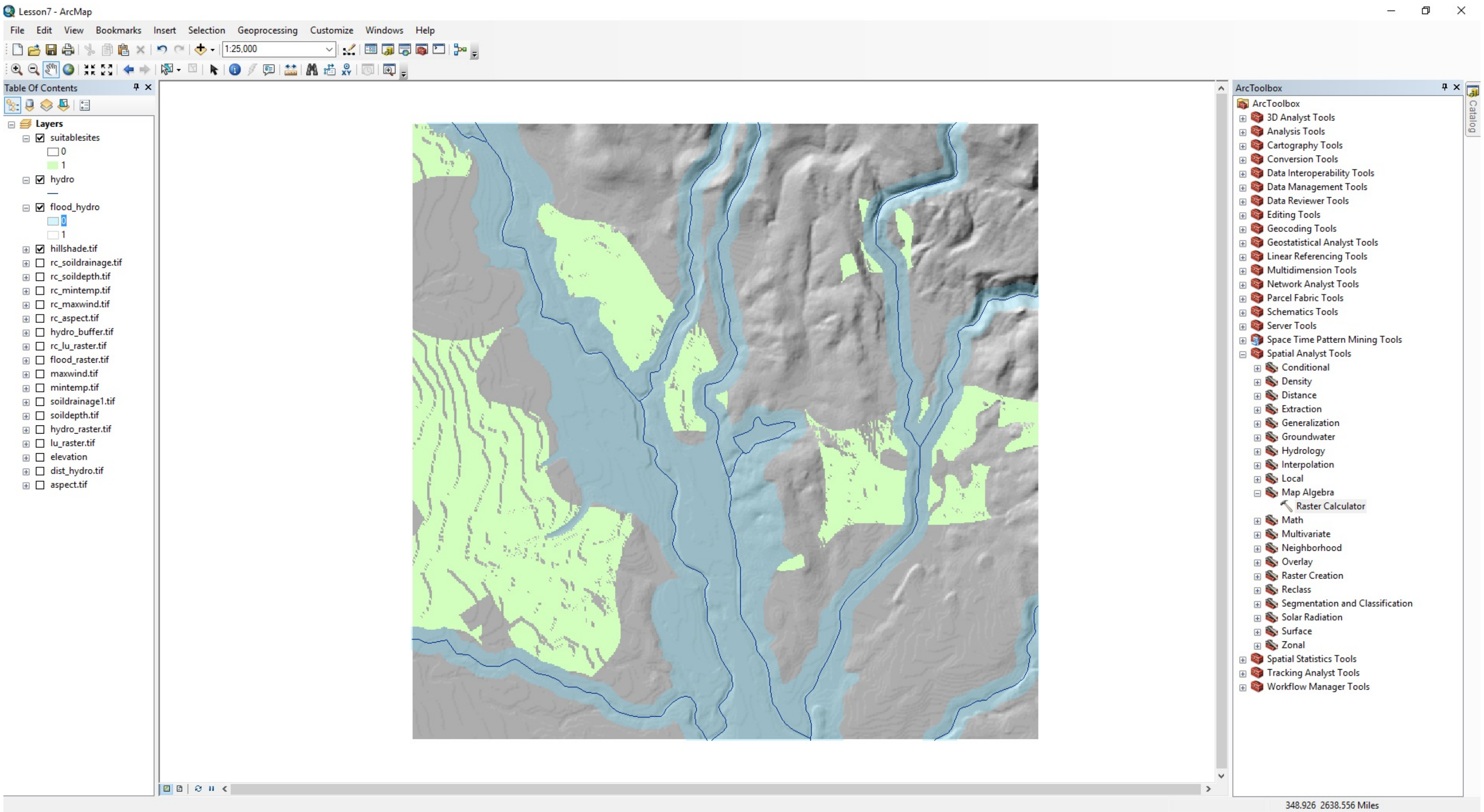
Creation of a raster layer by interpolating between a dataset of vector point values.



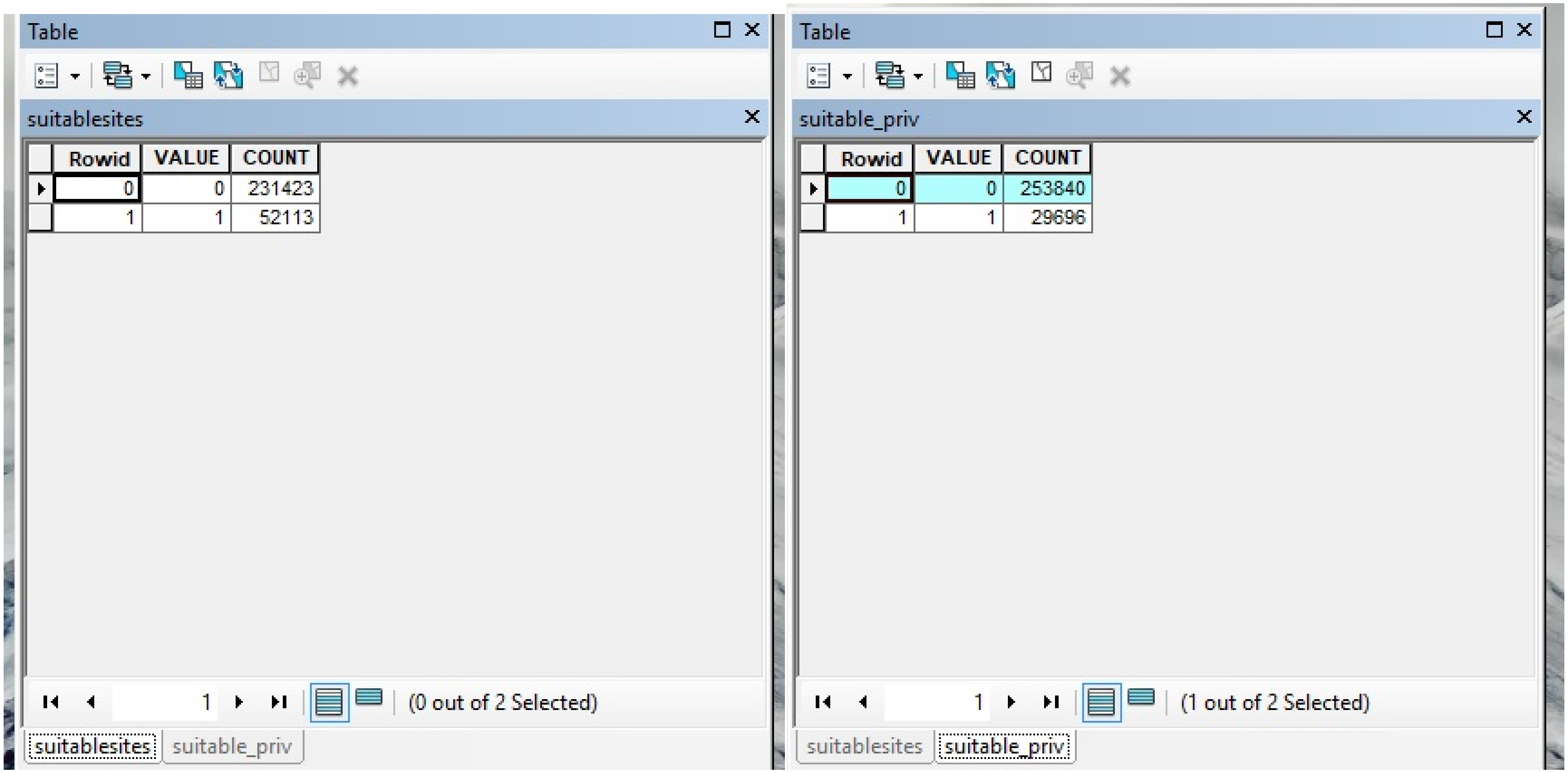
Converting a vector polygon layer to a raster layer will cell values indicating landuse type.



Reclassifying raster data values to 0 or 1 depending on the whether the original value meets criteria or not.



Multiplying reclassified rasters together produces a output raster of suitable site locations; each with raster cell values = 1.



Rowid	VALUE	COUNT
0	0	231423
1	1	52113

Rowid	VALUE	COUNT
0	0	253840
1	1	29696

Pictured above are the attribute tables describing the values and counts for the output raster layers. The left pictures the layer produced from all the criteria initially described in the Project Summary section. The attribute table on the right shows the value and counts if an additional criteria is added to the site selection process: that the land should be privately owned. Using these values and knowing that each cell is ~100 square meters: the total suitable area for vineyards is 1287.7 acres with 733.8 acres being privately held while 553.9 acres being publicly owned.

The final two maps are the formal results of the site selection exercise: the first map accounts for all the primary criteria mentioned in the Project Summary while the second map depicts the results if limited to suitable land which is privately owned.

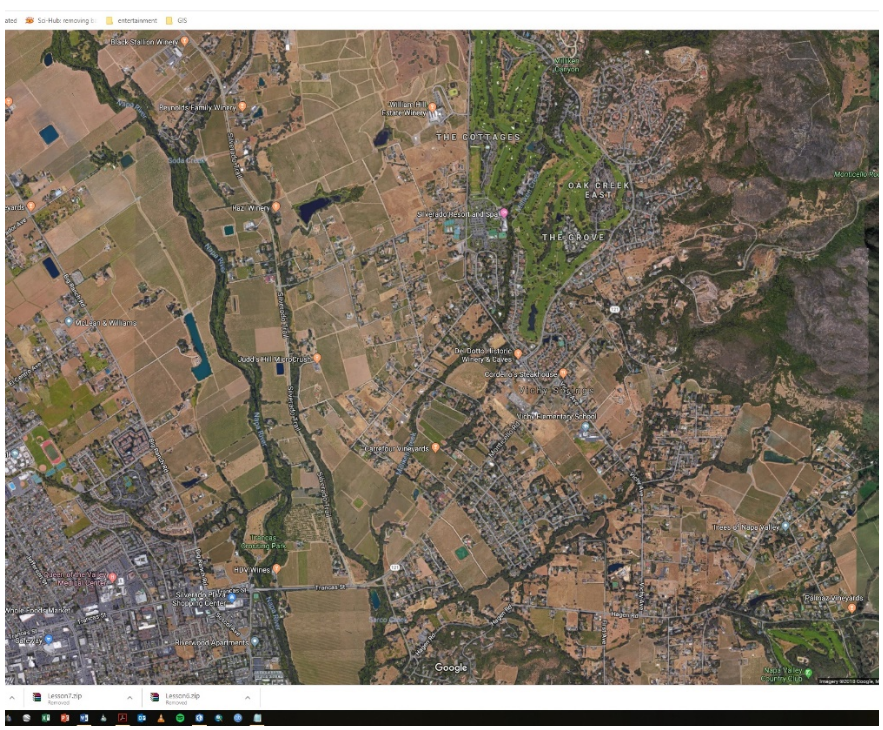
The site selection analysis could be further refined by consulting subject matter experts on the best type of interpolation algorithm as well as appropriate settings for calibration variables (such as the 'power' variable to IDW interpolation) for producing surfaces from point data of measured phenomena.

The site selection analysis could have also been improved by using additional criteria and input data – such as precipitation information. Additionally, the selection criteria may be different depending upon the grape varietal intended to be grown. There could be multiple analyses for each varietal.

If further resolution is needed, criteria could be divided into more categories and simply pass/fail. For example, rasters could be reclassified into 0 – 4 values from unacceptable to most desirable. In this way, the output raster of the final map algebra step will have some spatial variation indicating the optimal locations within the areas that meet all baseline criteria.

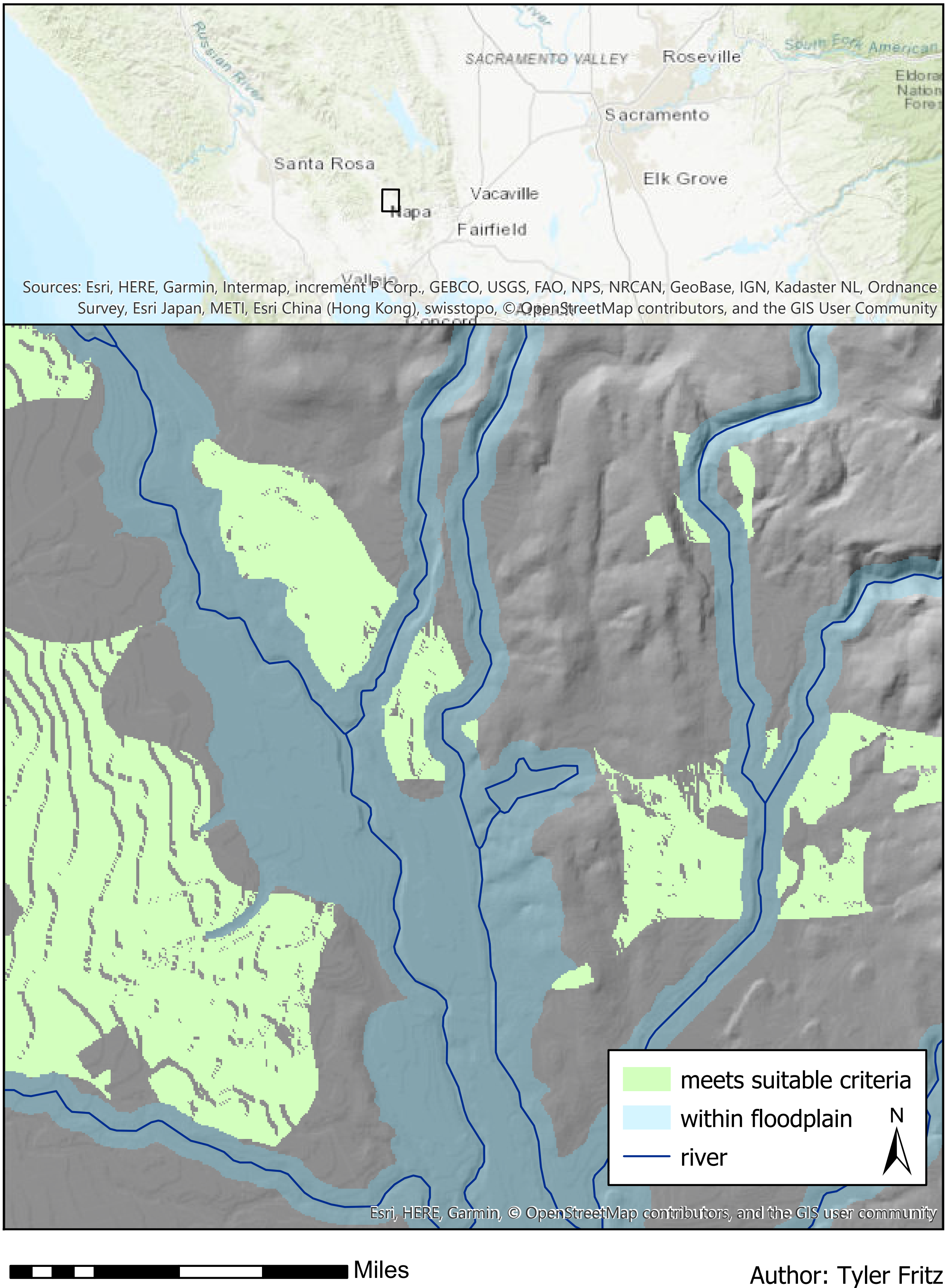
Both maps indicate that the analysis results in suitable land locations clumped at two major locations: one location in the southeast quadrant of the map where much of the land is suitable and flat but has significant areas which are under public ownership and a second location in the southeastern map quadrant at the confluence of two streams discharging from the eastern mountains into the valley center. It seems this second location might have the largest uninterrupted bloc of suitable acreage.

Satellite imagery from Google Earth shows that much of the current-day vineyards are along the banks of Napa River and the flat areas and slightly sloped areas in the middle of the valley.



Suitable Vineyard Locations within Napa Valley, CA

Description: Vineyard locations determined by various criteria including landuse type, surface aspect, flood susceptibility, average wind speed, average minimum temperature, soil depth, and soil drainage.

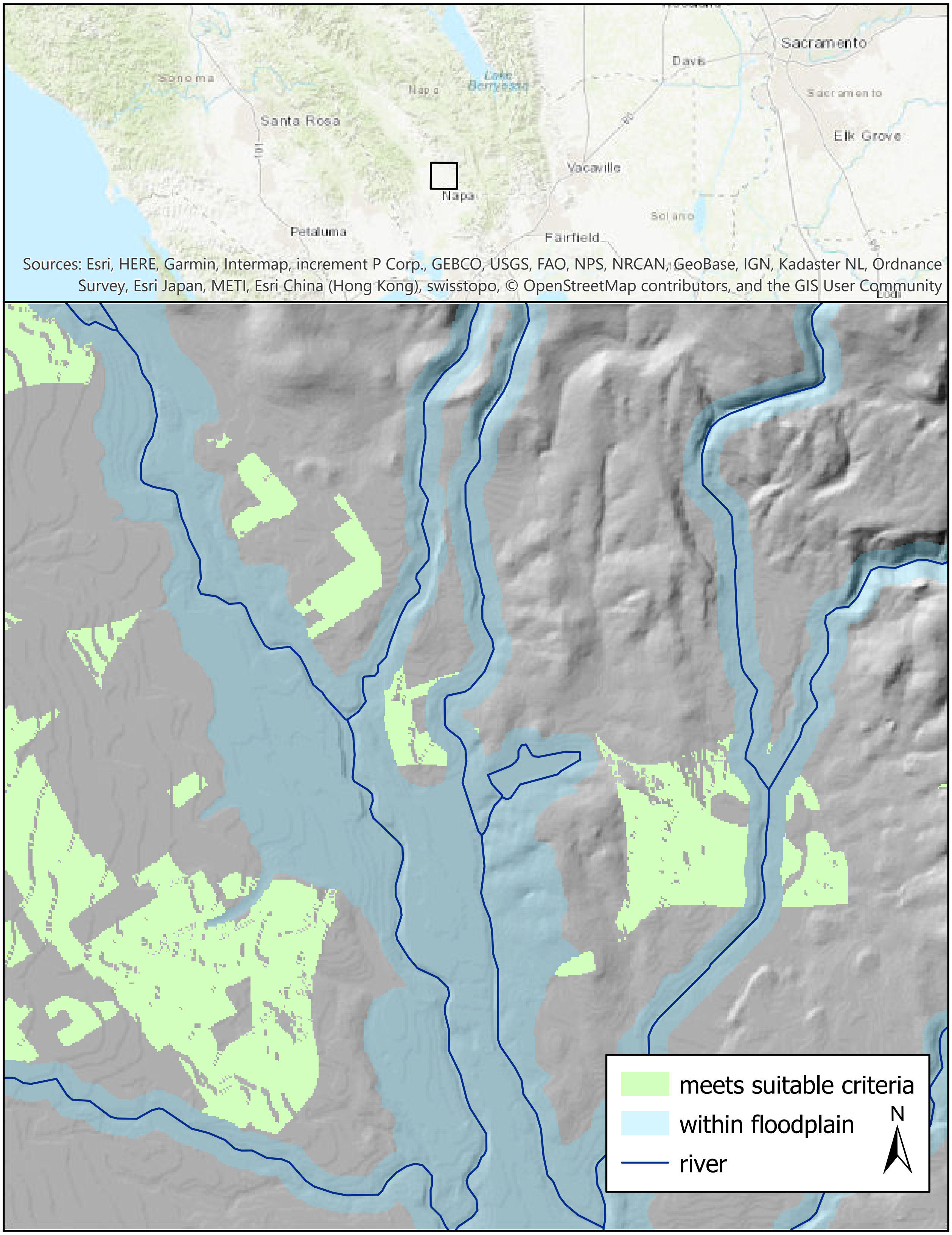


Author: Tyler Fritz

Suitable area = 1287.7 acres

Suitable Vineyard Locations on Private Land in Napa Valley, CA

Description: Vineyard locations determined by various criteria including land ownership, landuse type, surface aspect, flood susceptibility, average wind speed, average minimum temperature, soil depth, and soil drainage.



0 0.150.3 0.6 0.9 1.2 Miles

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Suitable area = 733.8 acres