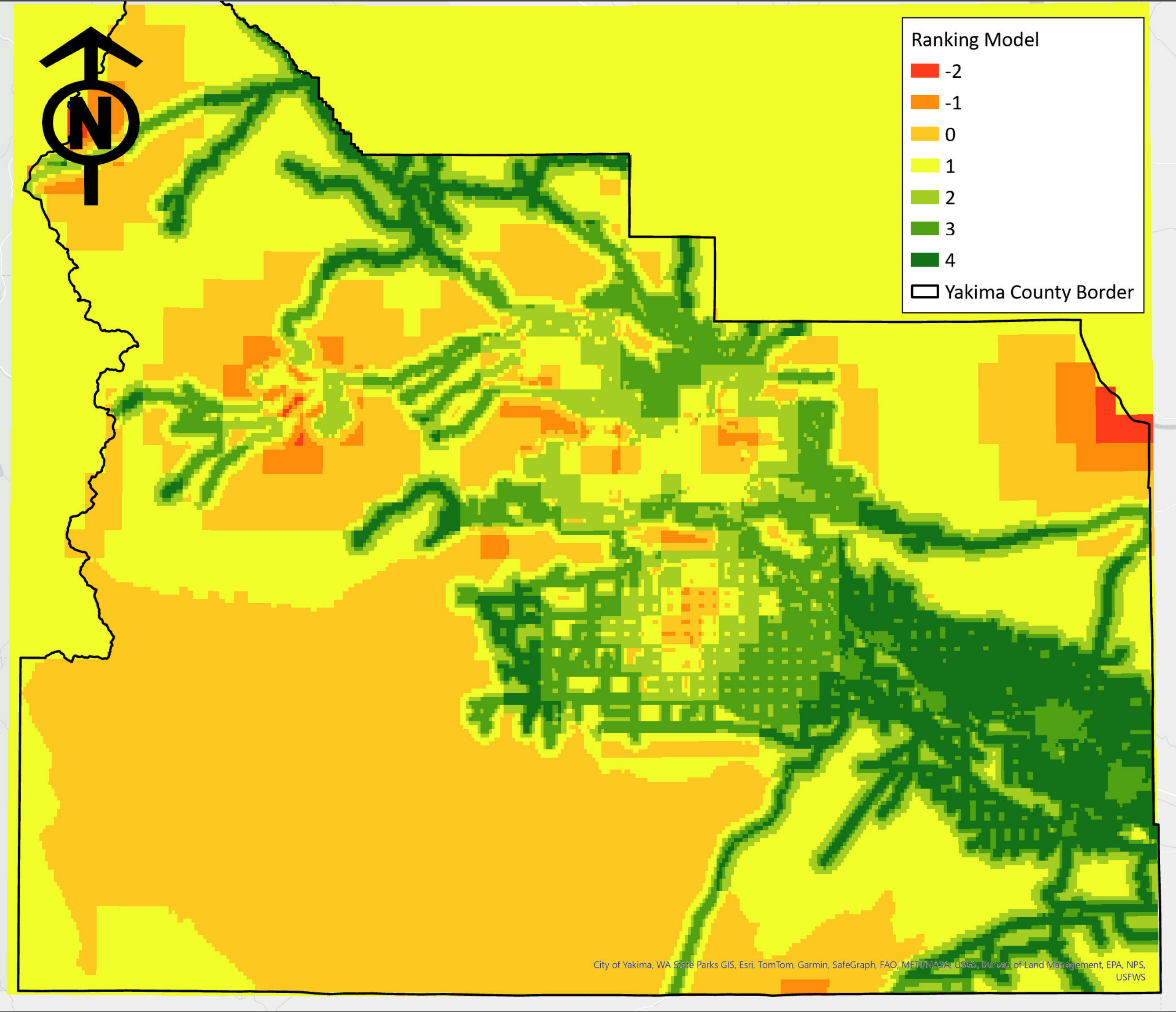


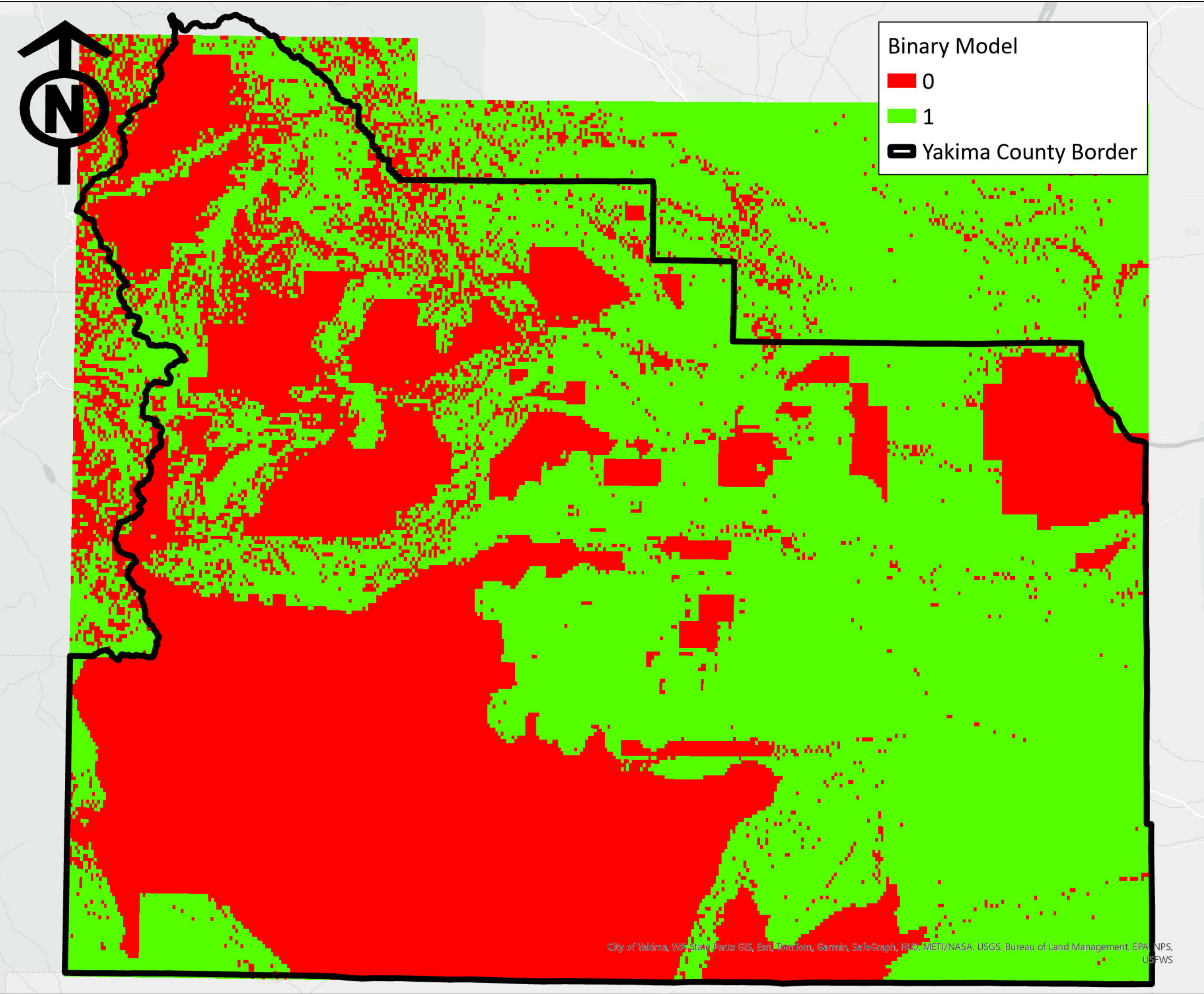
Solar Energy Site Analysis: How GIS Can Be Used to Identify Locations for the Development of Solar Energy

Human Constraints:



The map above displays a ranking model made from vectorized polygon shapefiles of the different human constraints pertaining to solar farm site selections. Some of the variables include, distance from other power plants, distance from major roads and zoning codes.

Binary Sites Map:



The map frame above displays a binary ranking model which shows all possible site locations, even if they are not ideal.

Abstract:

As the world population expands, the demand for energy, specifically renewable energy, has greatly increased. This prompts the question of suitable sites for renewable energy sources. Specifically, this project will go into detail about utilizing ArcGIS to assess different aspects of site selection pertaining to solar energy development. Various geospatial datasets will be examined in this process, from general land use patterns to specified sunshade analyses. This project will serve as a foundation for future developers in the planning and creation of solar energy installations.

This project will follow a multistep approach utilizing ArcGIS Pro for data composition and analysis. The data crucial to identifying suitable sites for solar farms is land use data. This will ensure that chosen sites do not conflict with already established land uses. A set of data that will be needed is topographical data, in the form of a digital elevation model (DEM). A point layer of current renewable energy sources in the area will also be necessary in order to confirm the proximity of the solar panel installment is not in a close to another energy plant. Another layer that will be needed is the roadways. The solar plant should be in close proximity to a major roadway for easy access for installation and routine maintenance. The site constraints of distance from other powerplants, distance from roadways and zoning codes will be compiled in a ranking model titled human constraints. A slope analysis will be performed on the DEM and the slopes will be ranked accordingly. This ranking will be used as an environmental constraints map.

Once all the data is collected and the analyses are run properly, the results will be compiled into two distinct models: a binary suitability model and a ranking suitability model. The conditionals for these models will be found based upon online research regarding solar panel optimization. These models will ensure that the potential sites for solar energy installations have proper assessment and will provide valuable insight for sustainable energy planning.

Methods:

Human Constraints:
The next step was to create a multi-ring buffer zone around the already existing renewable power plants to ensure that the new site would not be in close proximity to another plant. The streets of Yakima county was downloaded as a shapefile and a multi-ring buffer was created because the solar farm would need easy access for construction and maintenance. Ideally, the farm would be 0.3 mi from a major roadway. One half mile is less optimal, and for any distance beyond one mile additional roadway construction would be needed. The third part of human constraints for solar farms is zoning. A layer was created with Yakima county zoning information and then filtered into a new layer displaying only areas where solar farms can be built based upon zoning codes. After those operations, all of the data was rasterized and reclassified to fit a scoring equation for the raster calculator tool. A ranking model was created for potential sites for a solar farm. Variables that influenced the rating were: distances to roads increased ranking, distance to current power plants decreased ranking, and proper zoning increased ranking.

Environmental Constraints:
The raster data was obtained from the USGS as four separate TIFF files. These files were merged into one raster image and then clipped to the extent of Yakima county. Then a slope analysis was run, to filter slopes in which solar farms cannot be built on, slopes where additional engineering must occur for the farms to be built, and ideal slopes. More specifically, solar farms cannot be built on slopes above 20% due to issues with the solar tracker movement. Slopes of 15.1-20% are possible but costly due to additional engineering requirements. Slopes of 10.1-15% require little additional infrastructure and slopes of 0-10% do not require extra infrastructure due to the slope.

Binary and Ranking Model
After the environmental and human constraint conditions were defined and mapped out, two models were made. First, a binary model, which displays all of the possible site locations, even if the sites are not ideal. Second, a ranking model was created which displays and ranks different solar sites based on the previously defined constraints. The ranking model includes a legend where the higher the score is, the more suitable the site is.

Data Sources:

United States Geological Survey. (2022a, September 19). USGS 1/3 Arc Second n47w120 20220919 - ScienceBase-Catalog. <https://www.sciencebase.gov/catalog/item/632a9a9cd34e71c6d67b95a7>

United States Geological Survey. (2022b, September 19). USGS 1/3 Arc Second n47w121 20220919 - ScienceBase-Catalog. <https://www.sciencebase.gov/catalog/item/632a9a9bd34e71c6d67b95a5>

United States Geological Survey. (2022c, September 19). USGS 1/3 Arc Second n47w122 20220919 - ScienceBase-Catalog. <https://www.sciencebase.gov/catalog/item/632a9a9ad34e71c6d67b95a3>

United States Geological Survey. (2023, March 7). USGS 1/3 Arc Second n48w122 20230307 - ScienceBase-Catalog. <https://www.sciencebase.gov/catalog/item/640824fed34e76f5f75e4055>

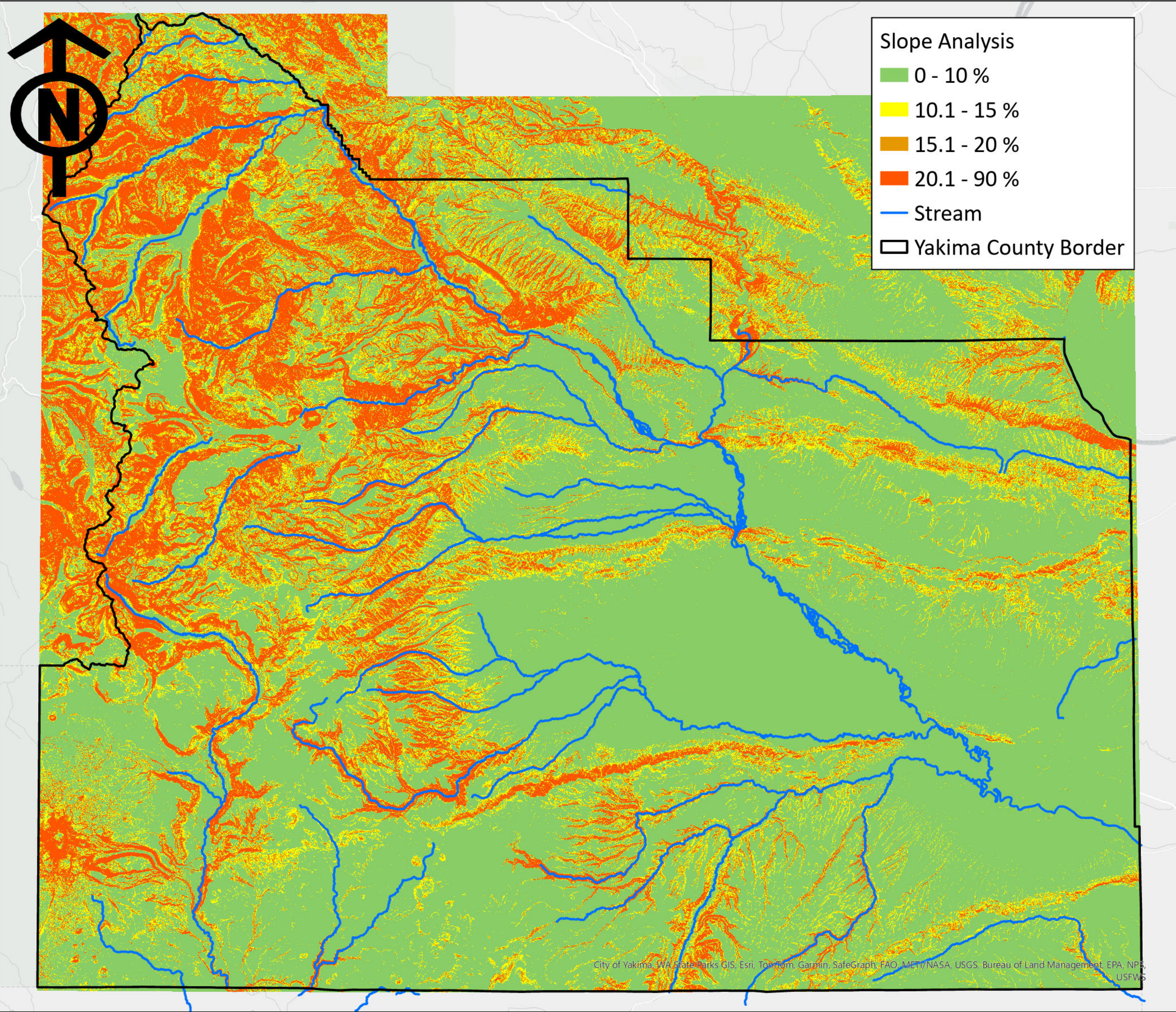
U.S. Energy Information Administration (EIA.gov). (2024, April 15). Power plants. https://atlas.eia.gov/datasets/bf5c5110b1b944d299bb683cdbc02d2a_o/explore?location=46.348469%2C-120.055583%2C8.74

Washington State Department of Ecology. (2023, March 22). Hydrography - major streams. Washington Geospatial Open Portal. https://geo.wa.gov/datasets/1deded9ca468406c802bfd5190be602b_13/explore?location=46.625116%2C-120.431316%2C10.68

Yakima County GIS. (2022, April 13). Yakima County Streets. Yakima County, WA - Open Data. https://gis-yakimacounty.opendata.arcgis.com/datasets/89999fd456e4c468fa3440117341f521f_o/explore

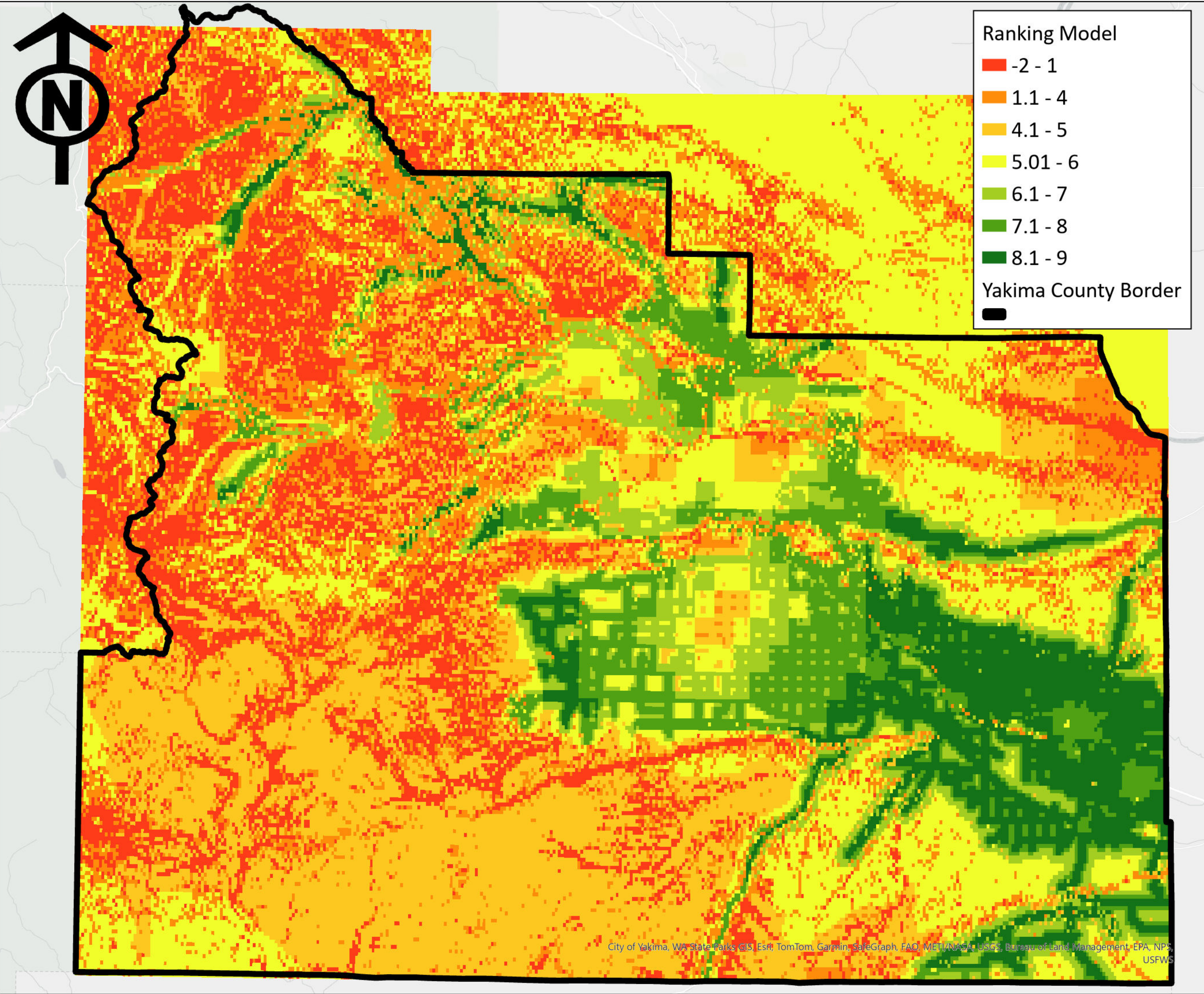
Yakima County GIS. (2024, April 4). County Zoning. Yakima County, WA - Open Data. https://gis-yakimacounty.opendata.arcgis.com/datasets/95cefc081aa44cf96b914fc42a41526_o/explore?location=46.559075%2C-120.705763%2C9.95

Environmental Constraints:



The map above displays a slope analysis made from a composite image of multiple .TIFF files.

Ranking Sites Map:



The map frame above displays a ranking model, which combines the human and environmental constants pertaining to solar farm site selection. The most ideal sites are those of higher value, while the opposite is true for less ideal sites.