

Drought Forecast Modeling and Assessment of Hydrologic Impacts of Climate Change on

Lower Colorado River

Mohammad K. Samady, David Watkins

Michigan Technological University



Michigan Tech



Background

A severe hydrologic drought afflicted central Texas from 2008 through 2015. The data for 2014 reveal that this drought has caused the Lower Colorado River basin to experience its driest conditions on record, making this the worst drought in the basin's history from a water supply perspective. Lakes Travis and Buchanan serve as water supply reservoirs, providing water to 1.1 million residents in central Texas and hydropower within 55 counties.

Objective

The objective of this study is to use physically based semi-distributed hydrologic model to understand the effects of climate change and forecast season ahead drought for the Lower Colorado River basin.

Study Area

The Colorado river streambed is more than 900 miles long, the longest river in the United States contained within one state.

It is divided into two part upper and lower basin.

The Lower Colorado River Authority (LCRA) manages water along the Lower Colorado River from San Saba to the Gulf of Mexico.

The watershed extent is approximately 18,300 square miles.

Moving downstream, the lakes include Lake Buchanan, Inks, Lyndon B. Johnson (LBJ), Marble Falls, Travis, and Austin.

Lakes Buchanan and Travis are the two primary Reservoirs to collect and store water for water supply.

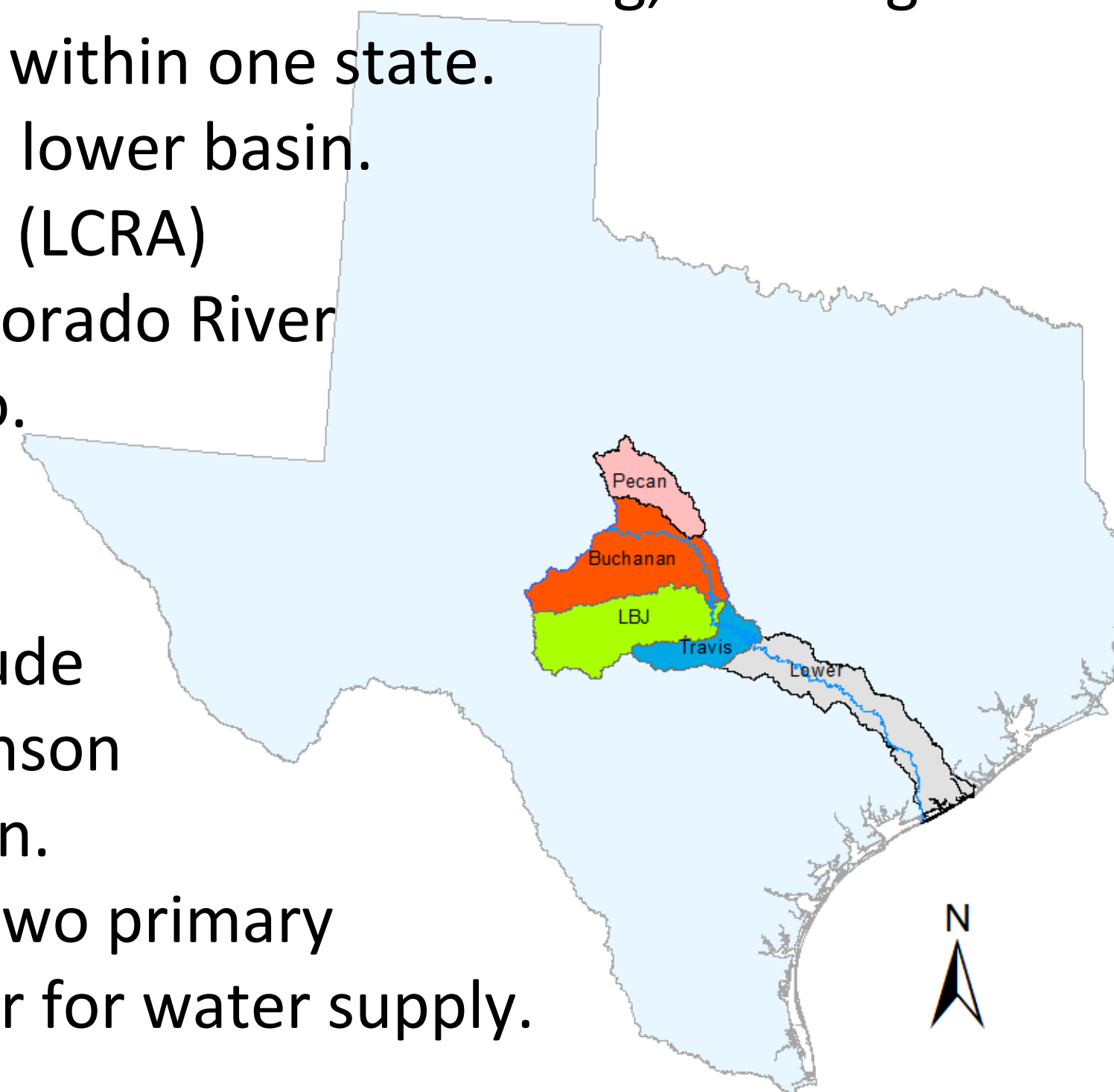


Figure 1. The Lower Colorado River Basin (Figure by Author)

Methods

The Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS 4.2) with soil moisture accounting algorithm (SMA) is applied to The Lakes Buchanan and Travis, Texas with different climatic and land-use characteristics. The HEC-HMS model with SMA algorithm accounts for watershed's soil moisture balance over a long-term period and it is suitable for simulating daily, monthly, and seasonal runoff. Inputs to the HEC-HMS model are potential evapotranspiration, precipitation, temperature, canopy interception, surface depression and ground water level. Physically based soil parameters estimated using ArcMap and STATSGO databases are used as inputs to the model. Rainfall-runoff characteristics, stream-flow and base flow are simulated at a daily time step.

Calculation and Results

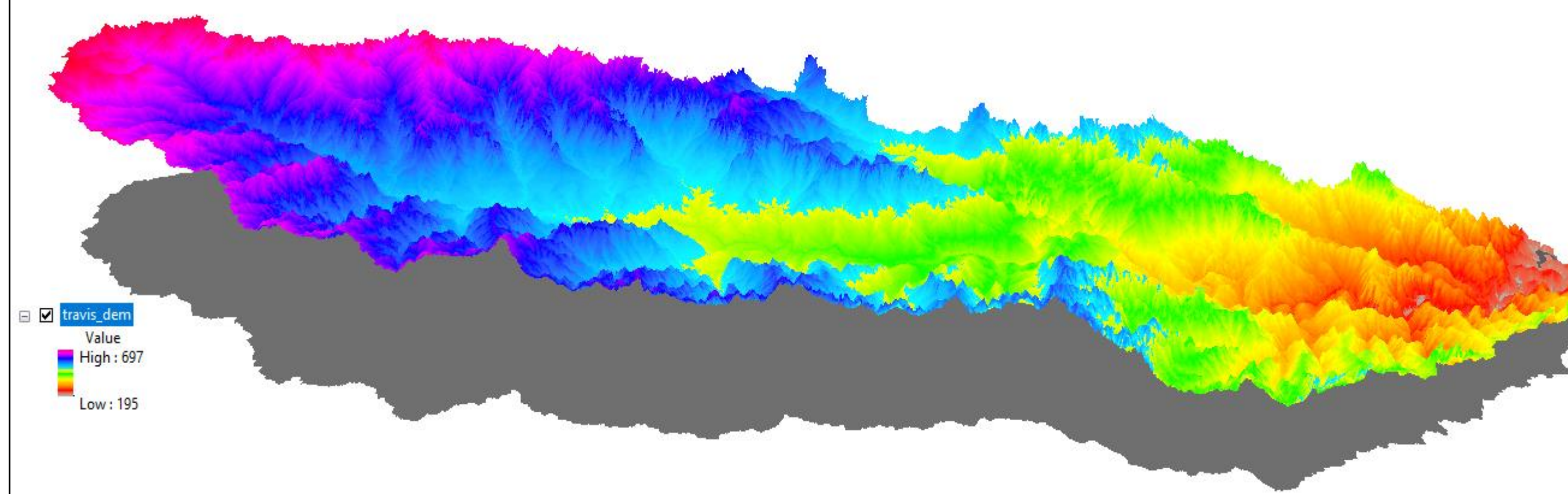


Figure 2. Digital Elevation Model (Figure by Author)

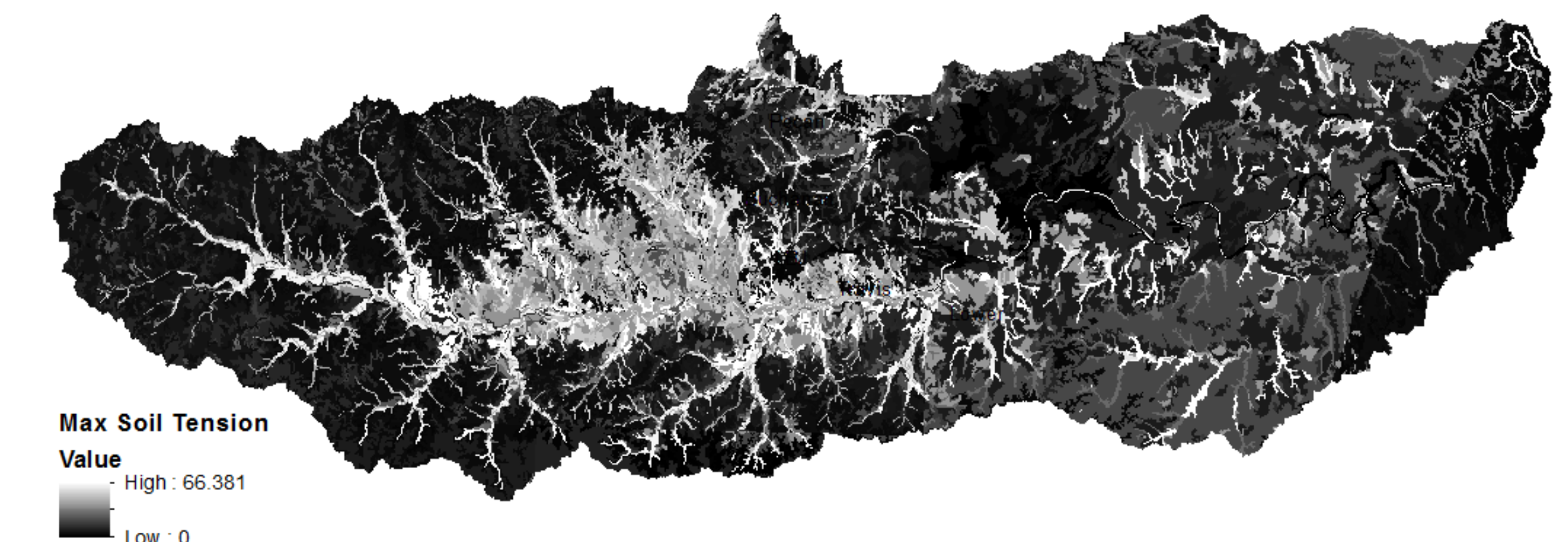


Figure 3. Maximum Soil Tension Raster (Figure by Author)

Figure 6. HEC-HMS Travis watershed Including its sub-basins. (Figure by Author)

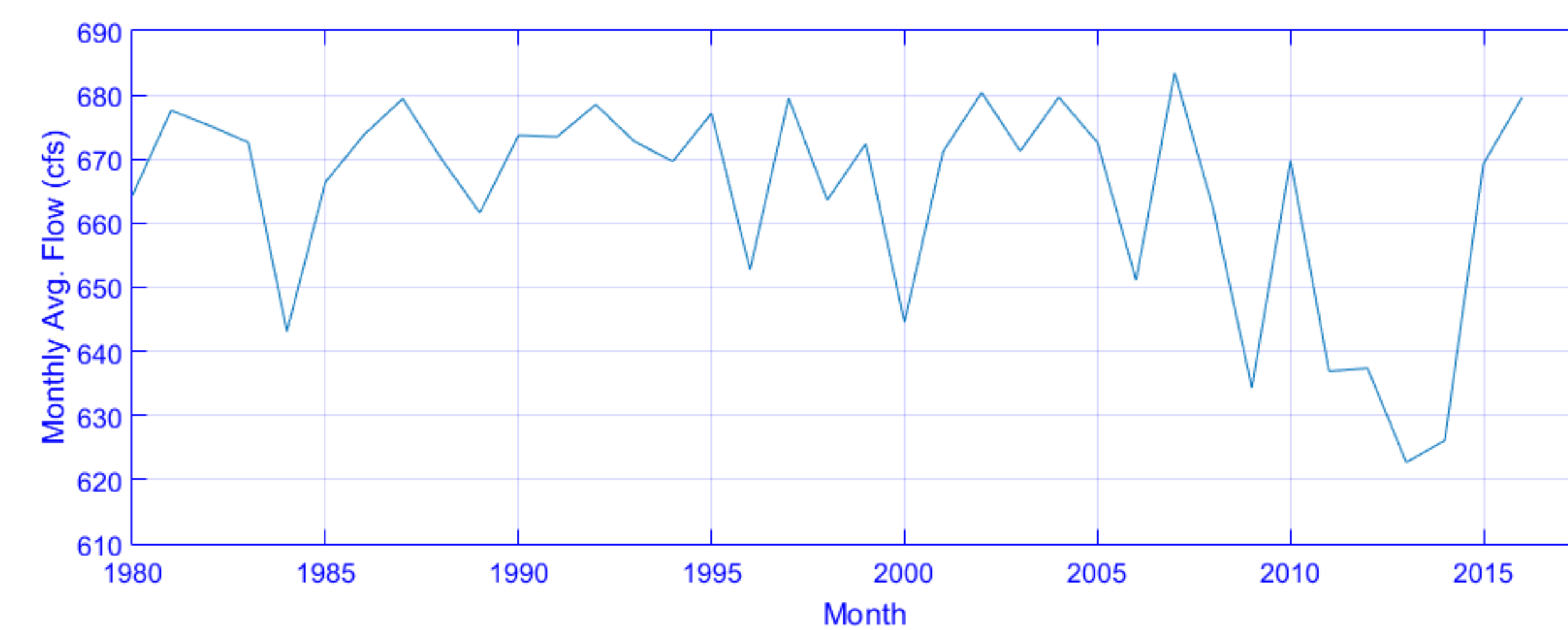
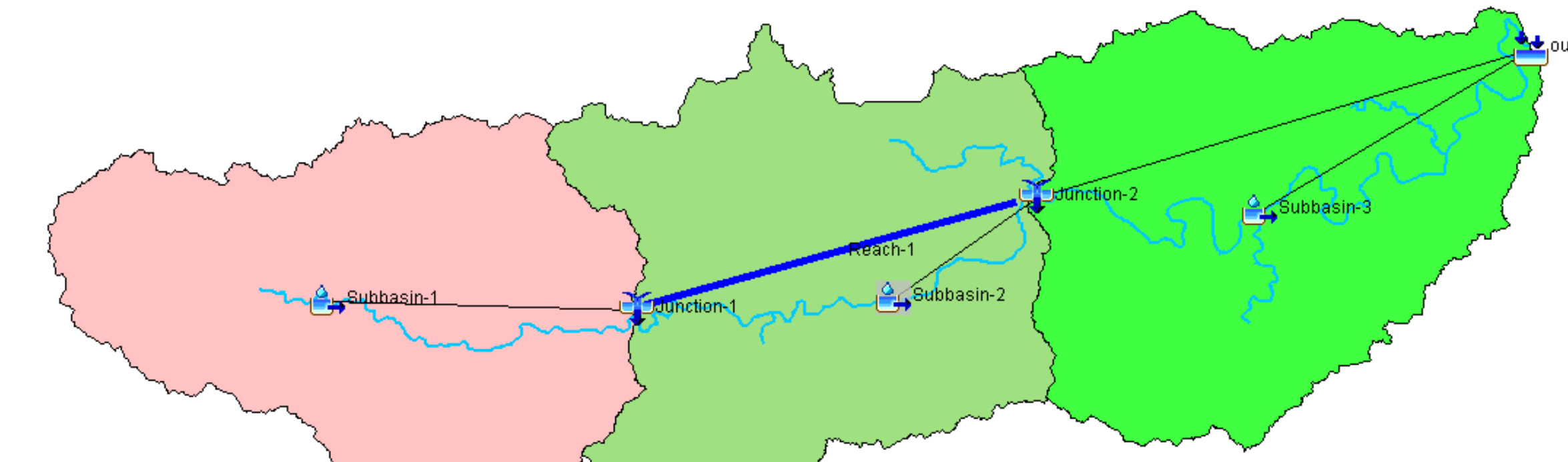


Figure 7. Discharge values from Lake Travis outlet. (1980-2016) (Figure by Author)

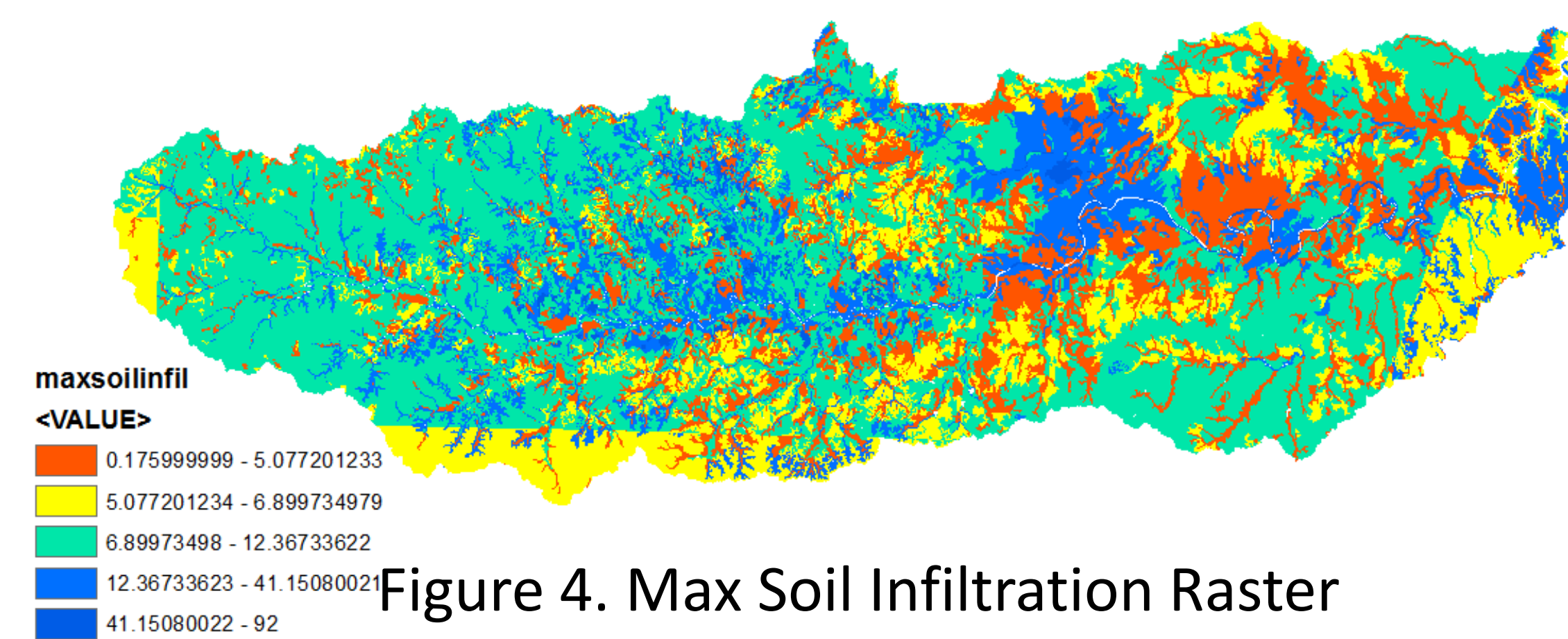


Figure 4. Max Soil Infiltration Raster (Figure by Author)

Land Use/Cover

- Shrub/Scrub
- Herbaceous
- Evergreen Forest
- Developed
- Deciduous Forest
- Cultivated Crops

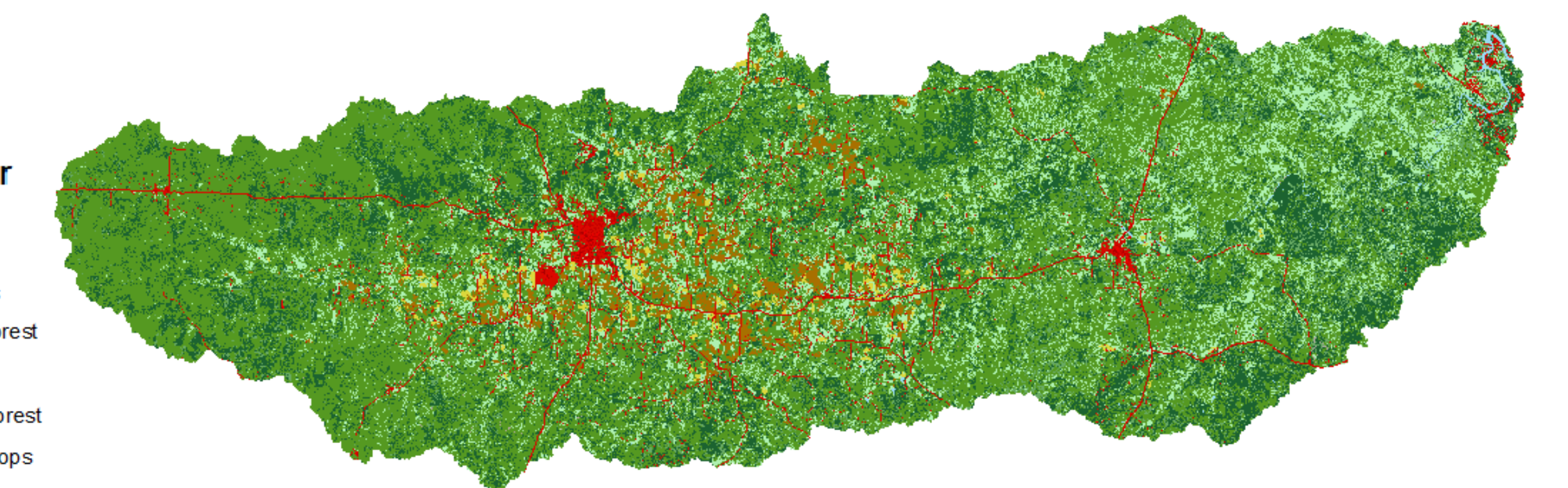


Figure 5. Land Use / Land Cover Map (Figure by Author)

Conclusion

The results from HEC-HMS model indicates that this model is capable of simulating streamflows and runoff accurately except for the high flows. Under-prediction of high flows is an inherent problem seen in hydrological modeling of the basin for longer period calculations. This is due to the lack of extreme event modeling capability of the hydrological model.

References

- Hydrologic Engineering Center (2006). Hydrologic Modeling System HEC-HMS User's Manual, Version 3.1.0, U. S. Army Corps of Engineers.
- Watkins, D. (PI) (2001). "Stochastic Reservoir System Analysis." Lower Colorado River Authority, Austin, TX
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