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# Exploring the Relationship Between Saltwater Disposal Wells and Earthquake Magnitudes in Oklahoma, 2019



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## Introduction

Saltwater disposal wells (SWD) are drilled to dispose large amounts of wastewater from hydraulic fracturing back into the subsurface. As part of Class II disposal wells, SWD wells are used to inject fluids associated with oil and natural gas production. Induced seismicity, or earthquakes, are seismic events that are a result of human activity, and in this case, are a result of the wastewater injections and SWD wells.

## Objectives

- The objective of this project is to use data about SWD wells from the State of Oklahoma along with earthquake data from USGS to understand the relationship between SWD well performance and earthquakes potentially induced from wastewater disposal.
- This project aims to use data-driven approaches to find such relationship between the given SWD well performance data and the earthquake data.

## Obtain Data

From [1] Oklahoma Corporation Commission (OCC) and [2] US Geological Survey (USGS)

## Filter Data

- Selected earthquakes from Oklahoma in 2019
- Selected SWD wells from 2019
- Selected only 2DCm & 2CNC wells

## Methodology

### Spatial Join

Associated each SWD well with the closest earthquake, using ArcGIS

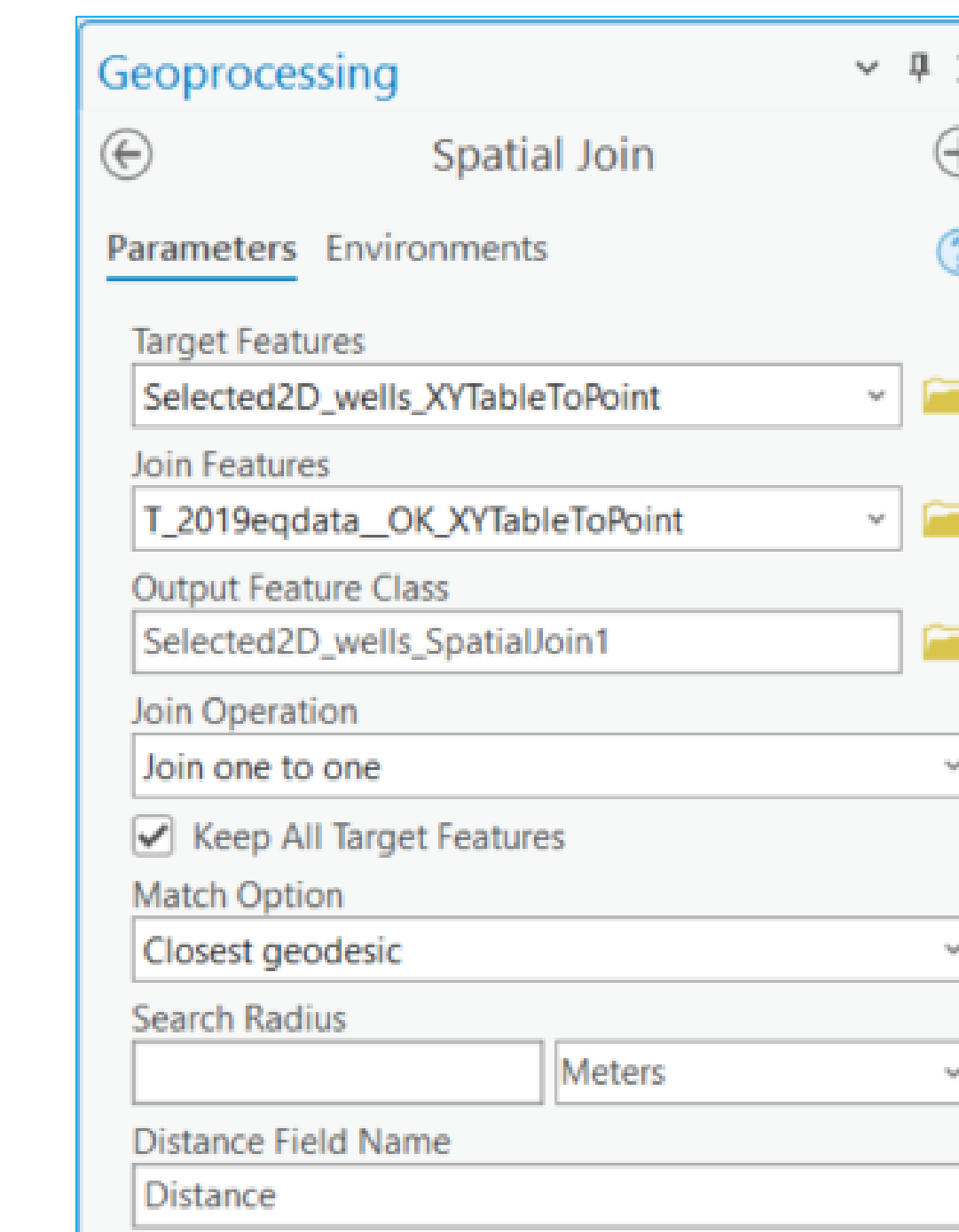


Figure 1: Spatial Join Query from ArcGIS

## Transform Data

Using MS Excel, data columns were added for log and standardized transformations

## Explore Data

- Checked distributions
- Checked skewness

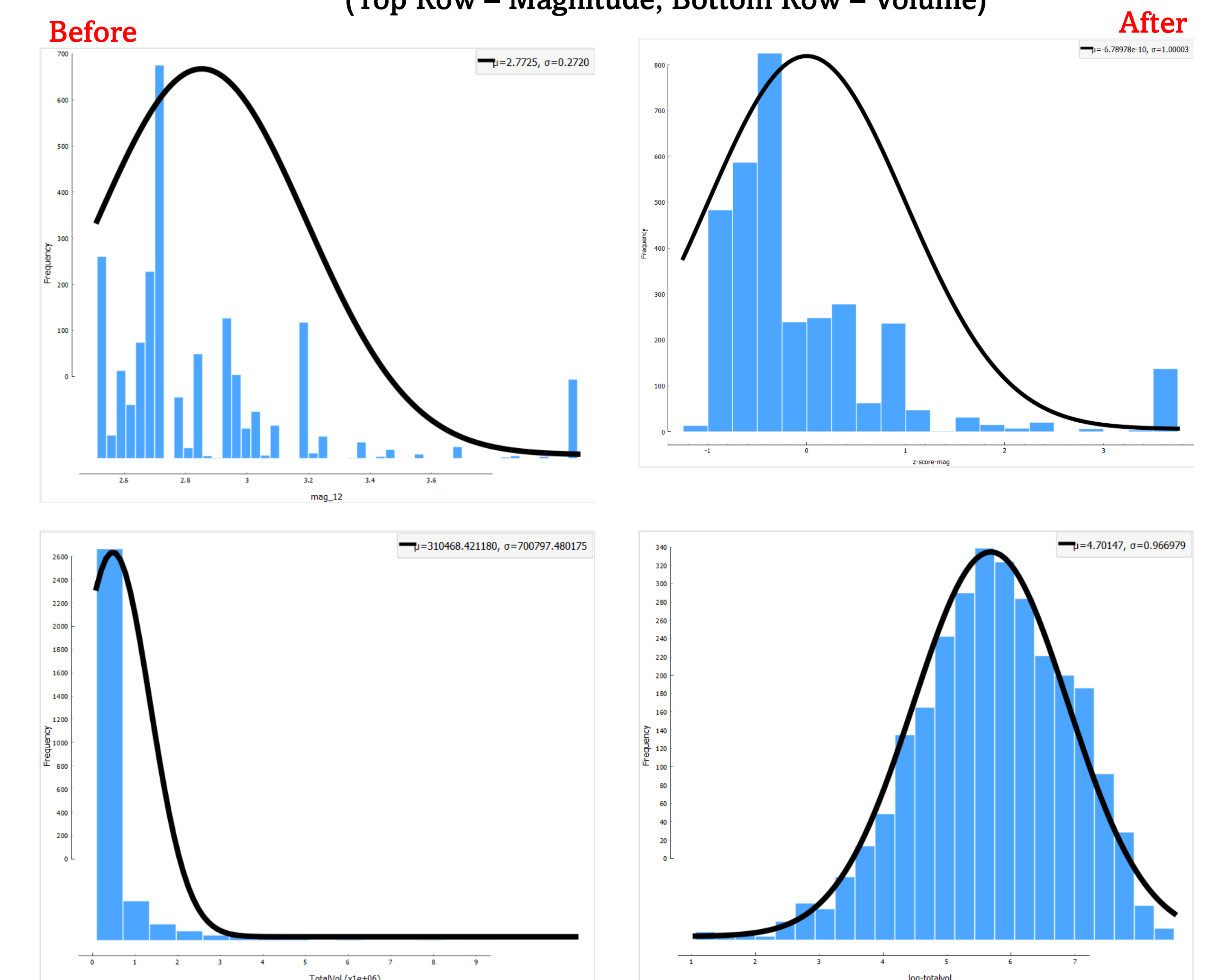
## Explore Data Again

Using Tableau, looked at relationship between total volume and associated earthquake magnitude

## Visualize Analytics

Graph all relationships and tables in Tableau

Figure 2: Data Transformation Distributions from Orange (Top Row – Magnitude, Bottom Row – Volume)



## Results

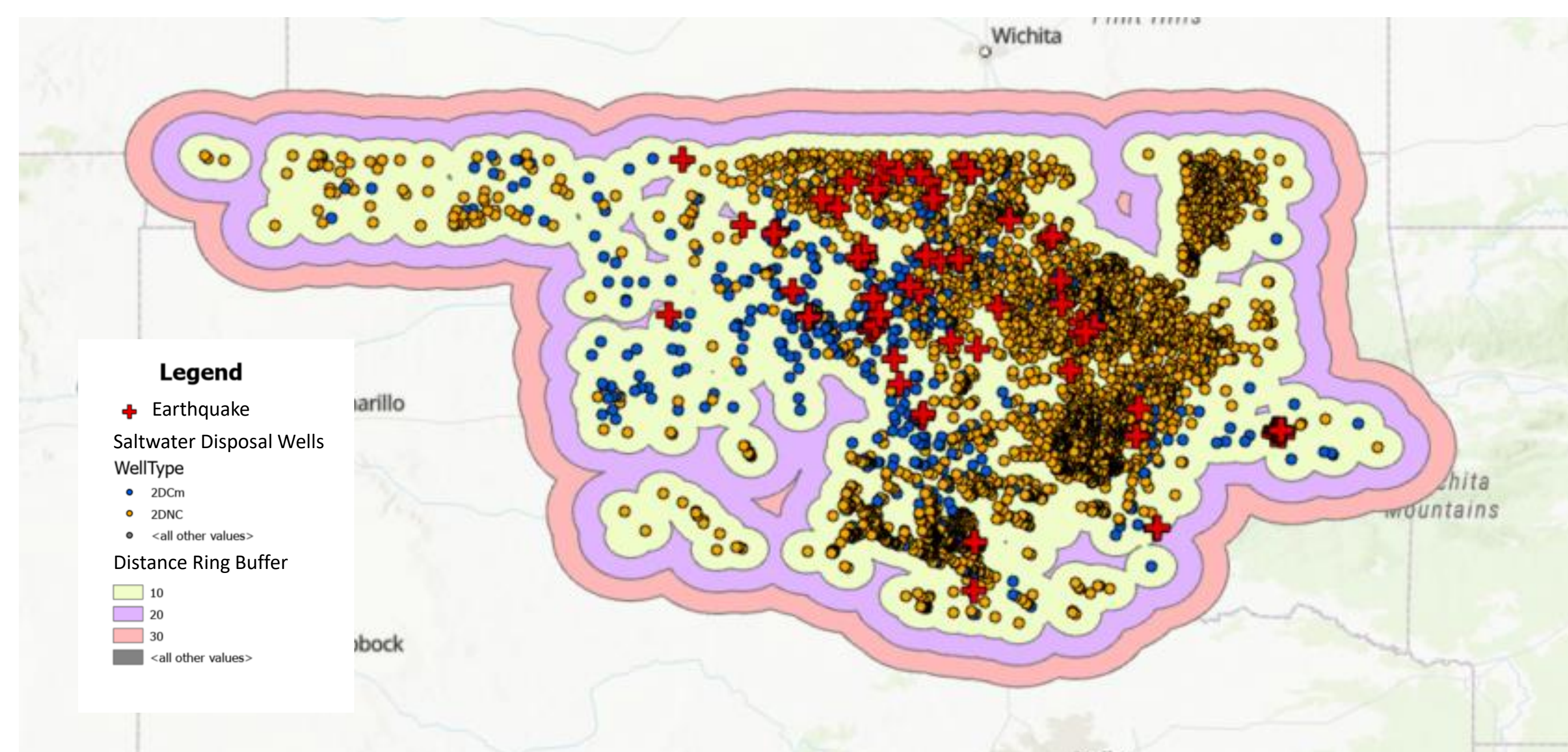


Figure 3: Spatial Join of the Disposal Wells and Earthquakes With Non-Overlapping Radii of 10,20,30 Miles from ArcGIS

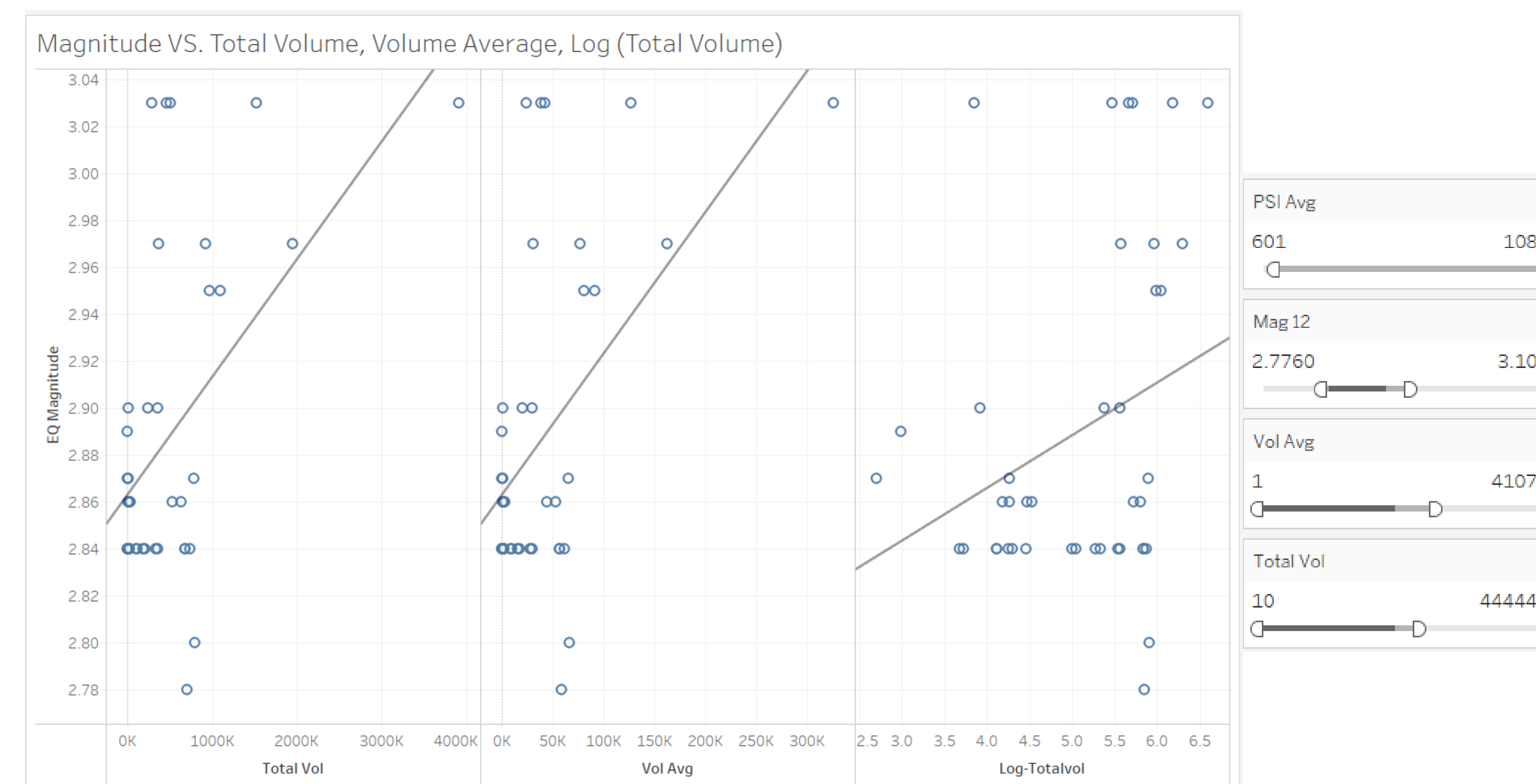


Figure 4: Scatter Plot of Magnitude VS. Total Volume, Volume Average, Total Volume (Log) with Filtering (on the right) from Tableau

## Conclusion

- Was able to spatially join the data using ArcGIS, with no coding
- Using descriptive analytics, found a positive correlation between magnitude and volume with  $R^2$  score of 0.264969, which is significant with a p-value of 0.0006778 < 0.001

## References

- "Oil and Gas Data Files." Oklahoma Corporation Commission, [oklahoma.gov/occ/divisions/oil-gas/oil-gas-data.html](http://oklahoma.gov/occ/divisions/oil-gas/oil-gas-data.html).
- "Search Earthquake Catalog." U.S. Geological Survey, [earthquake.usgs.gov/earthquakes/search/](http://earthquake.usgs.gov/earthquakes/search/).

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