MassGIS' Geocoding Resources

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Outline

- Brief overview of Geocoding
- Data products from MassGIS
- Address best practices
- Web services from MassGIS

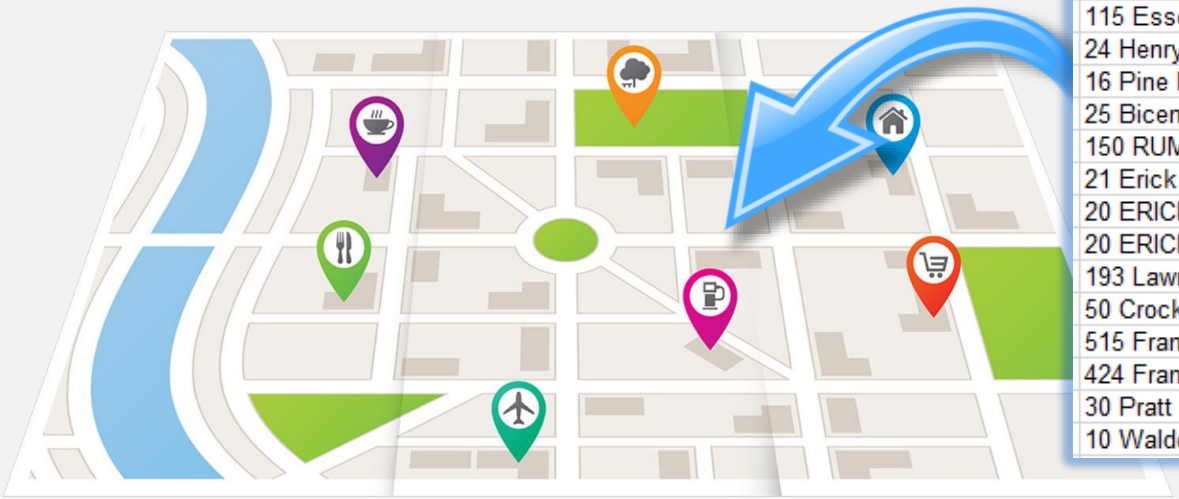
Brief overview of Geocoding

- **Geocoding** is the process of transforming a description of a location—such as a pair of coordinates, an address, or a name of a place—to a location on the earth's surface.

https://desktop.arcgis.com/en/arcmap/latest/manage-data/geocoding/what-is-geocoding.htm

Brief overview of Geocoding

- **Address matching** is a type of geocoding based on an input table of street addresses



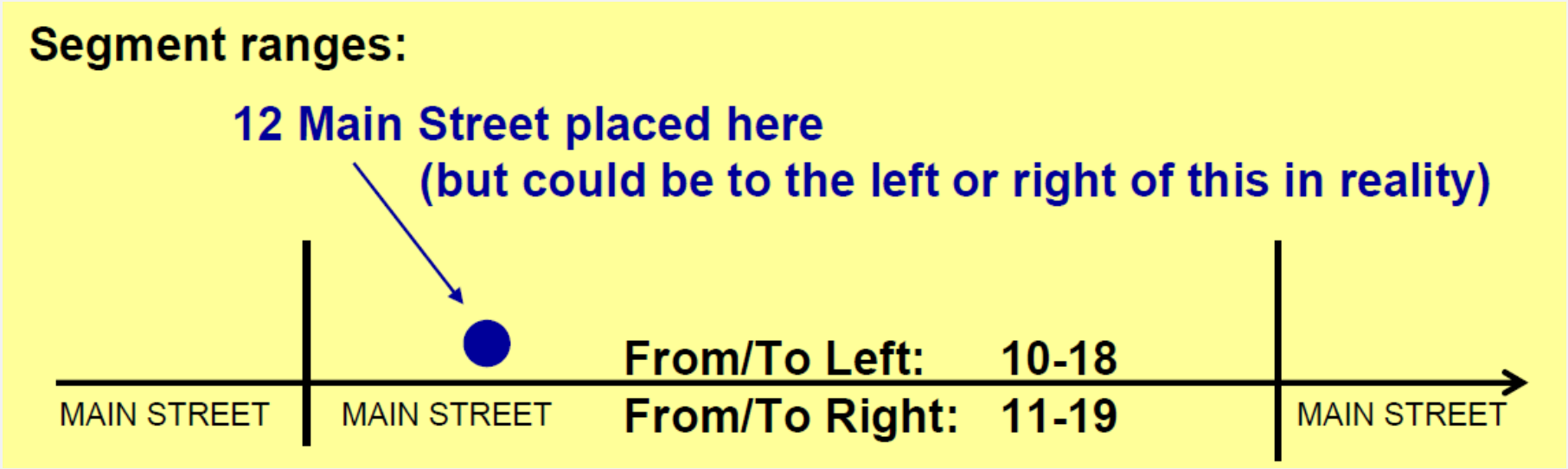
ADDRESS	CITY	STATE	ZIPCODE
16 Erick Rd.	Mansfield	MA	02048
5 FRANCIS AVENUE APT 522	Mansfield	MA	02048
115 Essex St.	Mansfield	MA	02048
24 Henry St.	Mansfield	MA	02048
16 Pine Needle Ln.	Mansfield	MA	02048
25 Bicentiennial Dr.	Mansfield	MA	02048
150 RUMFORD AVE APT 109	Mansfield	MA	02048
21 Erick Road	Mansfield	MA	02048
20 ERICK RD APT 12	Mansfield	MA	02048
20 ERICK RD APT 33B	Mansfield	MA	02048
193 Lawndale Rd	Mansfield	MA	02049
50 Crocker St.	Mansfield	MA	02048
515 Francis Ave.	Mansfield	MA	02048
424 Franklin St.	Mansfield	MA	02048
30 Pratt St	Mansfield	MA	02048
10 Waldor Dr	Mansfield	MA	02048

Geocoding requirements

- **Address table**
- **Reference data** – feature classes representing real-world objects (streets, buildings, etc., with address info)
- **Software** – ArcMap, ArcGIS Pro, etc.
- **“Address locator”** - the main tool for geocoding in ArcGIS

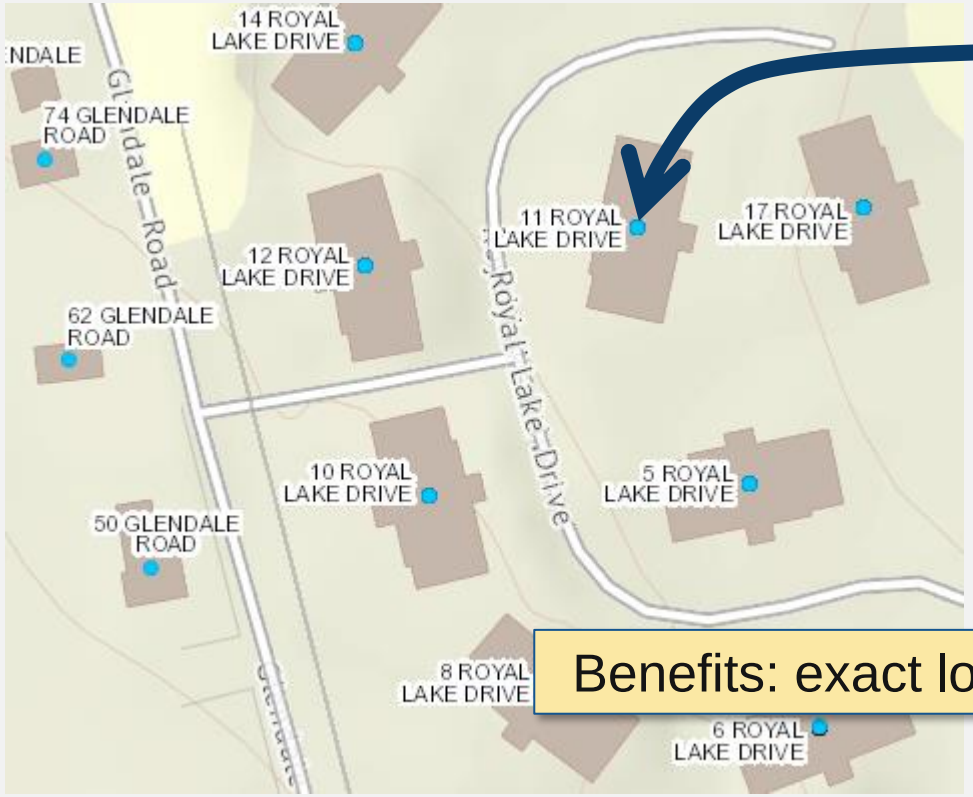
Types of reference data

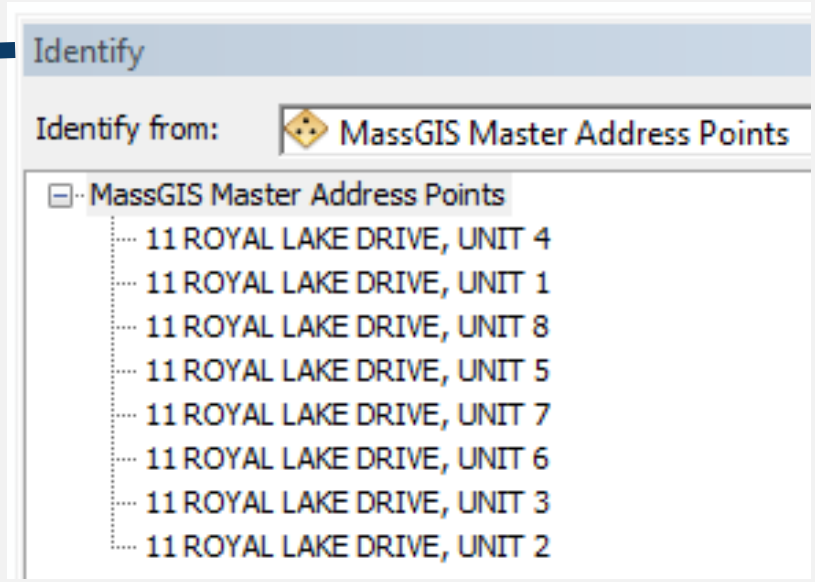
- **Linear geocoding** – e.g. streets



Types of reference data

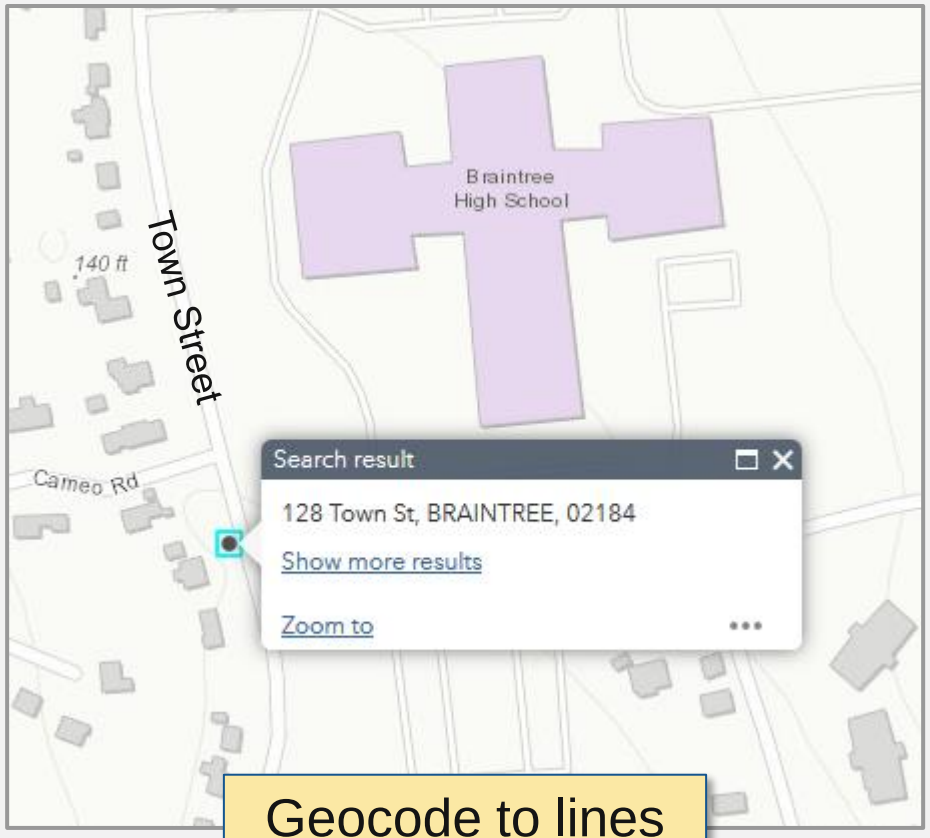
- **Point geocoding** – e.g. buildings



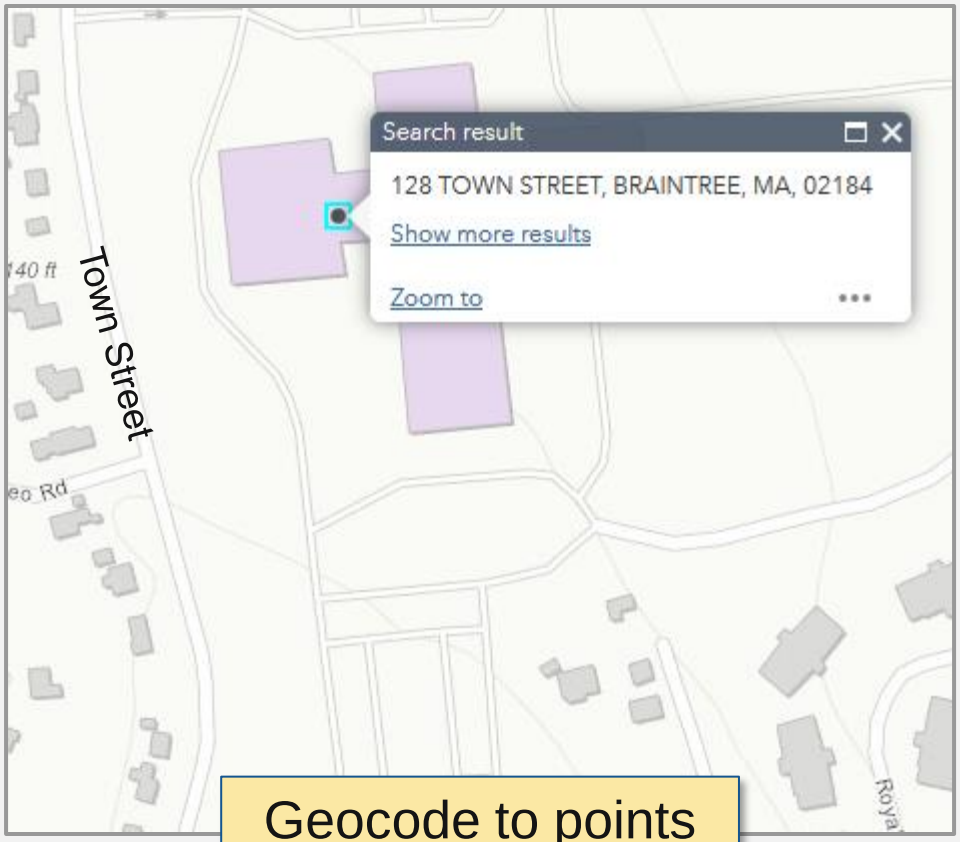


Benefits: exact location, unit/floor

Types of reference data: Lines vs. points



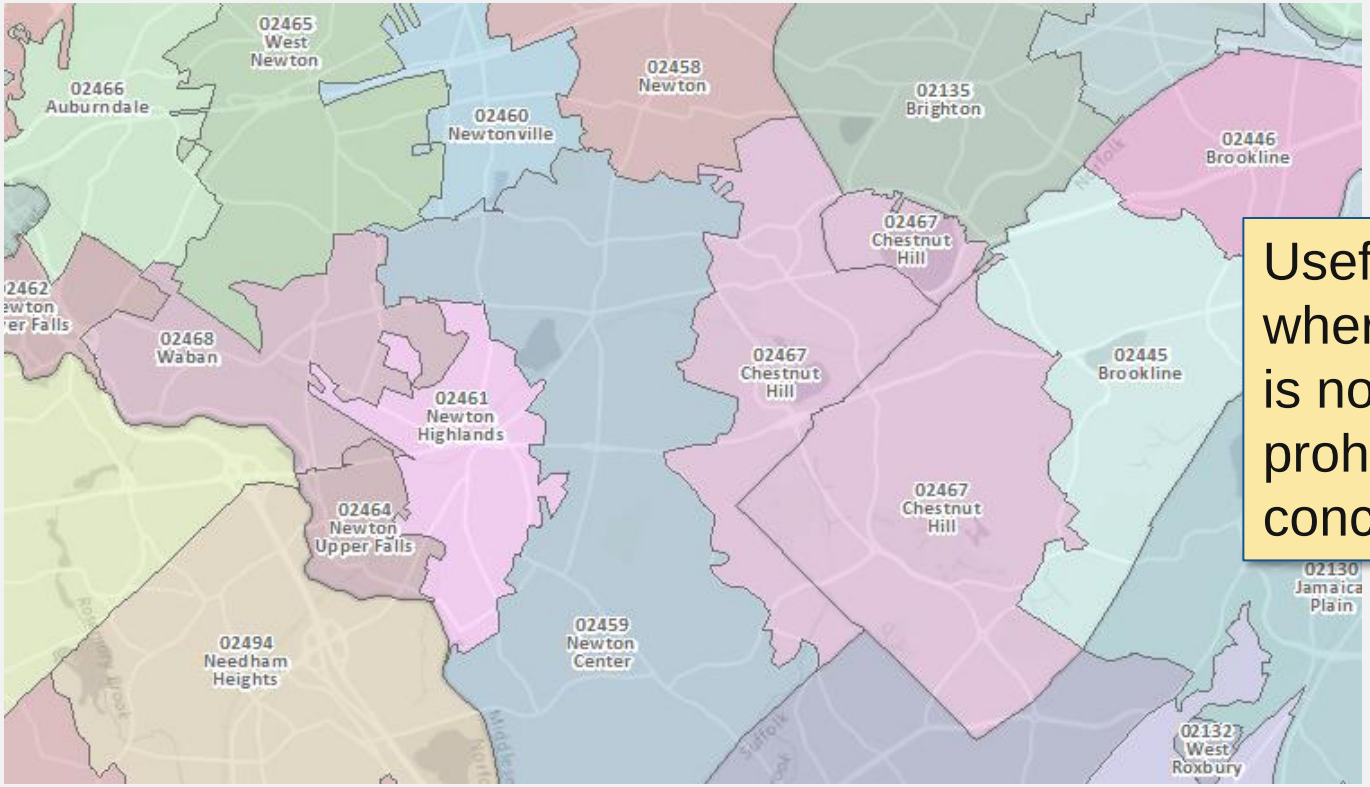
Geocode to lines



Geocode to points

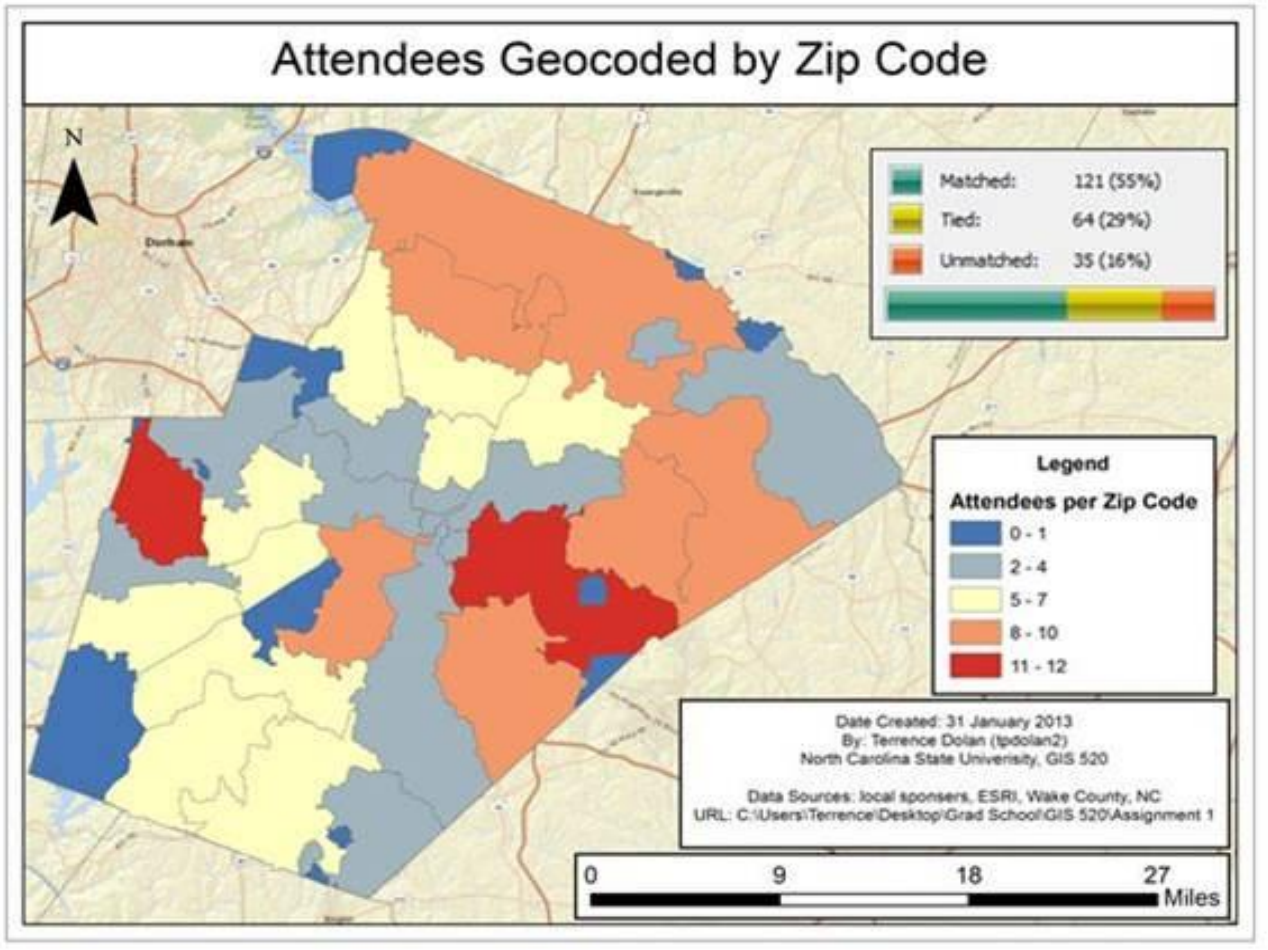
Types of reference data

- **Polygon geocoding** – e.g. ZIP Codes



Useful for counts, where exact location is not necessary or prohibited by privacy concerns

Types of reference data



Example of summarizing matches by ZIP Code to produce a choropleth map

What data MassGIS provides - Points

- **Statewide Address Points for Geocoding data layer**
  - 3.6 million points
  - Free download, updated weekly
  - Located on building or at parcel centroid
  - From parcels and 911 Emergency Service List (ESL), voter registration, MassDOT, DCR, Comcast, National Grid, and field data collection

https://www.mass.gov/info-details/massgis-data-master-address-data-statewide-address-points-for-geocoding

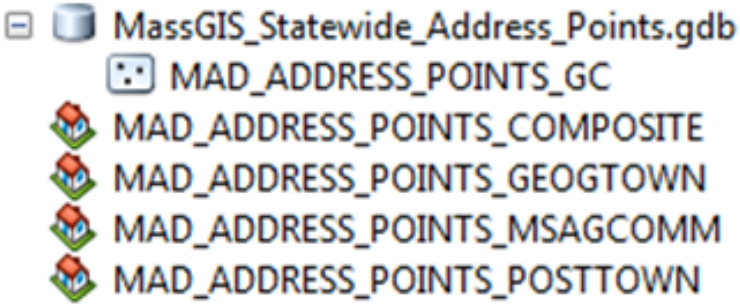
What data MassGIS provides - Points

Field	Value
OBJECTID	1928612
REL_LOC	<null>
FLOOR	<null>
UNIT	<null>
STATE	MA
SHAPE	Point
CENTROID_ID	M_241853_881975
FULL_NUMBER_STANDARDIZED	49
ADDRESS_NUMBER_PREFIX	<null>
ADDRESS_NUMBER	49
ADDRESS_NUMBER_SUFFIX	<null>
ADDRESS_NUMBER_2_PREFIX	<null>
ADDRESS_NUMBER_2	<null>
ADDRESS_NUMBER_2_SUFFIX	<null>
STREET_NAME	PROCTOR ROAD
MASTER_ADDRESS_ID	2393397
STREET_NAME_ID	114003
SITE_ID	<null>
BUILDING_NAME	LIBERTY SCHOOL
GEOGRAPHIC_TOWN_ID	40
COMMUNITY_ID	42
COMMUNITY_NAME	BRAINTREE
GEOGRAPHIC_TOWN	BRAINTREE
POSTCODE	02184
PC_NAME	BRAINTREE
COUNTY	NORFOLK

What data MassGIS provides - Points

- Download includes data and address locators

Statewide Address Points for Geocoding data package from MassGIS



Statewide address points file GDB feature class

Composite address locator referencing the next three locators

Address locator using geographic town as 'City or Place'

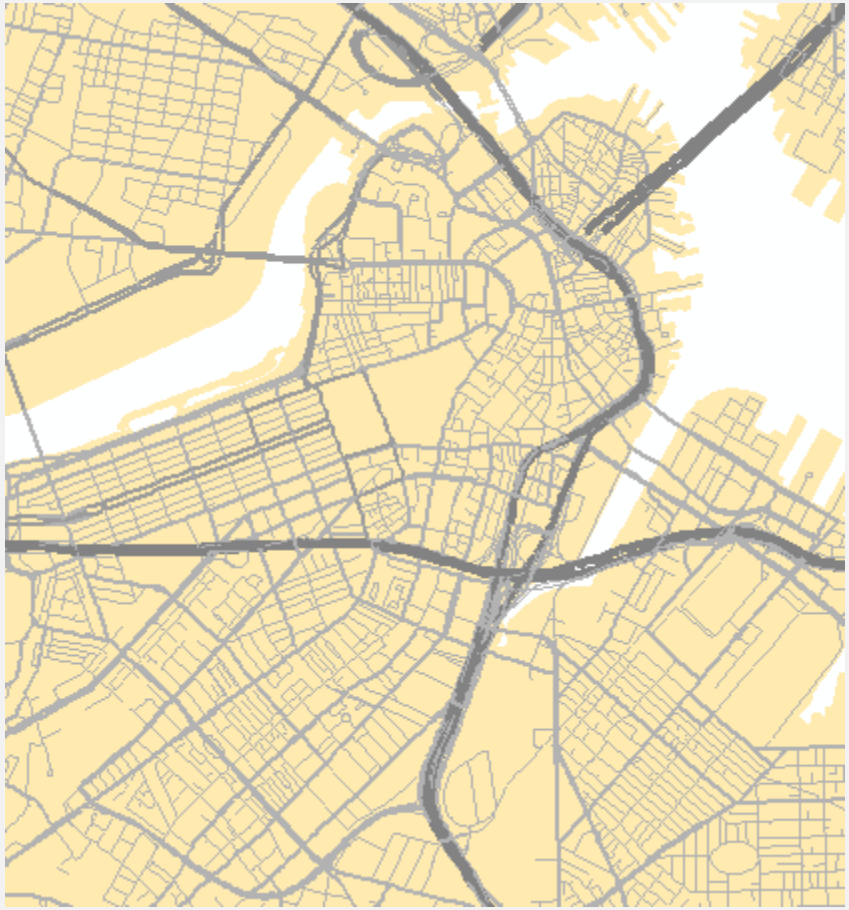
Address locator using MSAG community as 'City or Place'

Address locator using postal town as 'City or Place'

The locators work in ArcMap and ArcGIS Pro

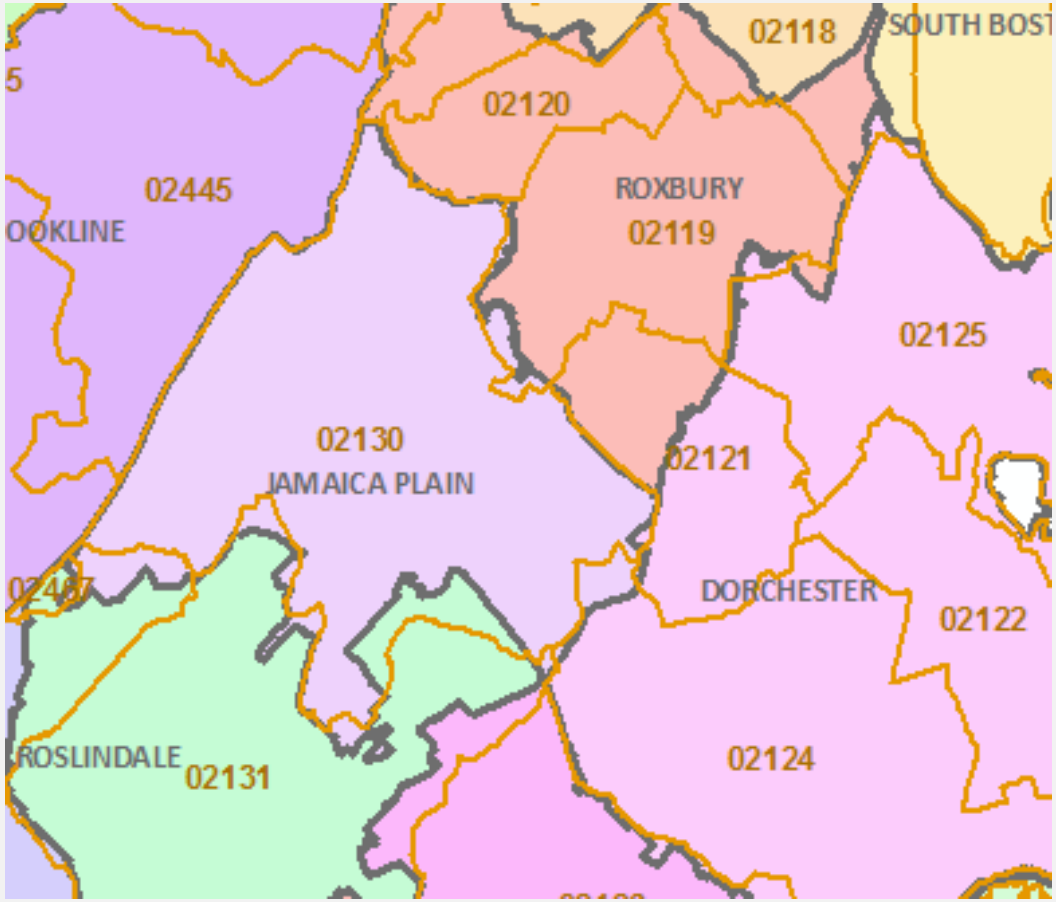
What data MassGIS provides - Lines

- "Base" streets
  - Only for public agency staff (originally from Navteq, has proprietary ranges), by request
  - We have a composite locator that looks at points first, then lines.
- TIGER 2010 streets



What data MassGIS provides - Polygons

- ZIP Codes, municipalities, legislative districts, counties, etc.

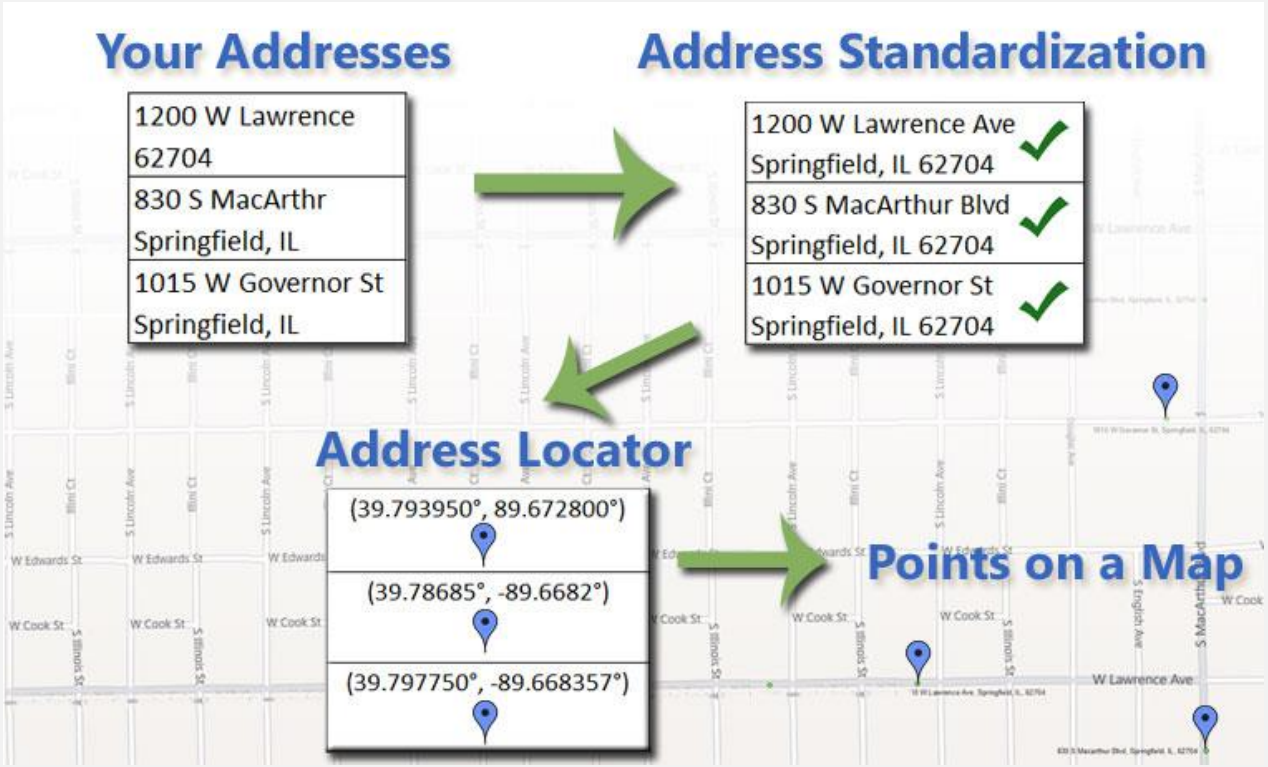


ZIP Codes

MSAG Communities

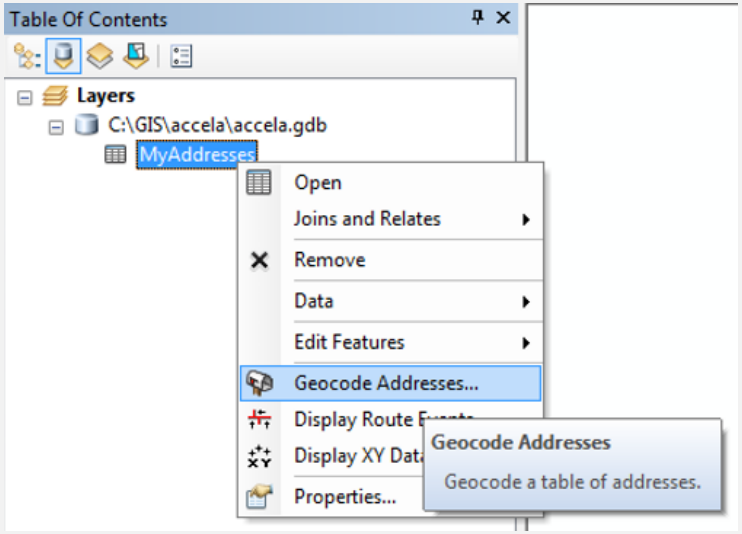
Geocoding in ArcGIS Desktop

- **Basic process**

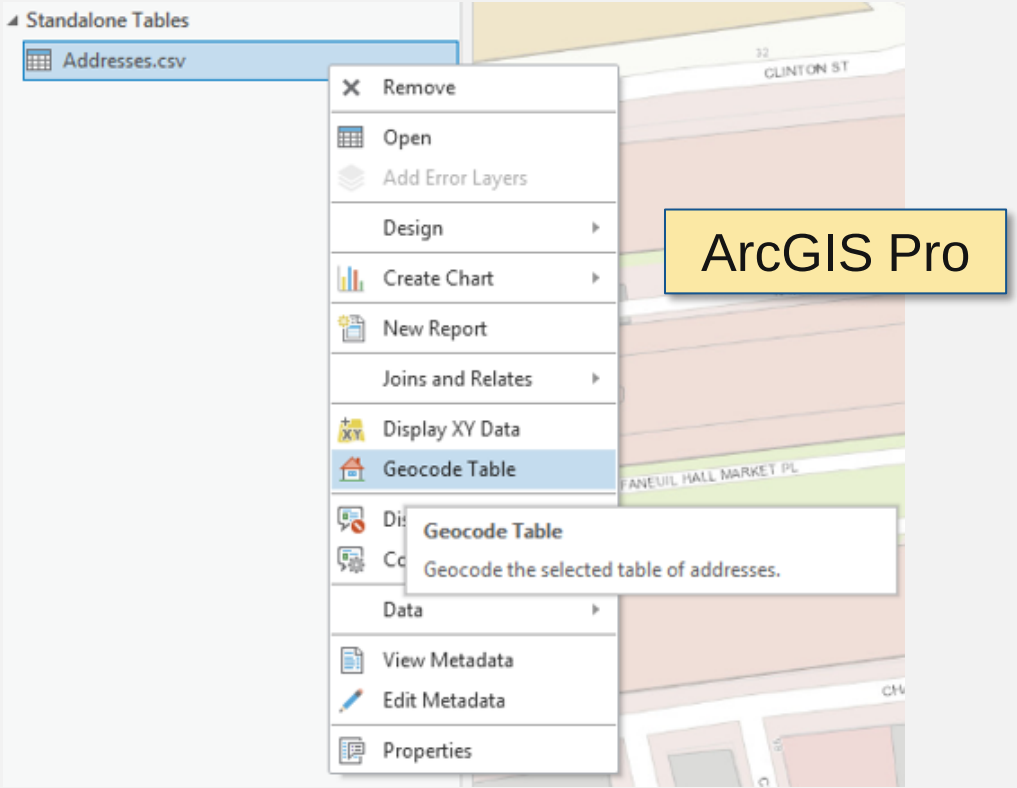


Geocoding in ArcGIS Desktop

- **Right-click a table in a map**

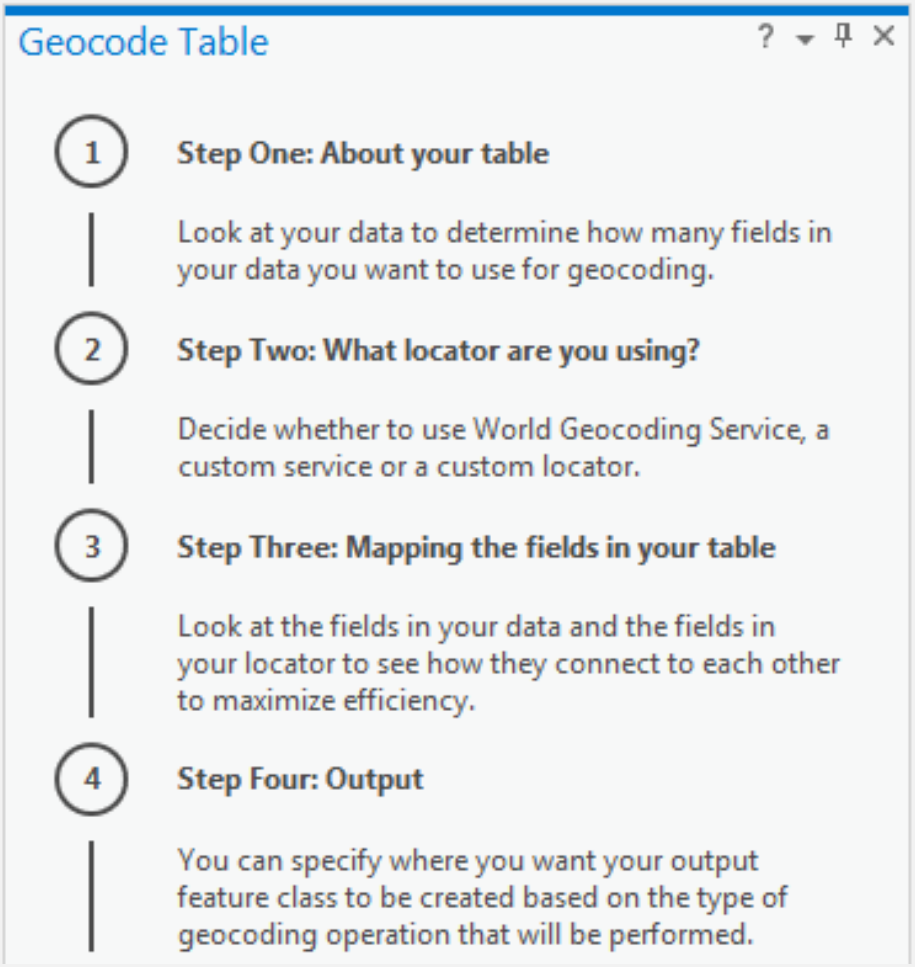


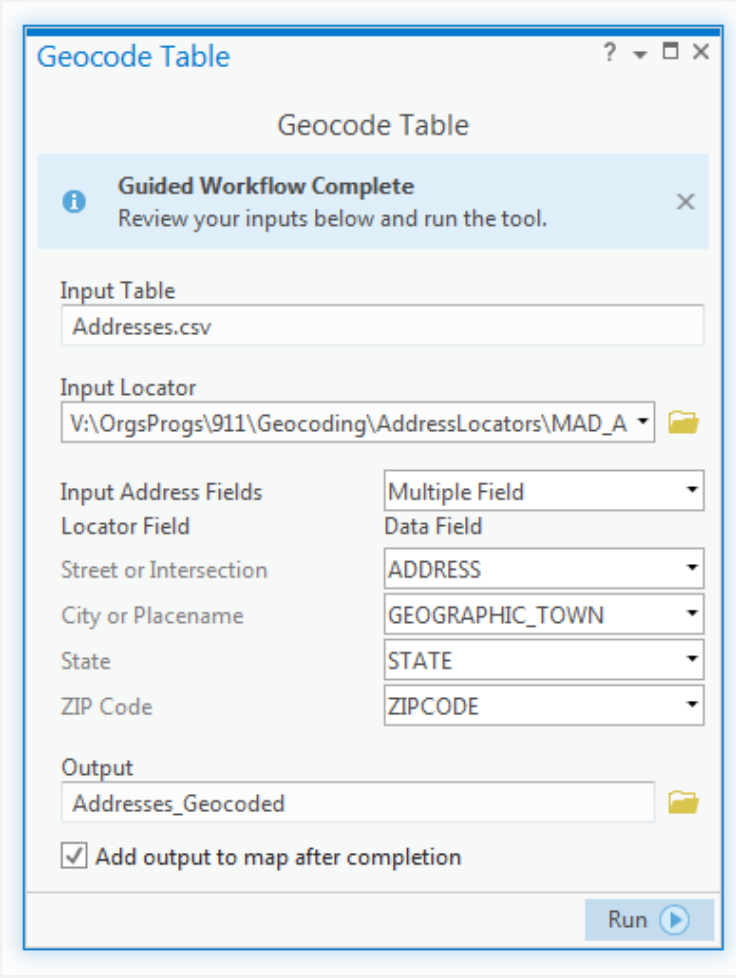
ArcMap



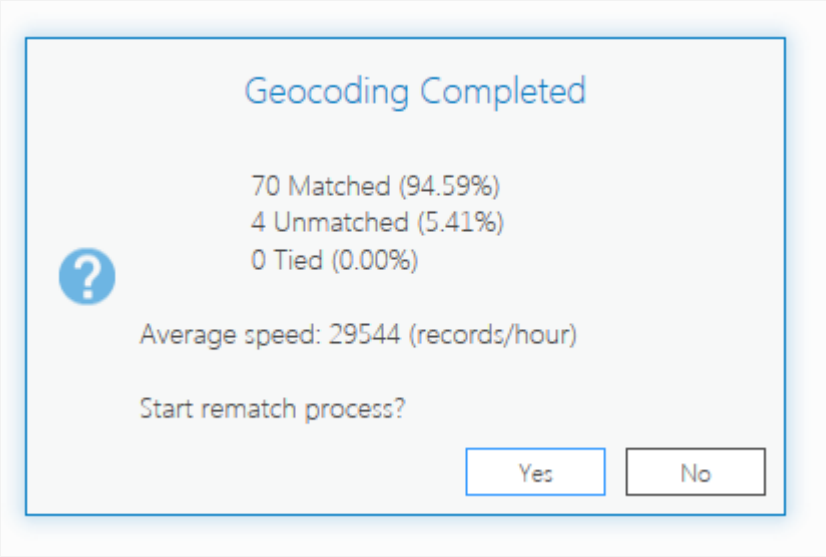
ArcGIS Pro

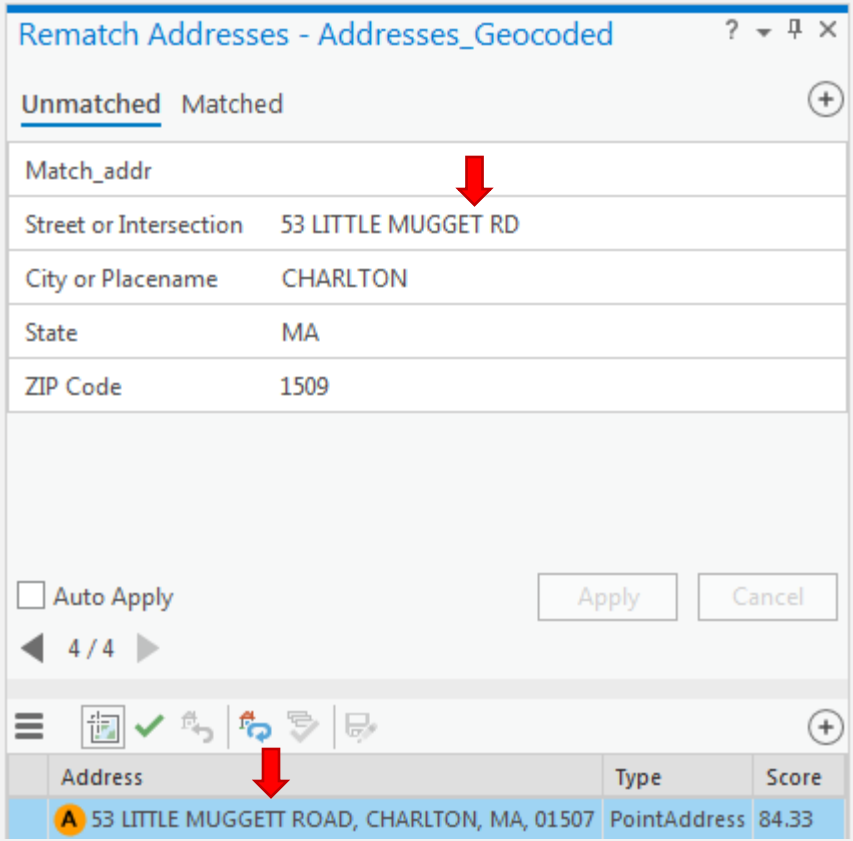
Geocoding in ArcGIS Desktop





Geocoding in ArcGIS Desktop

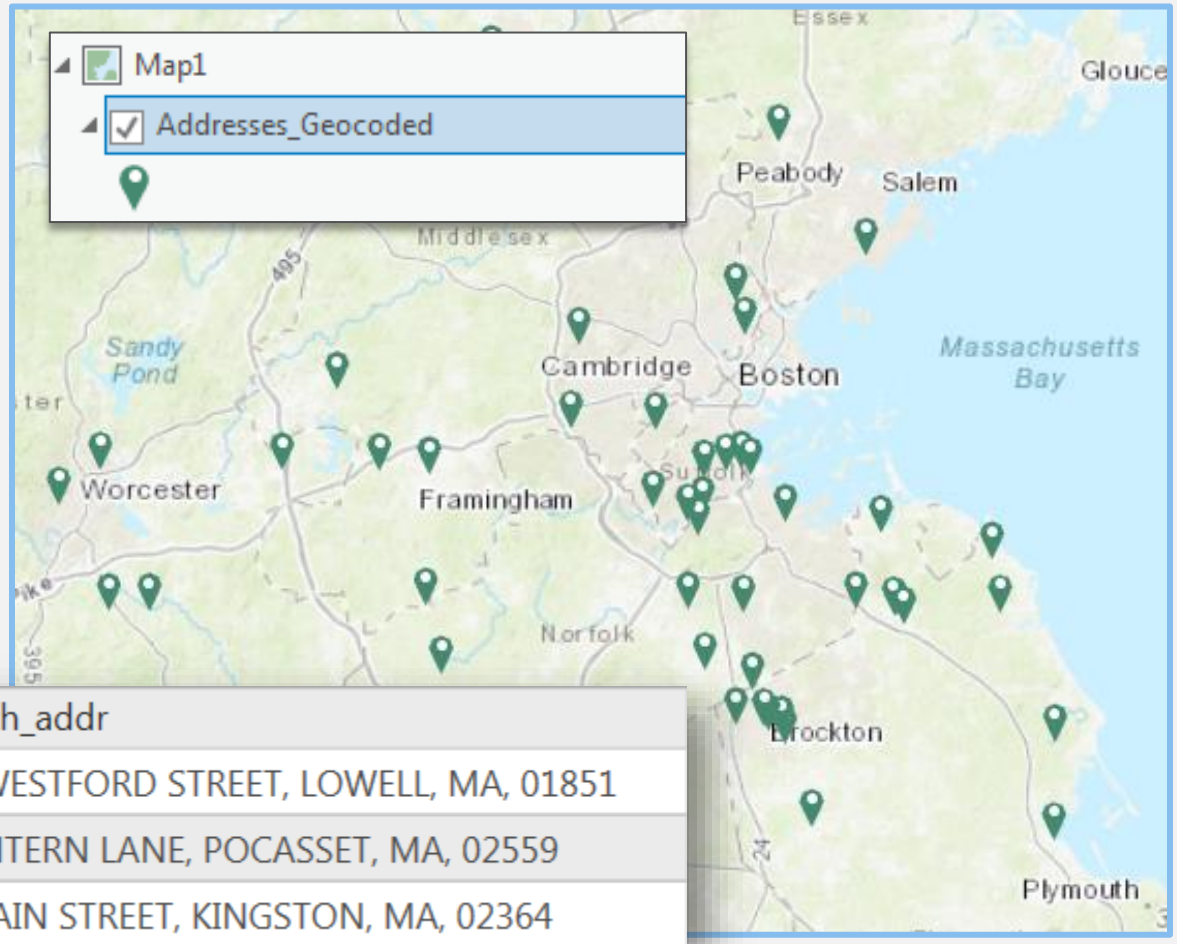




Rematch any unmatched addresses if necessary

Geocoding in ArcGIS Desktop

Result is a feature class of points with all the attributes of the input table, plus a Score and other fields added by the GP tool



Status	Score	Match_type	Match_addr
M	100	A	508 WESTFORD STREET, LOWELL, MA, 01851
M	97.06	A	2 LANTERN LANE, POCASSET, MA, 02559
M	100	A	12 MAIN STREET, KINGSTON, MA, 02364

Applications of geocoding

- Analysis
- Business and customer management
- Emergency response
- Spatial patterns and trends (crime, diseases…)
- So many!!

Applications of geocoding

Map by Dr. John Snow of Cholera cases in London, 1854 – an early example of geocoding!

Address best practices

- **Prepare and clean your addresses**
  - Check for misspellings and improper formatting
    - BAYLSTON ST or BOYLSTON ST ??
    - HORSENECK ROAD or HORSE NECK ROAD ??
    - SHEPARD STREET or SHEPHERD STREET ??
    - ELIOT STREET or ELLIOT STREET ??
    - 3 RIVER ROAD, not 3RIVER ROAD
    - GAR HWY vs GRAND ARMY OF THE REPUBLIC HIGHWAY
    - ORLEANS, not S ORLEANS or SOUTH ORLEANS

Address best practices

- Prepare and clean your addresses
  - Do not use P.O. Boxes
  - Put unit info in separate field
  - Have town and/or ZIP Code, but you need at least one
  - Beware of “vanity addresses”
  - Optionally use alias table and/or place name table
  - Standardize with custom code

Address best practices

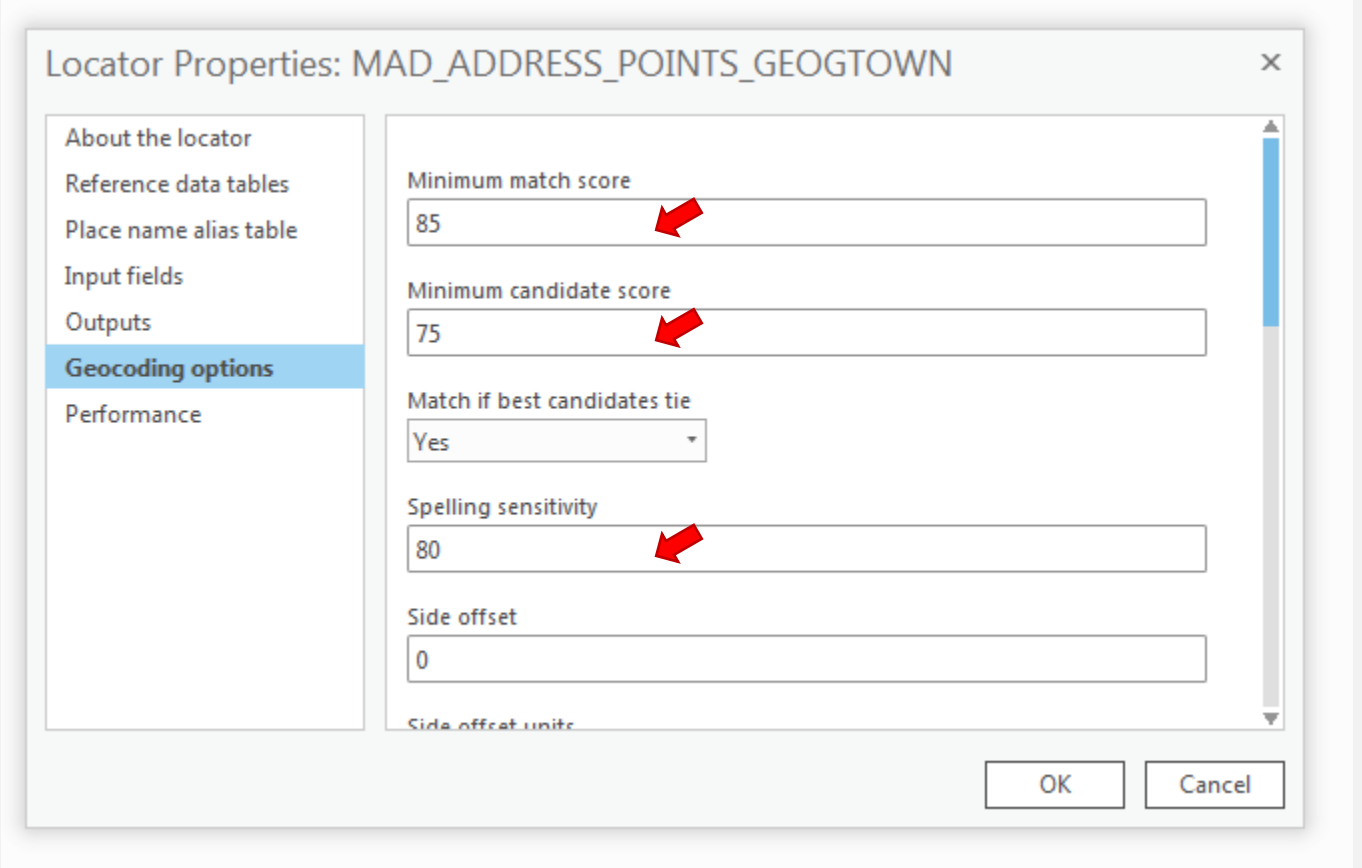
- Prepare and clean your addresses

STREET_NAME	UNIT	GEOG_TOWN	COMMUNITY_NAME	POSTAL_NAME	ZIPCODE	STATE
88 RIVER RIDGE DRIVE		BARNSTABLE	MARSTONS MILLS	MARSTONS MILLS	02648	MA
92 FALMOUTH ROAD	B	BARNSTABLE	CENTERVILLE	CENTERVILLE	02632	MA
12 GOODSON STREET	4	BOSTON	DORCHESTER	DORCHESTER CENTER	02122	MA
5 SAINT ROSE STREET	23	BOSTON	JAMAICA PLAIN	JAMAICA PLAIN	02130	MA
86 LEWIS STREET		QUINCY	QUINCY	QUINCY	02171	MA
78 DAVID AVENUE		BARNSTABLE	CENTERVILLE	WEST HYANNISPORT	02672	MA

88 RIVERRIDGE DIRVE		BARNSTABLE	MARSTONS MILLS	MARSTONS MILLS	02648	MA
92B FALMOUTH ROAD		BARNSTABLE	CENTERVILLE	CENTERVILLE	02632	MA
12 GOODSON STREET UN#4		BOSTON	DORCHESTER	DORCHESTER CENTER	02122	MA
5 SAINT ROSE STREET APT 23		BOSTON	JAMAICA PLAIN	JAMAICA PLAIN	02130	MA
86 LEWIS STREET PO BOX 12		NORTH QUINCY	NORTH QUINCY	NORTH QUINCY		MA
78 DAVID AVENUE		CENTERVILLE				MA

Address best practices

- Adjust geocoding options of the locator



Address best practices

- **If you are sure your addresses are correct, but they don't match to our data?**

  Let us know! Missing addresses that we can verify will be added to our database.

Also see Esri's Tips for improving geocoding quality

Web-based geocoding services

- **Basic definition:** Same concept as in desktop but sending the request (address) to a web server to get the response (geographic location)
- Our services use the same reference data already described

Web-based geocoding services

- **Out-of-the-Box Generic:** ESRI ArcGIS Server Geocode service with MassGIS point data (Where)

```
Shape:

    Point:
    X: 236052.86181816473
    Y: 901068.6080946173

Score: 100.0
Address: 1 ASHBURTON PLACE, Boston, MA, 02108
```

Can be used in a search widget in Web App Builder

Web-based geocoding services

- **Custom:** MassGIS .NET Service Application (Where plus What – what is near me, closest X, distances to Y, etc., with extra analysis with all layers we have)
  - *SOAP based request and response*
    - *(https://resources.arcgis.com/en/help/soap/latest/#/FindAddressCandidates/01vp0000096000000/)*
  - *Extra processing behind the scenes*
  - *Custom-made for client needs*

Web-based geocoding services

Example: Lead screening (user provides an address)

* <X>236052.86068687477</X>
* <Y>901068.60647998226</Y>
* <MatchedAddress>1 ASHBURTON PLACE, BOSTON, MA, 02108</MatchedAddress>
<OwnerName>COMMONWEALTH OF MASS</OwnerName>
<YearBuilt>1960</YearBuilt>
<FiscalYear>2016</FiscalYear>
<CensusID>250250303003024</CensusID>
<VillageName>BOSTON</VillageName>
* <Score>100</Score>
<Lat>42.359284651514947</Lat>
<Long>-71.06235962129167</Long>
<MassGISID>35005052</MassGISID>

* Is returned by default

Web-based geocoding services

Example: Get closest RMV office and type of service center from a user's input address

```
<X>236052.86068687477</X>
<Y>901068.60647998226</Y>
<MatchedAddress>1 ASHBURTON PLACE, Boston, MA, 02108</MatchedAddress>
<Score>100</Score>
<Lat>42.359284651514947</Lat>
<Long>-71.062359621291677</Long>
<AddressType>Exempt</AddressType>
<MasterAddressID>35005052</MasterAddressID>
<_RMVLocationsWithDistance>
  <RMVsArray>
    <RMVLocation>
      <RMVName>Boston (Haymarket) RMV Service Center</RMVName>
      <RMVStreetAddress>136 Blackstone Street</RMVStreetAddress>
      <RMVTown>BOSTON</RMVTown>
      <DistanceFromGeocodedAddress>0.32204086489223682</DistanceFromGeocodedAddress>
      <RMVStatusError />
    </RMVLocation>
    <RMVLocation>
      <RMVName>Boston AAA</RMVName>
      <RMVStreetAddress>125 High Street</RMVStreetAddress>
      <RMVTown>BOSTON</RMVTown>
      <DistanceFromGeocodedAddress>0.55049416967892328</DistanceFromGeocodedAddress>
      <RMVStatusError />
    </RMVLocation>
    <RMVLocation>
      <RMVName>Revere RMV Service Center</RMVName>
      <RMVStreetAddress>9c Everett Street</RMVStreetAddress>
      <RMVTown>REVERE</RMVTown>
      <DistanceFromGeocodedAddress>4.7634134854880426</DistanceFromGeocodedAddress>
      <RMVStatusError />
    </RMVLocation>
  </RMVsArray>
```

Web-based geocoding services

Example of Reverse geocoding: (Motor Vehicle Automated Citation and Crash System: MACCS - trooper's handheld tablet generates lat/lon and we provide other info)

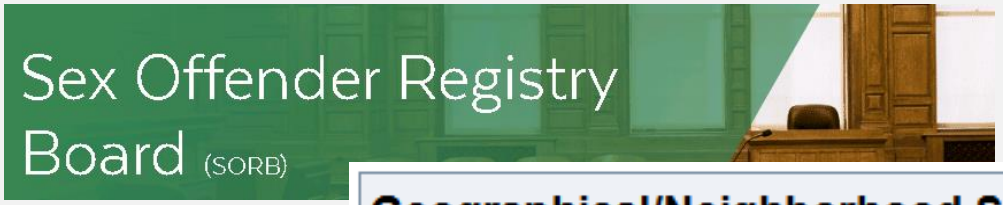
- **Closest Exit #**
- **Closest Ramp**
- **Closest Intersection**
- **Closest Street**
- **Closest Mile Marker**


```
<ReverseGeoCodeLatLongResult>
  <OriginalLat>42.612</OriginalLat>
  <OriginalLong>-71.331</OriginalLong>
  <X>213866.67047262783</X>
  <Y>929061.53613683209</Y>
  <Street>6 GLEN AVE</Street>
  <SplitStreetNumber>6</SplitStreetNumber>
  <SplitStreetName>GLEN AVE</SplitStreetName>
  <City>CHELMSFORD</City>
  <State>MA</State>
  <Zip>01824</Zip>
  <MileMarker>
    <MileMarkerRouteNumber>SR110</MileMarkerRouteNumber>
    <MileMarkerRouteDirection>EAST</MileMarkerRouteDirection>
    <DirectionFromMileMarker>SOUTH</DirectionFromMileMarker>
    <DistanceFromMileMarker>0.049587320061262805</DistanceFromMileMarker>
    <MileMarkerRoute>SR110 EB</MileMarkerRoute>
    <MileMarkerNumber>33.9</MileMarkerNumber>
    <MileMarkerTown>CHELMSFORD</MileMarkerTown>
    <MileMarkerZip>01824</MileMarkerZip>
    <MileMarkerStatus />
  </MileMarker>
  <Exit>
    <ExitNumber>31</ExitNumber>
    <ExitRouteNumber>3</ExitRouteNumber>
    <ExitRouteDirection>SOUTH</ExitRouteDirection>
    <DirectionFromExit>SOUTH</DirectionFromExit>
    <DistanceFromExit>0.14887638377965509</DistanceFromExit>
    <ExitName>US3 SB 31</ExitName>
    <ExitTown>CHELMSFORD</ExitTown>
    <ExitZip>01824</ExitZip>
    <ExitStatus />
  </Exit>
  <Ramp>
    <DirectionFromRampStart>SOUTH</DirectionFromRampStart>
    <DistanceFromRampStart>0.057975175841161387</DistanceFromRampStart>
    <RampName>RAMP-RT 110 TO RT 3 SB</RampName>
    <RampTown>CHELMSFORD</RampTown>
    <RampZip>01824</RampZip>
    <RampStatus />
  </Ramp>
  <Intersection>
    <IntersectionRoadway>CHELMSFORD STREET</IntersectionRoadway>
    <IntersectingRoadway>GLEN AVENUE</IntersectingRoadway>
    <AlsoIntersectingRoadway>
    </AlsoIntersectingRoadway>
    <DirectionFromIntersection>SOUTH</DirectionFromIntersection>
    <DistanceFromIntersection>0.042008899307354013</DistanceFromIntersection>
    <IntersectionName>CHELMSFORD STREET &amp;amp; GLEN AVENUE</IntersectionName>
    <IntersectionTown>CHELMSFORD</IntersectionTown>
    <IntersectionZip>01824</IntersectionZip>
    <IntersectionStatus />
  </Intersection>
  <ClosestStreet>
    <DistanceFromStreet>0.027274630421317444</DistanceFromStreet>
    <StreetName>GLEN AVENUE</StreetName>
    <StreetTown>CHELMSFORD</StreetTown>
    <StreetZip>01824</StreetZip>
    <StreetStatus />
  </ClosestStreet>
  <SiteTown>CHELMSFORD</SiteTown>
```

Web-based geocoding services

Web based client application

https://sorb.chs.state.ma.us/sorbpublic/standardSearchforSexOffenders.action?_p=PXgnGplB8GxzM9L4m0af-jvacSDuNagxnvdMMRYNNu4



Geographical/Neighborhood Search

This search relies on GIS map distance technology that is continually being upc
please use the City/Town or name search options. If you have concerns about a

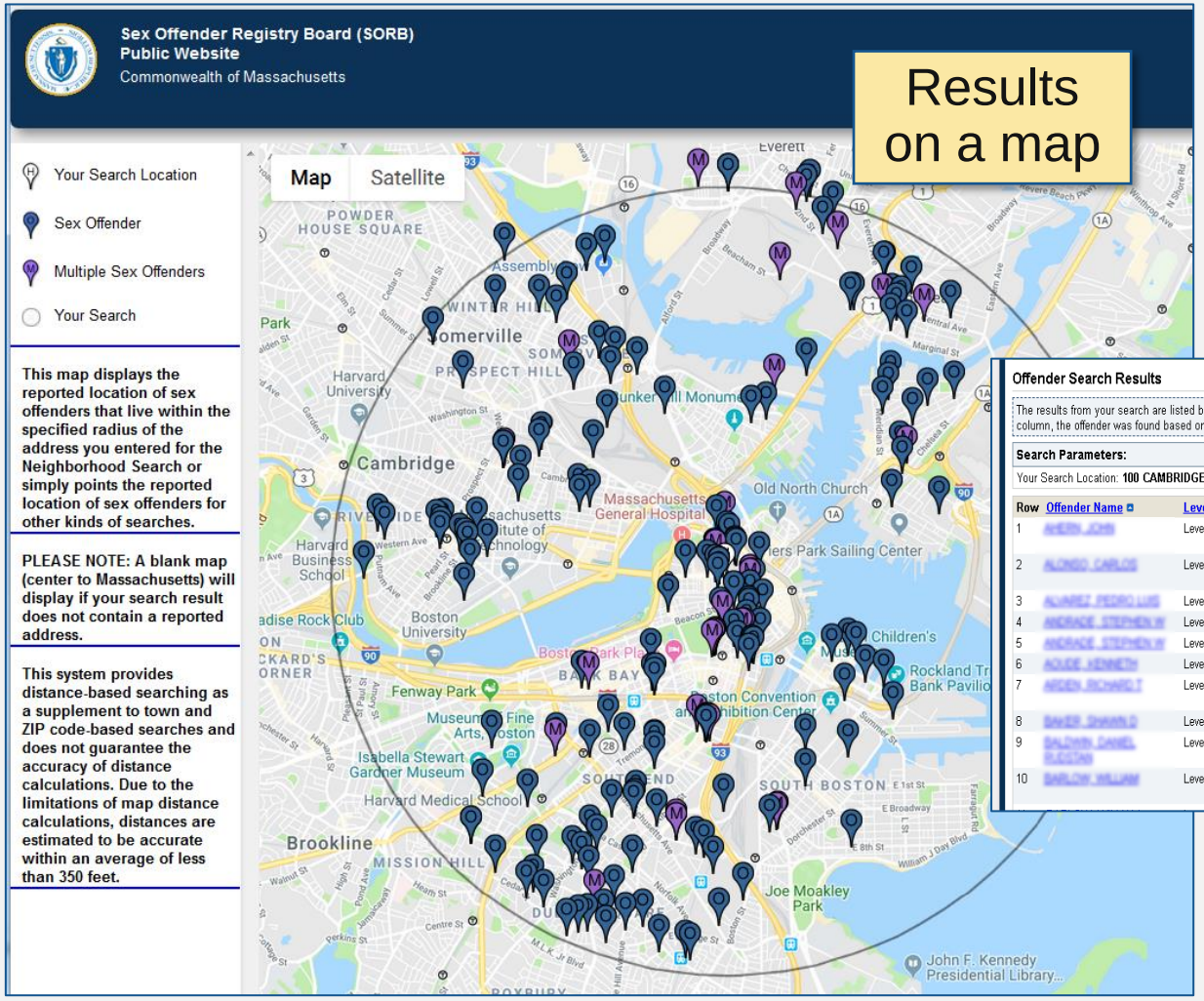
Street Number and Street Name (both are required for accurate results): 100 Cambridge St

City/Town: BOSTON

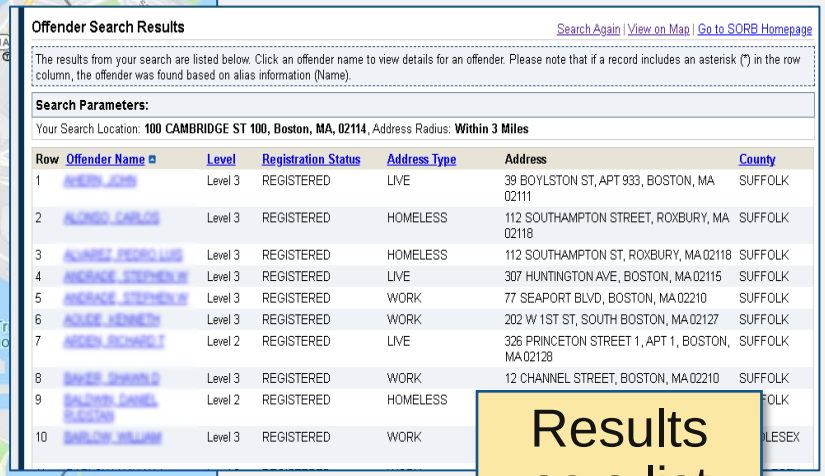
Address Radius: Within 3 Miles

Search

Web-based geocoding services



Results on a map



Offender Search Results

Search Again | View on Map | Go to SORB Homepage

The results from your search are listed below. Click an offender name to view details for an offender. Please note that if a record includes an asterisk (*) in the row column, the offender was found based on alias information (Name).

Search Parameters:

Your Search Location: **100 CAMBRIDGE ST 100, Boston, MA, 02114**, Address Radius: **Within 3 Miles**

Row	Offender Name	Level	Registration Status	Address Type	Address	County
1	[redacted]	Level 3	REGISTERED	LIVE	39 BOYLSTON ST, APT 933, BOSTON, MA 02111	SUFFOLK
2	[redacted]	Level 3	REGISTERED	HOMELESS	112 SOUTHAMPTON STREET, ROXBURY, MA 02118	SUFFOLK
3	[redacted]	Level 3	REGISTERED	HOMELESS	112 SOUTHAMPTON ST, ROXBURY, MA 02118	SUFFOLK
4	[redacted]	Level 3	REGISTERED	LIVE	307 HUNTINGTON AVE, BOSTON, MA 02115	SUFFOLK
5	[redacted]	Level 3	REGISTERED	WORK	77 SEAPORT BLVD, BOSTON, MA 02210	SUFFOLK
6	[redacted]	Level 3	REGISTERED	WORK	202 W 1ST ST, SOUTH BOSTON, MA 02127	SUFFOLK
7	[redacted]	Level 2	REGISTERED	LIVE	326 PRINCETON STREET 1, APT 1, BOSTON, MA 02128	SUFFOLK
8	[redacted]	Level 3	REGISTERED	WORK	12 CHANNEL STREET, BOSTON, MA 02210	SUFFOLK
9	[redacted]	Level 2	REGISTERED	HOMELESS	[redacted]	[redacted]
10	[redacted]	Level 3	REGISTERED	WORK	[redacted]	[redacted]

Results as a list

Web-based geocoding services

- Some clients include:
  - Dept. of Public Health
  - Registry of Motor Vehicles
  - Public Safety (SORB, Inspection, State Trooper)
  - Dept. of Education
  - Health & Human Services

Web-based geocoding services

- We can expose two methods:
  - Candidate List (e.g., unit, door) and
  - Best Result (highest score)
- We can use Point-based and Linear reference data
- We can do Geocoding and Reverse Geocoding
- One potential client can be ArcMap (a custom toolbar that accesses our custom .NET service application and presents results on a map)

Thank You

Questions?

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Gabriela.Laird@mass.gov