Geocoding

11

Introduction

Geocoding is the process of transforming a description of a location such as an address, or a name of a place to a location on the earth's surface. You can geocode by entering one location description at a time or by providing many of them at once in a table. The resulting output is a location feature with attributes, which can be used for mapping or spatial analysis. With geocoded addresses, you can spatially display the address locations as a points in ArcMap, which help user recognize patterns by using some of the analysis tools available with ArcGIS.

In this chapter, you will learn techniques for finding various types of addresses. The user will be introduced to the preparation of geographic data necessary for address matching called reference data. Technically geocoding is a process of using an address locator to enter address text or a table of addresses to find a corresponding address locations in a geographic database.

Geocoding requires the following:

1. **Address table**: This is a table that includes the addresses that need to be converted into a feature class location.
2. **Reference data**: This is a snapshot of geographic information (point, line, or polygon feature classes) with address information such as streets, or feature class.
3. **Address locator**: An address locator lets you convert textual descriptions of locations into geographic features. Address locators are stored and managed in a workspace you choose. The workspace can be a file folder or geodatabase (file or personal geodatabase).

Once you know what you want to find, the next step to prepare for geocoding is to build or locate sources of geographic data for reference data. In this chapter you are going to perform Geocoding based on

1. Zip Code
2. Street Address

Geocoding Based on Zip Code

In this exercise, you are going to geocode based on the ZIP code. The ZIP code is usually associated with the residents and business addresses. Therefore, utilizing the ZIP code address is an easy approach to be converted into a point feature and using it in ArcMap for analysis.

Scenario 1: About three quarters of the population in Wisconsin and especially those who are living in rural areas rely on groundwater as a source for domestic purposes. Many of these wells are shallow and are susceptible to groundwater contamination, especially from septic tanks on owners' properties of the wells. As a new employer at the USGS, you have been given

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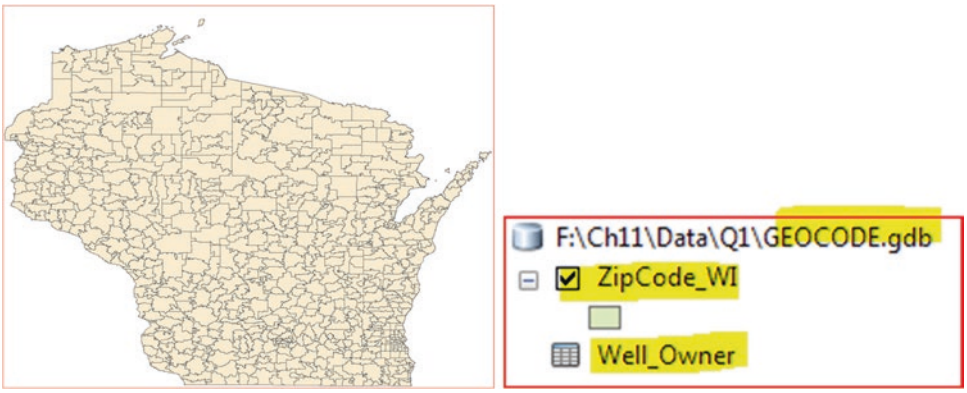
a database table of well owners that their wells have nitrate concentration higher than 20 mg/L. You have been asked to geocode the wells' addresses; based on their zip code and prepare a table showing the average nitrates in the wells in each zip code.

Your duty is to do the following

1. Geocode the database file based on the zip code
2. Summarize the matched addresses based on the zip code
3. Join the summarized matched addresses with the geocoded shapefile

GIS Approach

1. Start ArcMap and rename the Layers data frame "ZIP CODE"
2. Add Data and browse to \\Data\Q1 folder and D-click **GEOCODE.gdb** and highlight **ZipCode_WI** and **Well_Owner** and click Add



3. In the TOC/r-click **Well_Owner**/Open/ and familiarize yourself with the fields/then close the attribute table

Table

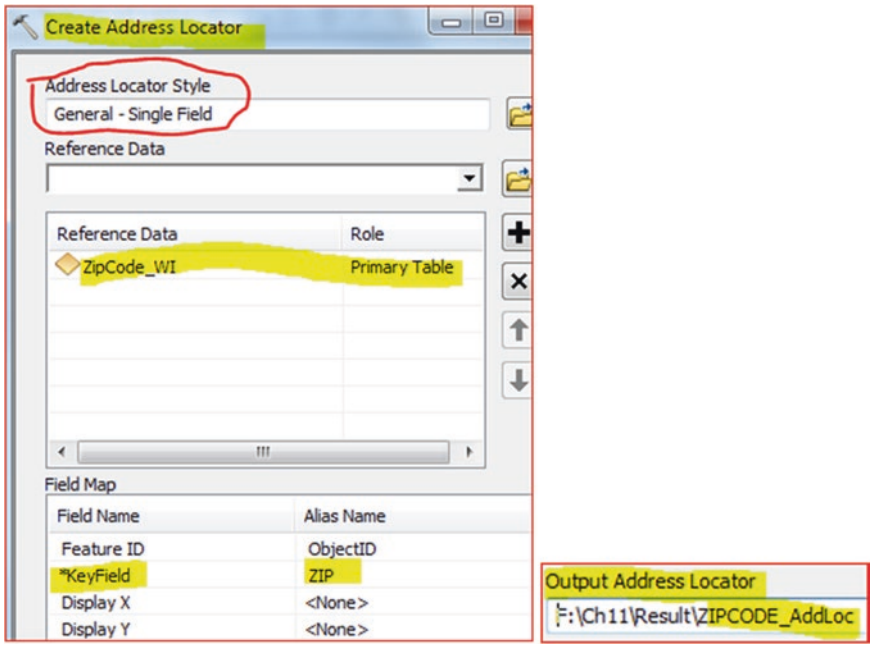
Well_Owner

OBJECTID *	No	Name	Address	City	State	ZipCode	NO3
1	1	Aaron	1614 Gafton Rd.	Madison	WI	53716	40
2	2	Adam	5022 Ironwood Rd.	Madison	WI	53716	34
3	3	Adam	1506 Drewry Ln	Madison	WI	53704	35
4	4	Adam	6834 Park Ridge Dr	Madison	WI	53703	36
5	5	Adam	3525 Concord Ave	Madison	WI	53714	35
6	6	Alan	13 Springwood Cir	Madison	WI	53717	41
7	7	Alan	5706 Odana Rd	Madison	WI	53719	42
8	8	Alexander	3529 Lexington Ave Apt 3	Madison	WI	53714	62
9	9	Allen	1329 Temkin Ave Apt 10	Madison	WI	53705	62
10	10	Angela	141 Metro Ter Unit 101	Madison	WI	53718	62
11	11	Angela	3309 Brighton Pl	Madison	WI	53713	62
12	12	Anthony	3507 Milwaukee St Apt A	Madison	WI	53714	62
13	13	Anthony	505 E Lakeview Ave	Madison	WI	53716	55
14	14	Antonio	4462 Windsor Rd #4	Madison	WI	53711	63
15	15	Archie	306 N Brook St Rm 310	Madison	WI	53715	69
16	16	Attila	4223 Country Road Ab	Madison	WI	53718	72
17	17	Kvenvolden	3138 Thorp St Apt 7	Madison	WI	53714	46
18	18	Benjie	3009 Muir Field Rd	Madison	WI	53719	75

Result: The table consists of 779 records and 8 fields. The fields that are relevant to the geocoding are the "Address" and the 5-digit "Zip Code". The table also contains the NO3 concentration.

Create Address Locator

4. Open the Catalog window/Browse to \\Result
5. R-click Result\New\Address Locator
6. In the Create Address Locator dialog box fill it as below
7. Address Locator Style: **General—Single Field**
8. Click OK
9. Reference Data: ZipCode_WI (Make sure Primary Table is selected)
10. *KeyField ZIP (Under Field Map)



Note: The *KeyField is important to change it to ZIP.

11. Output Address Locator: \\Result\ZIPCODE_AddLoc
12. Save/OK

Result: The address Locator (**ZIPCODE_AddLoc**) is created.

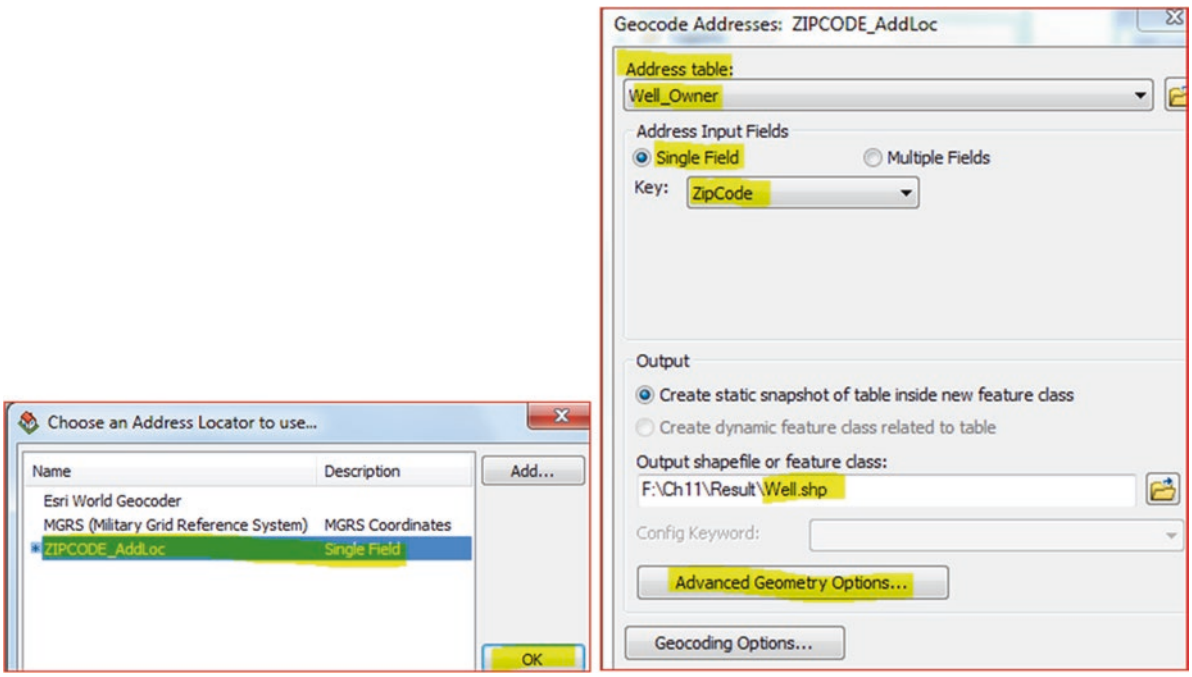
13. Customize menu/Toolbar/Geocoding

14. On the Geocoding toolbar select "**ZIPCODE_AddLoc**"
15. Type 54880 in the <Type an address>/Enter. (This to verify if the "**ZIPCODE_AddLoc**" address locator is established correctly and functioning).

Result: A point will be flashed inside Superior (North-West WI).

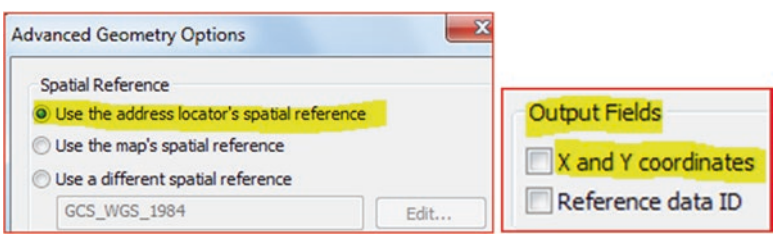
Geocode the Addresses

16. Click the Geocode Address button on the Geocoding toolbar
17. Click **ZIPCODE_AddLoc** to select it/then click OK



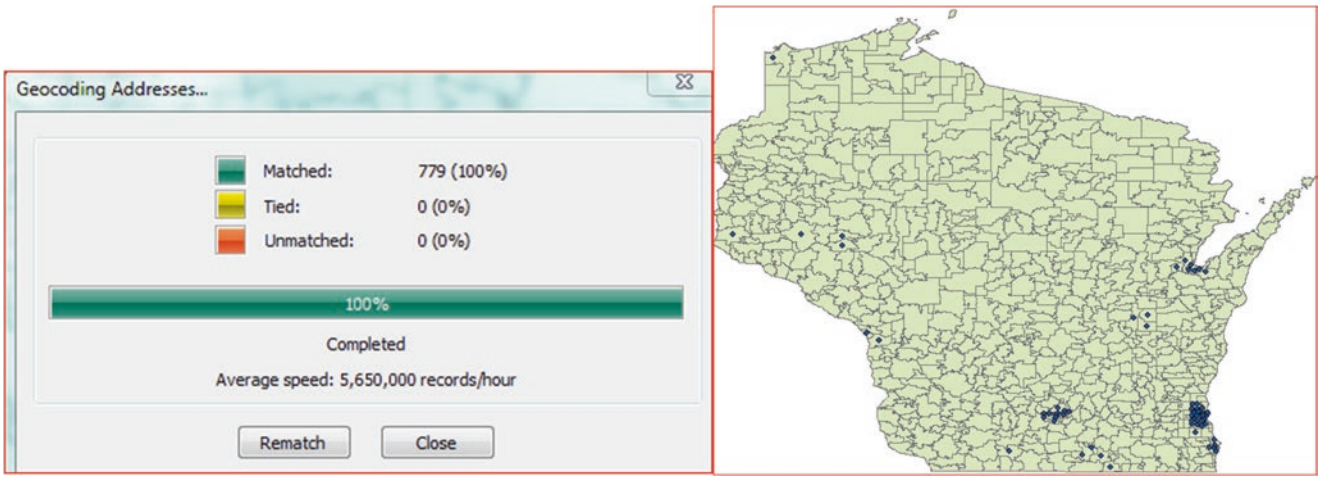
18. The Geocode Addresses: **ZIPCODE_AddLoc** dialog box display
19. Address table: Well_Owner
20. Check Single Field Key: ZipCode
21. Output shapefile or feature class: \\ch11\Result\Well
22. Click Advanced Geometry Options
23. Make sure the "Use the address Locator's spatial reference" is checked
24. Click OK
25. Click Geocoding Options
26. Under Output field uncheck X and Y coordinates
27. Click OK

Result: Geocoding Addresses dialog box display showing 779 addresses are matched.



28. Close the Geocoding Addresses dialog box
29. The **Geocoding Result: Well** is now added into the TOC
30. Open the attribute table of the **Geocoding Result: Well**

Result: The **Well** attribute table include fields such as Score, Match_Type, Match_addr, and all the fields from the **Well_Owner** table that used for geocoding. The Score field means that the candidate are matched or not matched and what is the percent of matching by the address locator. In this scenario all the candidates matched 100%. In the table matching, an address is matched automatically to the candidate with the highest score. The Match_Type field shows how the addresses were matched and in our case it automatically matched (A). The Match_addr field shows where the matched location actually resides based on the information of the matched candidate. For example, an input address of 53202 zip code is matched correctly to a candidate that has the same zip code.



Create Table with the Nitrate Information

This step is important in order to know number of wells in each zip code.

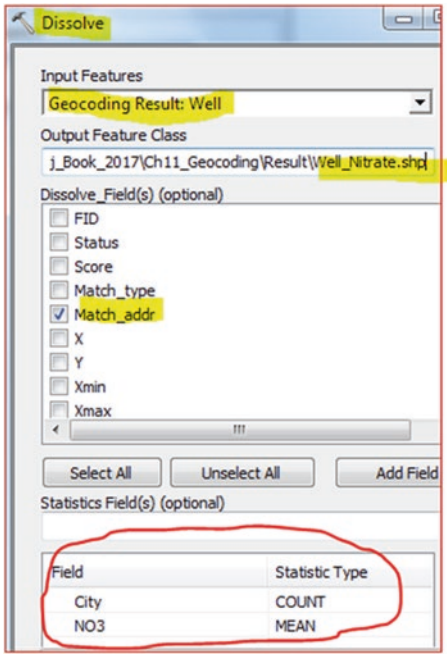
31. Make sure that the attribute table of Geocoding Result: Well is open
32. R-click "Match_adrr" field/Sort Ascending

Geocoding Result: Well

FID	Shape	Status	Score	Match_type	Match_addr	Addr_type	No	Name	Address	City	State	ZipCode	NO3
563	Point	M	100	A	53132	Address	564	Pamela	8885 S 68th St	Milwauke	WI	53132	47
494	Point	M	100	A	53202	Address	495	Thomas	270 E Highland Ave	Milwauke	WI	53202	53
498	Point	M	100	A	53202	Address	498	Thomas	1209a E Kane Pl	Milwauke	WI	53202	56
510	Point	M	100	A	53202	Address	510	Shaun	1614 N Farwell Ave	Milwauke	WI	53202	29
514	Point	M	100	A	53202	Address	514	Sean	1041 E Knapp St	Milwauke	WI	53202	66
527	Point	M	100	A	53202	Address	529	Robert	1683 N Franklin Pl	Milwauke	WI	53202	42
528	Point	M	100	A	53202	Address	528	Robert	728 E Juneau Ave	Milwauke	WI	53202	41
532	Point	M	100	A	53202	Address	533	Robert	1108 N Milwaukee St	Milwauke	WI	53202	46
555	Point	M	100	A	53202	Address	556	Phillip	1300 E Kane Pl	Milwauke	WI	53202	63

Note: The "Match_Adrr" field has identical different records as all these wells located in the zone that have the same zip code. Your duty is to know how many wells have the same zip code and their average nitrate.

33. Click the Geoprocessing menu/select Dissolve tool (fill it as below)
34. Input Features: Geocoding Result: Well
35. Output Feature Class: \\Result\Well_Nitrate
36. Dissolve Field: check Match_addr
37. Statistic Field: NO3 and Check MEAN
38. Statistic Field: City and Check COUNT
39. OK
40. Click Yes to add the table to TOC



Well_Nitrate

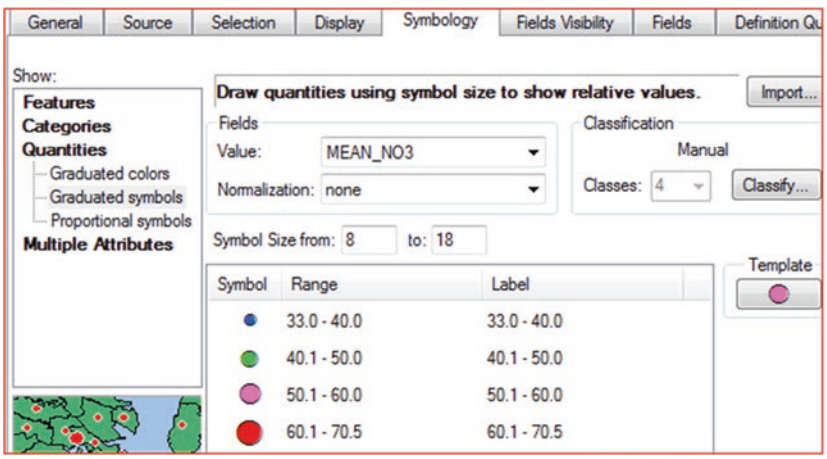
FID	Shape *	Match_addr	COUNT_City	MEAN_NO3
32	Multipoint	53406	10	50.2
8	Multipoint	53209	9	49.8
10	Multipoint	53211	9	50.9
15	Multipoint	53216	9	51.2
41	Multipoint	53711	9	50.4
65	Multipoint	54904	9	50.3
3	Multipoint	53204	8	49.6
9	Multipoint	53210	8	48.5
16	Multipoint	53218	8	54.5

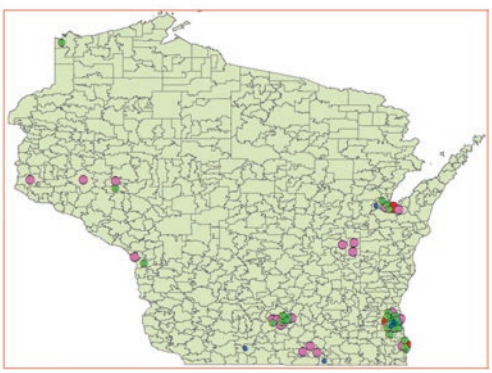
Result: The Well_Nitrate layer display in the TOC and if you open the attribute table you see three fields: Match_addr, COUNT_City, and MEAN_NO3 fields. The COUNT_City field shows how many wells existed in this particular zip code. The MEAN_NO3 is the average of nitrate in all the wells in a particular zip code. For example, the zip code "54904" has 9 wells and their average nitrate is 50.3 mg/L. Some Zip Code, and Zip Addresses include one well and others include many more.

Symbolizing

This step is important to provide symbology for the wells in the zip code. The zip code that has wells with high average nitrate concentration will have bigger symbol, while the zip code that has wells with lower average nitrate concentration will have smaller symbol.

41. D-click Well_Nitrate/Symbology/Quantities/Graduate Symbols
42. Value: MEAN_NO3
43. Click Template/choose Circle 2/Ok/Classes 4 and click Classify
44. Under Break value
45. Type 40, 50, 60, and leave the 70.5
46. Click OK
47. Change the symbol size from 8 to 18
48. Change the color of the symbol as seen below (red, pink, green, and blue)





Question: Use Well_Nitrate layer to find out the following:

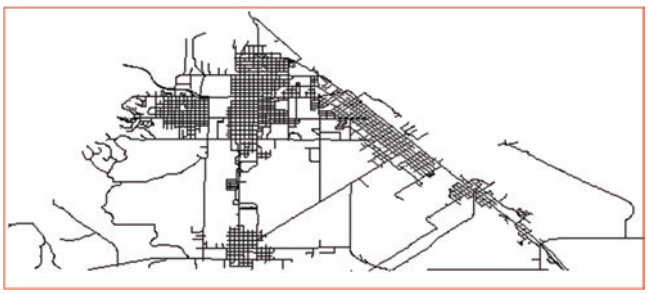
a) Which Zip code has the highest number of wells and what is the well numbers?
b) Which Zip code has the highest average NO3 concentration and what is the value?
c) Which Zip code has the lowest average NO3 concentration and what is the value?
d) How many Zip code have average NO3 concentration higher than 50 mg/L?
e) In which area of Wisconsin is the highest average NO3?

Geocoding Based on Street Address

Geocoding is a fundamental part of business data management. Every organization maintains address information for each client. In water resources, Wisconsin private wells have an address. The address is stored in a table that contains the well owner's address, well depth, and other relevant information.

Scenario 2: You are working for Douglas County in the city of Superior, you have been given an Excel file that contain well owners and their addresses. You have been asked to geocode the well address owners by converting them into a point shapefile and do some analysis to select the deepest wells that are tapping the sandstone aquifer to be used as an alternative source for water supply in case of emergency.

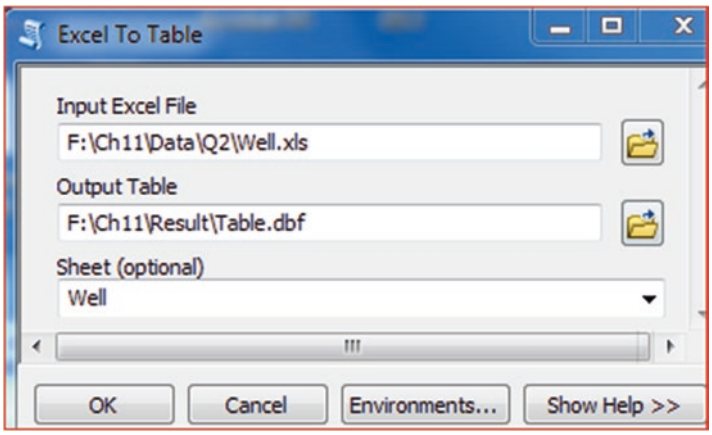
1. Insert Data Frame call it Superior
2. Add data, browse \\Data\Q2 folder and integrate **Street.shp**
3. Click the symbol of the street and select "**Arterial Street**" from the Symbol Selector



Integrate Excel Table

The excel table **Well.xls** has the information about the wells and your duty is to convert it into a **Table** format in ArcGIS

4. Click Search window/Type Excel/click search icon
5. Click Excel to Table (Conversion) tool
6. Input Excel File: \\Well.xls
7. Output Table: \\Ch11\Result\Table.dbf
8. OK

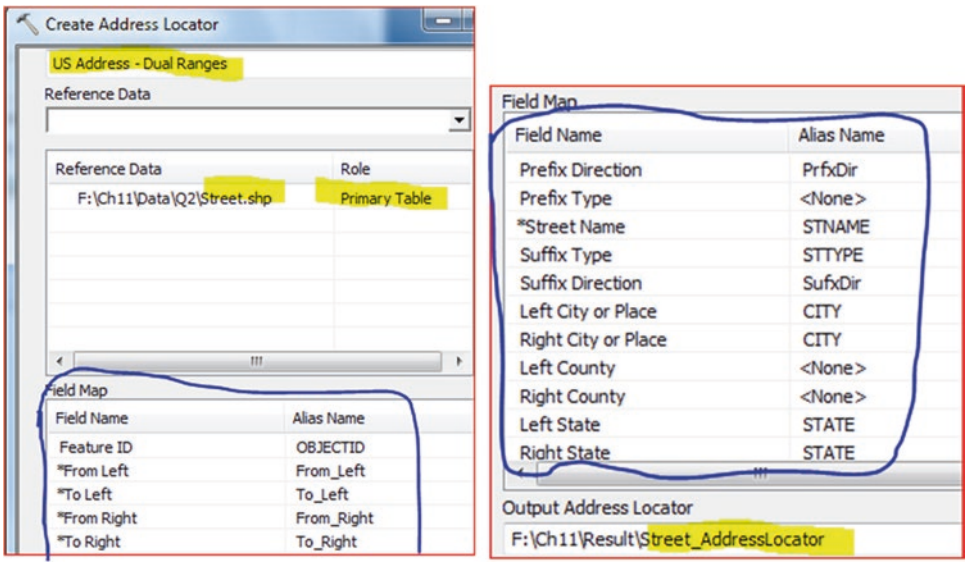


Result: The excel file now is converted into **Table.dbf** and it added into the TOC.

Create Address Locator

Geocoding is performed in ArcGIS with an address locator. An address locator is a dataset stored in either a geodatabase or a file folder that contains information about local conventions for addresses (known as an address locator style) and embedded map data such as street centerlines with address ranges (known as reference data). When you perform geocoding, the address locator interprets an address using the address locator style and finds that address on a map using the reference data. An address locator is created based on a specific locator style. The style determines the type of addresses that can be geocoded, the field mapping for the reference data, and what output information of a match would be returned. It also contains information about how an address is parsed, searching methods for possible matches, and default values for the geocoding options.

9. Click Catalog window/R-click **Result**\New\ Address Locator
10. Address Locator Style: click the browse button, choose **US Address - Dual Ranges/**OK
11. Reference Data: **Street**
12. Role: **Primary Table**
13. Field Map: Filled it as below



14. Output Address Locator \\Result\Street_AddressLocator
15. OK

Test Your Address Locator

In this step you will test the "**Street_AddressLocator**" that you just created. You will use the Geocoding toolbar to quickly search for an address in city of Superior and display the corresponding location on a map.

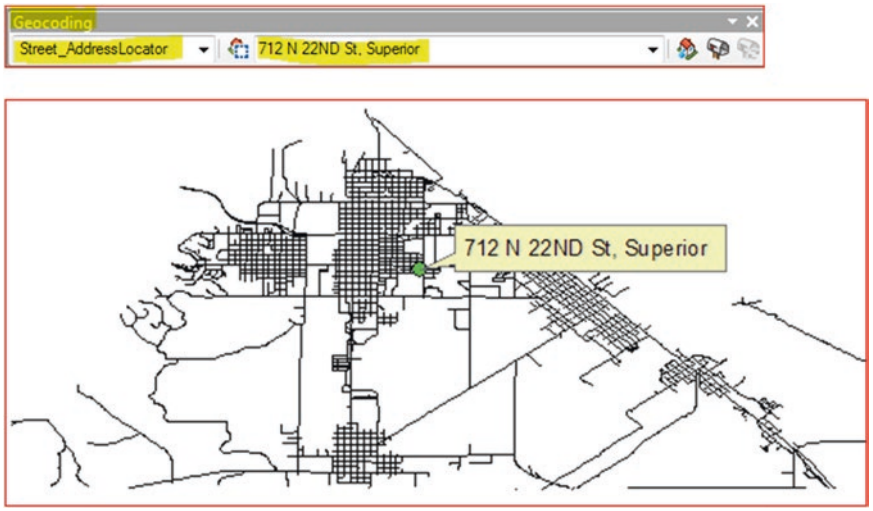
16. Make sure that the Geocoding toolbars is available from previous exercise
17. Choose the "**Street_AddressLocator**".
18. In the address box, type **712 N 22ND St, Superior** and press Enter.
19. Right-click the **712 N 22ND St, Superior** in the Geocoding toolbar and click **Add Point**

Result: A graphic point is added to the map.

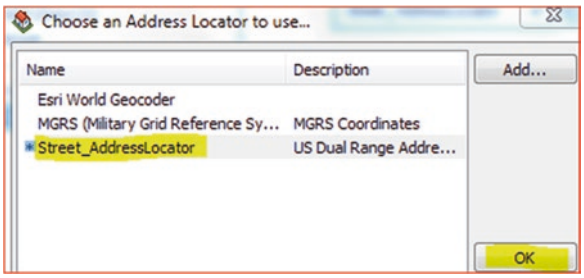
20. Right-click again the address in the Geocoding toolbar and click Add Callout

Result: A Callout is added to the map.

21. Edit menu/Select All Elements/click Delete button in the keyboard.

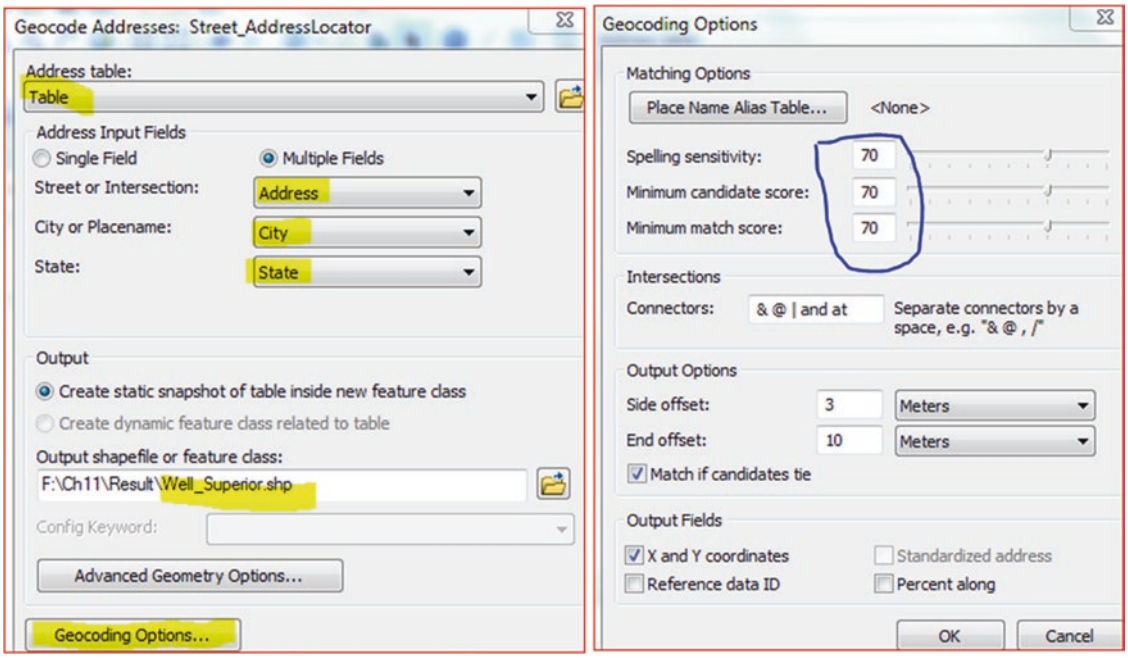


22. In the TOC/R-click Table\Geocode Addresses or click Geocode Addresses  on the Geocoding toolbar (2nd icon)
23. Select "**Street_AddressLocator**"
24. OK



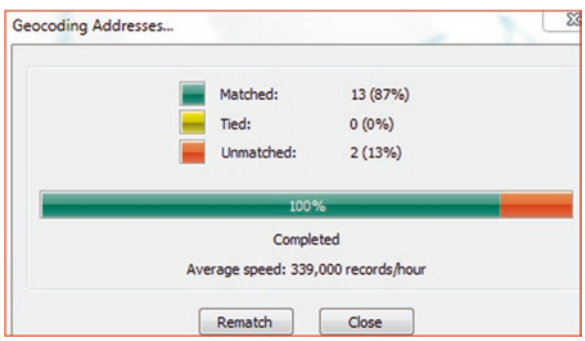
Result: The Geocode Addresses: **Street_AddressLocator** dialog box display.

25. Address table: Table
26. Street or intersection: ADDRESS
27. City or Placement: CITY
28. State: STATE
29. Output shapefile: \\Result\Well_Superior.shp\Save
30. Click Geocoding Options/Fill it as below
31. Spelling Sensitivity: 70
32. Minimum Candidate Score: 70
33. Minimum match score: 70
34. Click OK



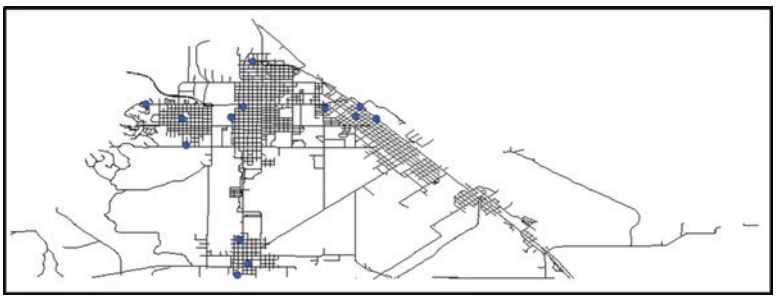
Comment: The spelling sensitivity setting controls how much variation the address locator allows when it searches for likely candidates in the reference data. For example, a low value for spelling sensitivity allows **Univercity** or **Universe** to be treated as match candidates for University. A higher value restricts candidates to exact matches. The Minimum candidate score is when an address locator searches for likely candidates in the reference data, it uses this threshold to filter the results presented. The minimum candidate score for an address locator is a value between 0 and 100. If the address locator seems unable to find any likely candidates for an address that you want to geocode, you can lower this settings so candidates with low scores are presented. The Minimum match score setting lets you control how closely addresses have to match their most likely candidate in the reference data to be considered a match for the address. A perfect match yields a score of 100. A match score between 80 and 99 can generally be considered a good match. An address below the minimum match score is considered to not have a good match.

Click OK to start geocoding



Result: 13 wells matches and 2 unmatched.

35. Click Close



Result: The 13 matched wells are now displayed on the map.

Examine the Geocoding Results

36. Open the attribute table of **Geocoding Result: Well_Superior**

Note: Under the Match_addr field, the unmatched records are empty. The geocoding algorithm was unable to match the two address and now you need to try to match these records. You contacted Douglas County regarding the unmatched two addresses of the wells and they provided you with the correct address (see table below).

Match the Unmatched Addresses

No	Wrong Address	True Address
1	2066 Fisher AV	2022 Fisher AV
4	666 20TH AV	606 20TH AV

37. Close the attribute table

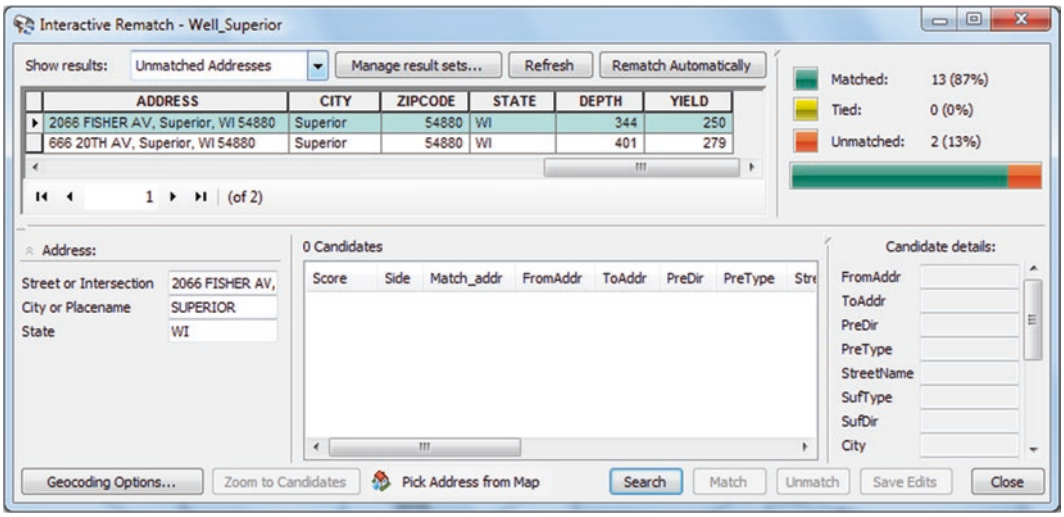
Rematch the Address

38. In TOC, make sure that the **Geocoding Result: Well_Superior** is selected.
39. On the Geocoding toolbar, make sure the Street Locator is selected

40. Click the Review/Rematch Addresses button (last icon) on the Geocoding toolbar

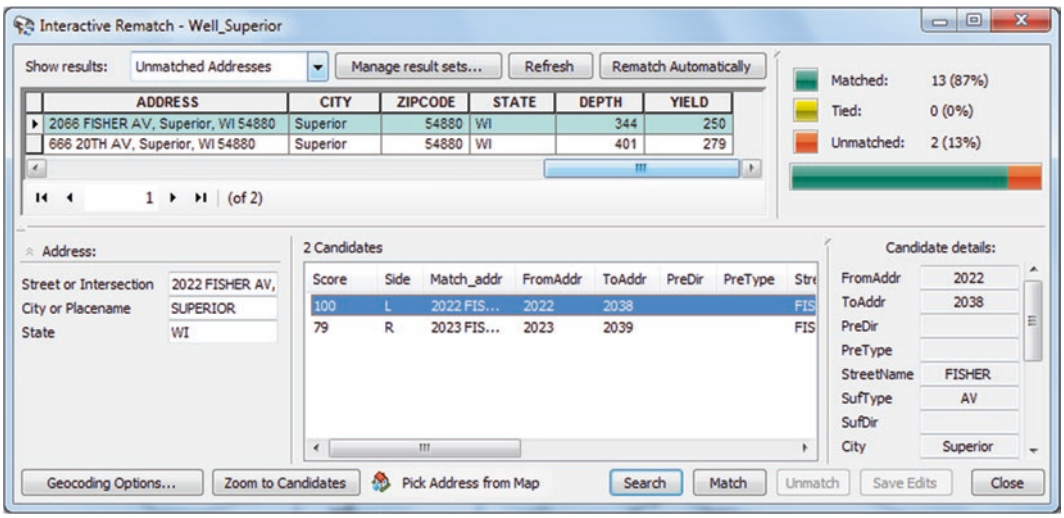
41. Maximize the Interactive Rematch dialog box
42. From the **Show results**: choose **Unmatched Addresses**
43. Scroll to the right to view the unmatched addresses

Comment: The Match_addr in the table of content of the "**Well_Superior**" values are blank because the two records are not matched. There may be candidates for a particular record, but there are no candidates with scores of 70 or higher. If there were, they would have been matched because the minimum match score for all your participating locators are 70.



First Address (2066 Fisher AV)

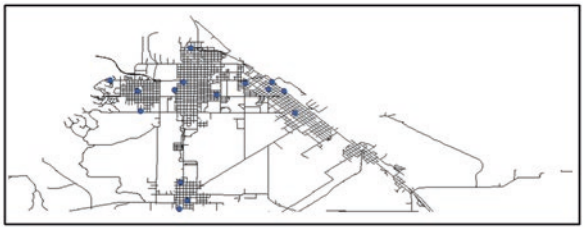
44. Select the first record for which the ADDRESS field has a value of **2066 Fisher AV**
45. Below the Address/Street or Intersection/replace the house number by typing 2022 before the street name Fisher AV, then Enter
46. The candidate score changes to a 100, highlight the 100 score
47. Click Match at the bottom of the Interactive Rematch dialog box



Second Address (666 20TH AV)

48. Select the second record for which the ADDRESS field has a value of 666 20TH AV
49. Change the street number and type 606 before the street name 20TH AV/Enter
50. The candidate score changes to 100.
51. Click Match at the bottom of the Interactive Rematch dialog box
52. Click Close

Result: All the wells now is matched and displayed on the map.



Geocoding Result: Well_Superior

FID	Shape	Status	Score	Match_type	Match_addr
0	Point	M	100	A	1908 WYOMING AV, Superior, WI
1	Point	M	100	A	1520 TOWER AV, Superior, WI
2	Point	M	100	A	6328 BANKS AV, Superior, WI
3	Point	M	100	M	2022 FISHER AV, Superior, WI
4	Point	M	92.43	A	1726 N 54TH ST, Superior, WI
5	Point	M	92.43	M	606 20TH AV E, Superior, WI
6	Point	M	100	A	302 JOHN AV, Superior, WI