

GEO 327G

Land Usage and Groundwater Contamination

Risk of Groundwater Contamination, in Austin,
Tx, 1990

Horton, Megan E

2010

Objective

Water has become an increasingly stressed resource in the past several decades. As global industrialization and population growth rates rise to greater levels, the limits of water resources available have become increasingly strained. In Austin, Tx, the main source of groundwater is the Edwards aquifer, a highly fractured, karstic carbonate aquifer that underlies much of central Texas . The high secondary permeability of the aquifer created by the fractures makes groundwater decontamination very difficult. Therefore, it is best to avoid contamination of the aquifer. One way to avoid contamination is to avoid building on areas of groundwater recharge, especially when those buildings present a high probability of contamination. To that end, I used data from 1990 to determine what types of buildings overlay the recharge zone within the City of Austin and what percentage of this recharge is most susceptible to contamination.

Data Sources:

The shapefiles for both the land usage in 1990 and the area of recharge were both obtained from the City of Austin Spatial Analysis Group and can be downloaded at the following website:

Ftp:// ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html

The website stated that all data was in NAD1983 StatePlane Texas Central FIPS 4203 (US Feet). However, the landuse_1990 shapefile was not specified as in this projection.

I would have liked to use more recent data. However, all of the data files for years after 1990 caused ArcMap to crash when opened, so I opted to use this slightly older data.

Data Processing

The first step was to make sure that all of the data was projected using the same DATUM and coordinate system. The land use file for 1990 was without a spatial reference. To change the spatial reference of the 1990 data, I:

- Opened landuse_1990 in ArcCatalog → Right click on Preferences → XY Coordinate Systems Tab → Select... → Projected Coordinate System → NAD 1983 (US feet) → NAD 1983 StatePlane Texas Central FIPS 4203 (US Feet)

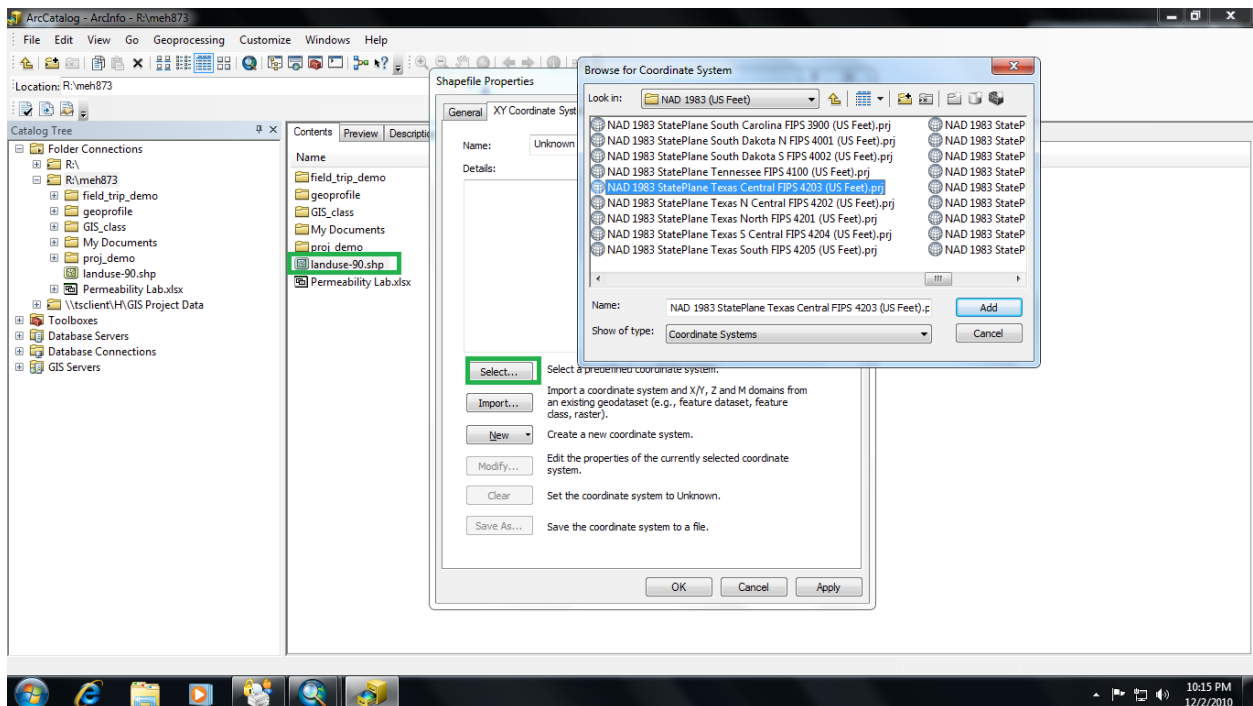


Figure 1: Setting the spatial reference

Now that all of the data was in the same Coordinate System, I decided to symbolize the data based on risk of contamination. As the original data used land use codes which provided little information without a legend, I decided to create a new field to symbolize usage called Use_name which categorized the land usages on a basis of probability of contamination. To do this I:

- Turned on editing:

Right click on toolbar → Select “Editor” → On editor toolbar drop down menu: select Start Editing

- Added a field to the attribute table:

Right click on landuse_1990 → Select “Open Attribute Table” → Table Options → Add Field →

In the window, I added the following information; NAME: Use_Name, Type: Text,

Precision: 50

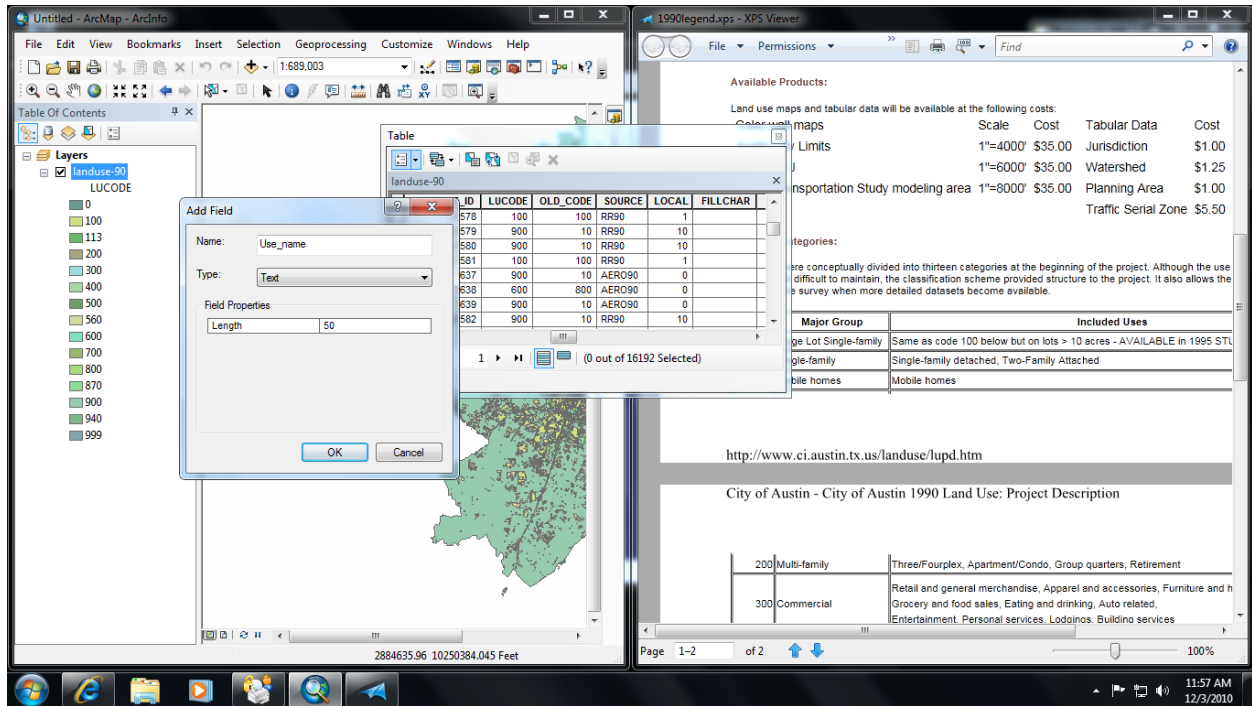


Figure 2: Adding the Use_name field to the Attribute table

The land use survey used many different classifications for land use. I wanted to simplify the data so I placed these land use categories into four probability ranges for contamination:

Very Low: Which includes lots previously labeled as Undeveloped/ Rural, Open Space, Water, and Unknown

Low: Which includes lots previously labeled Large Lot Single-Family, Single-Family, Mobile Homes, and Multi Family

Medium: Which includes lots previously labeled as Commercial, Civic, and Office

High: Which includes lots previously labeled as Industrial, Mining, Utilities, and Transportation

To add these classifications to the attribute table I selected attributes by LUCODE:

* On the attribute table: Click “Select by attribute” → Fill on SQL query with “LUCODE” = (ex. 100)

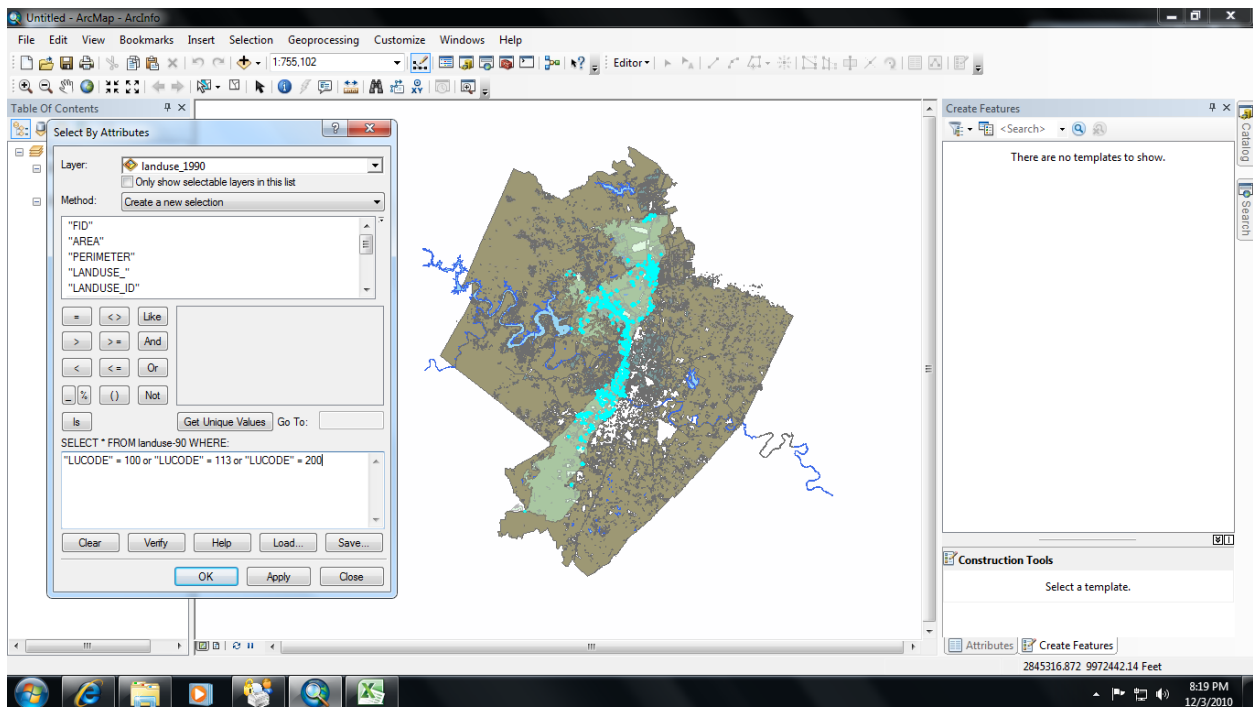


Figure 3: Selecting lot entries with the attribute LUCODE

Once the entries with the correct land use code were selected I filled in the Use_name field by:

* On the Editor table: Click the “Attribute table” button → Highlight landuse_1990 → Fill in the Use_name (ex. Low)

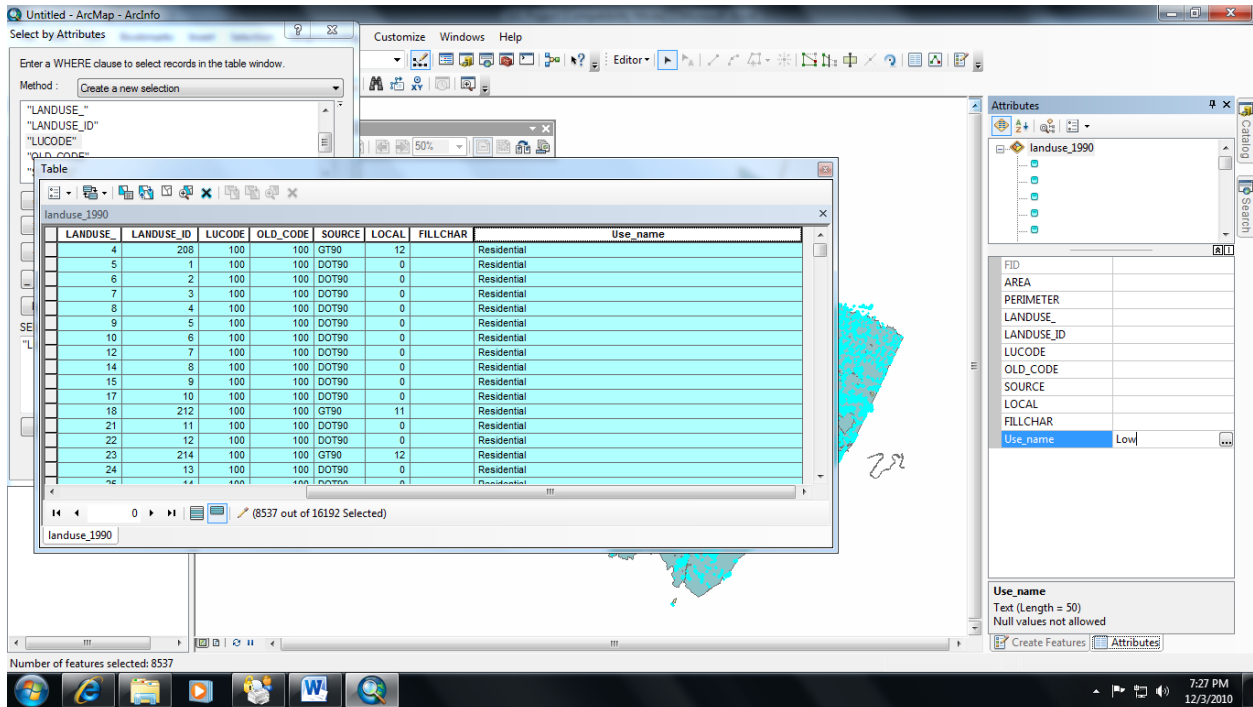


Figure 4: Adding Use_name data to attribute table

When all of the data had entries in the Use_name field, I symbolized the landuse_1990 by the probability of contamination:

- Right click on layer name (ex. landuse_1990) → Symbology → Category → Unique Values → In the Value Field choose Use_name → Add all values

With the data resymbolized to show probability of contamination, I now needed to calculate how much of the recharge area underlay each of the four probability categories. To do this I:

- Selected the features based on Attribute as above but this time using the probability categories (Use_name)
- Then I selected from these feature those that lay within the Area of Recharge
Selection toolbar → Select by location → Target Layer: landuse_1990, Source Layer : Area of

Recharge, select features from previously selected features, Target layer(s) features within the Source Layer feature

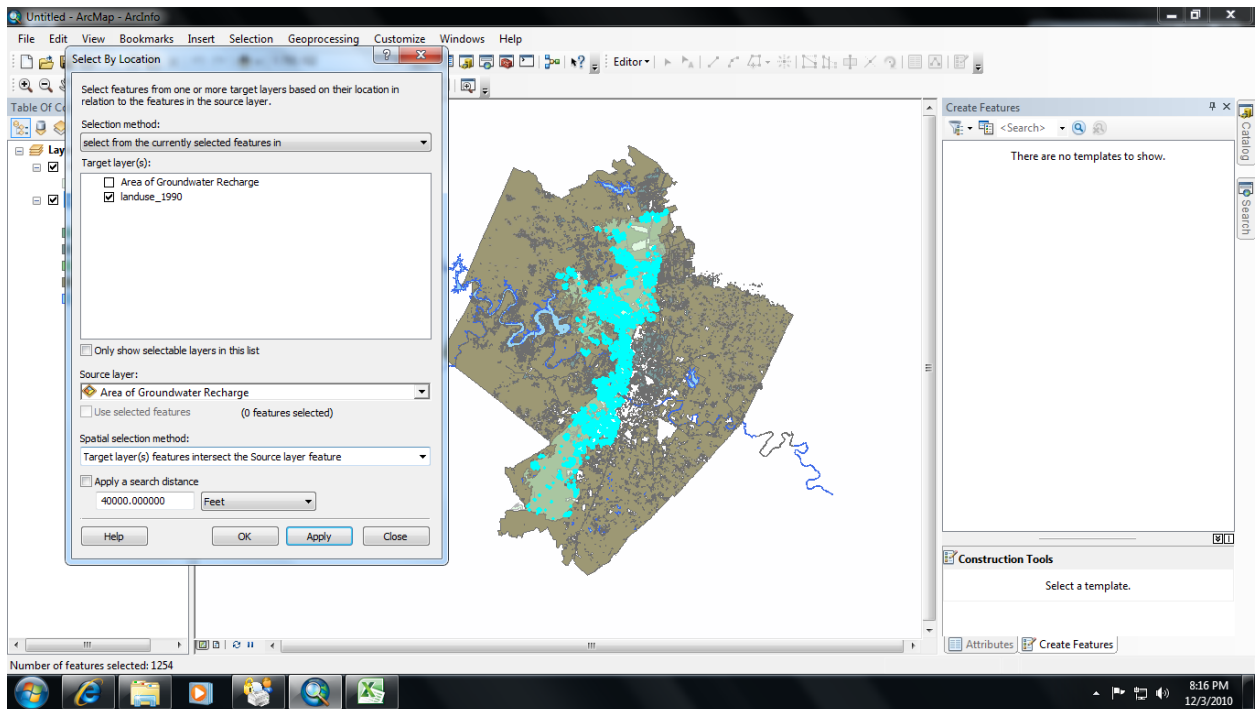


Figure 5: Selecting features by location.

Once the features had been selected by location and Use_name, I could calculate the area of the recharge zone underlain by each of the four categories. To do this I:

- Right-click on landuse_1990 → Open Attribute Table → Right-click on Area → Statistics → Copy the Sum

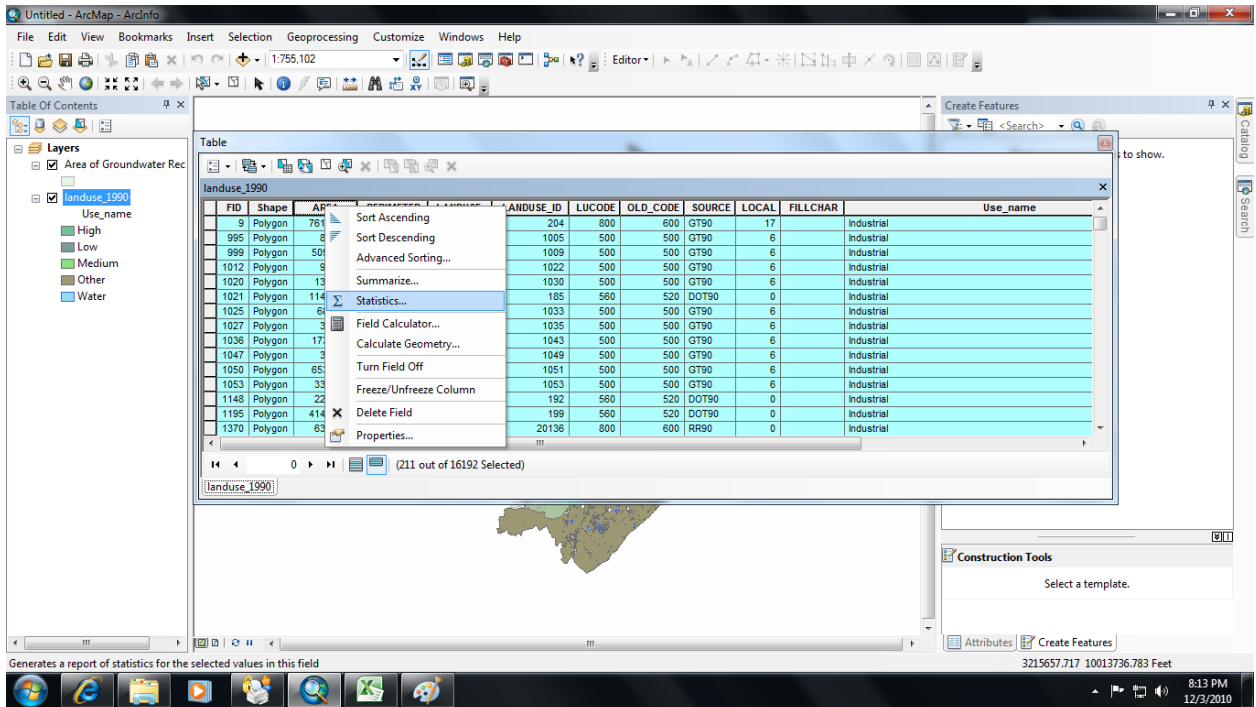


Figure 6: Summing the area of recharge underlain by High probability of contamination

I did this for all four probabilities and placed them in an excel spreadsheet. This produced the following table:

	Area (sq. ft.)	Area (sq. miles)	% of Recharge Zone
High Probability	62264326	22.3	22.1
Medium Probability	224220214	8.0	8.0
Low Probability	1474898425	52.9	52.4
Very Low Probability	494737196	17.7	17.6

I then made a map of Land Use for Austin, Tx 1990.

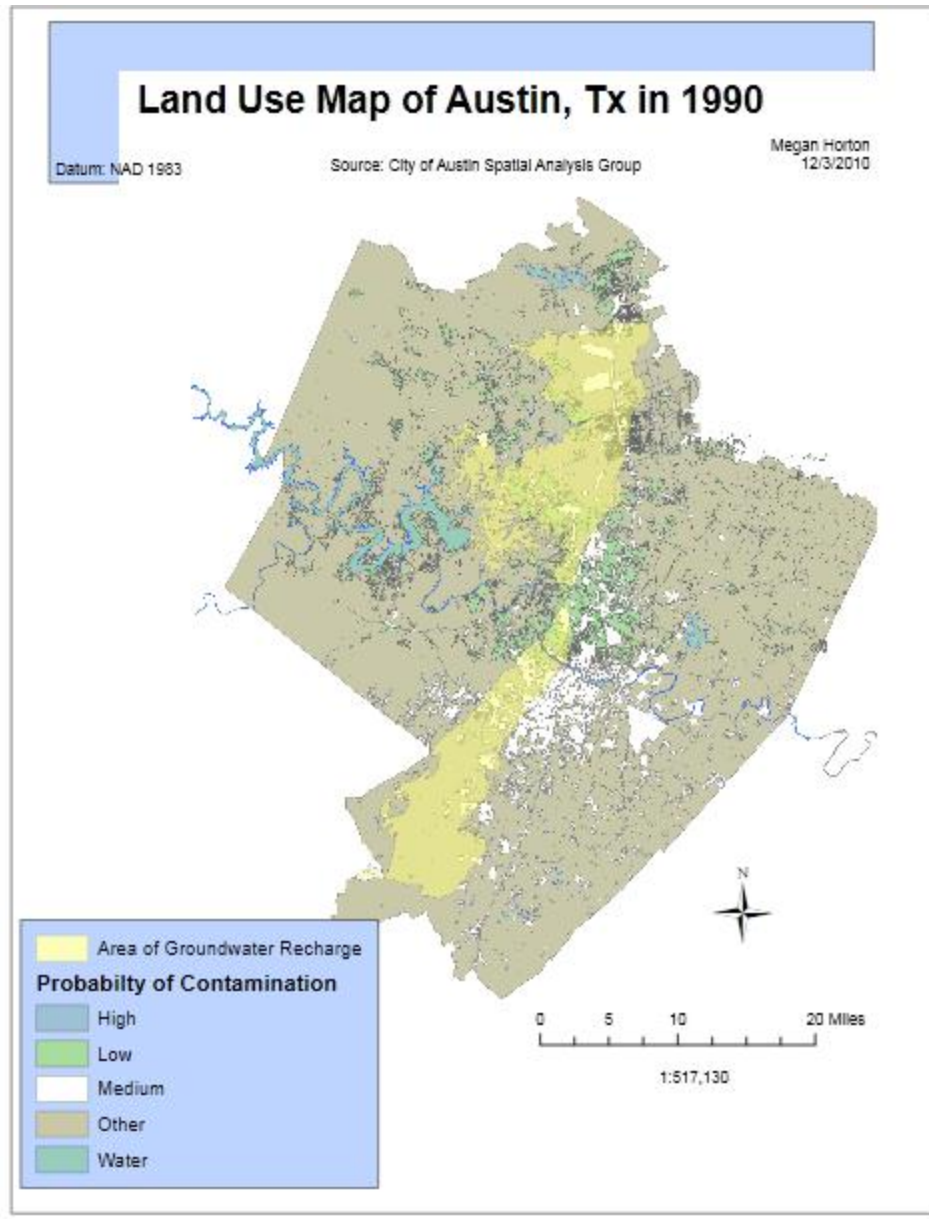


Figure 7: Land Usage Map of Austin, Tx in 1990 with recharge zone overlain.

Conclusion:

The groundwater in Austin, TX in 1990 was relatively safe from contamination. The majority of the recharge area, about 52.4 %, was overlain by lots with low chances of contamination like residential areas. Another 17.6% was overlain by lots with a very low chance of contamination,

including empty and rural lots. Only 22.1% of the recharge zone was overlain by lots with a very high probability of contamination such as mining and industrial zones. However, this data is almost 20 years old. Austin has grown a great deal of the best decades, including in areas such as industry that increase the chances of groundwater contamination. The same process described above can be applied to newer data to determine how much Austin is putting its groundwater at risk for contamination.