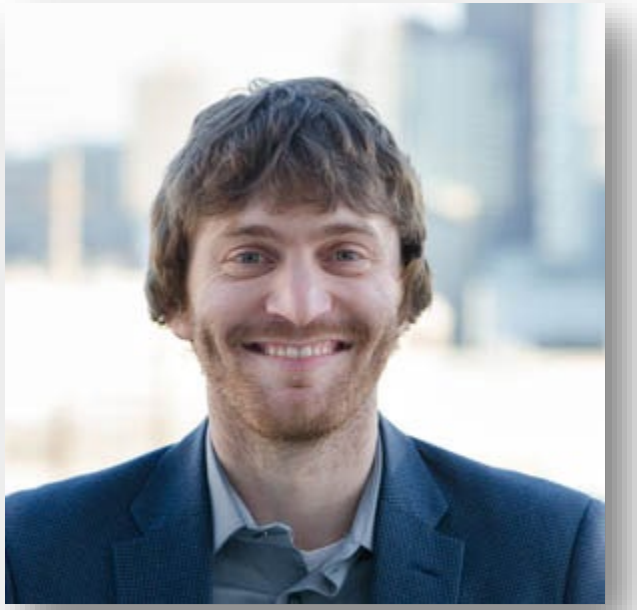
Philly Vehicle Locator

Office of Innovation & Technology
CityGeo
DATA ANALYSIS APPLICATION



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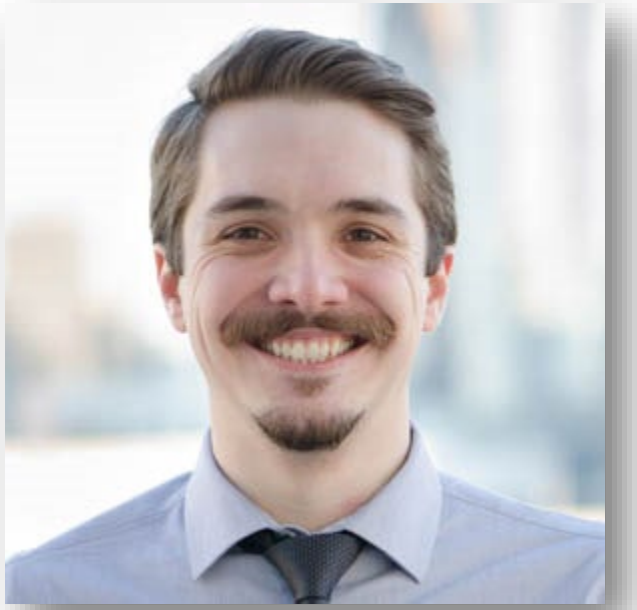
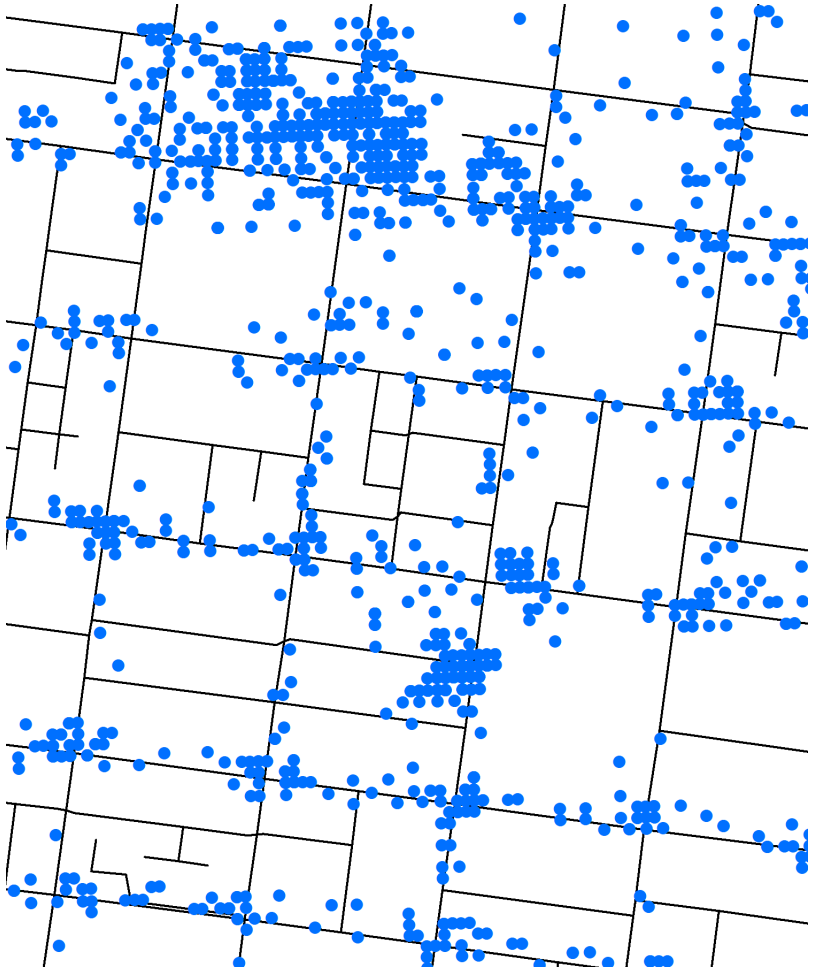


GPS in Philadelphia Street Vehicles

- GPS receivers installed in Streets sanitation and highway vehicles
- Data collected from vehicles every 15 seconds
  - Provided by Verizon NetworkFleet
  - ~ 550,000 points a day
- Location is received as coordinates without any street centerlines information
  - Location
  - Odometer / Heading / Speed
  - Vehicle assignments, garaging, etc

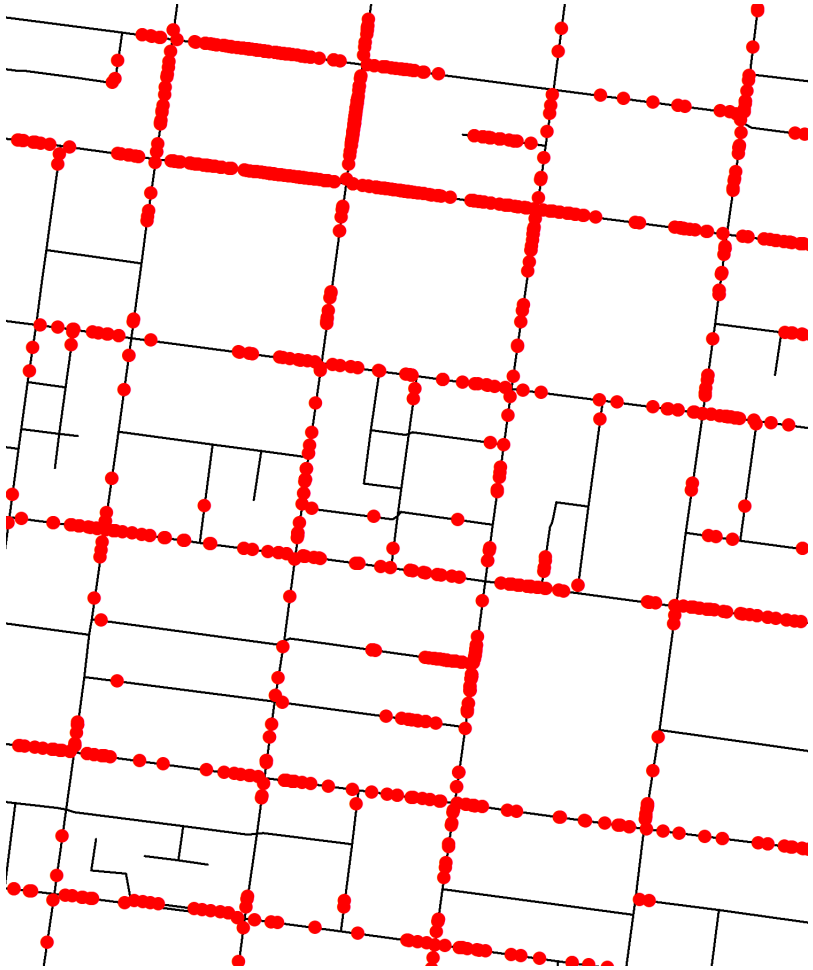
Limitations

- Raw GPS points on a map have limited utility
  - No connection to other datasets
  - Difficult to run analyses
  - Hard to use for reporting purposes
- Inherent GPS inaccuracies result in points ‘bouncing’ around, even when vehicles are stationary



How to make GPS data more useful

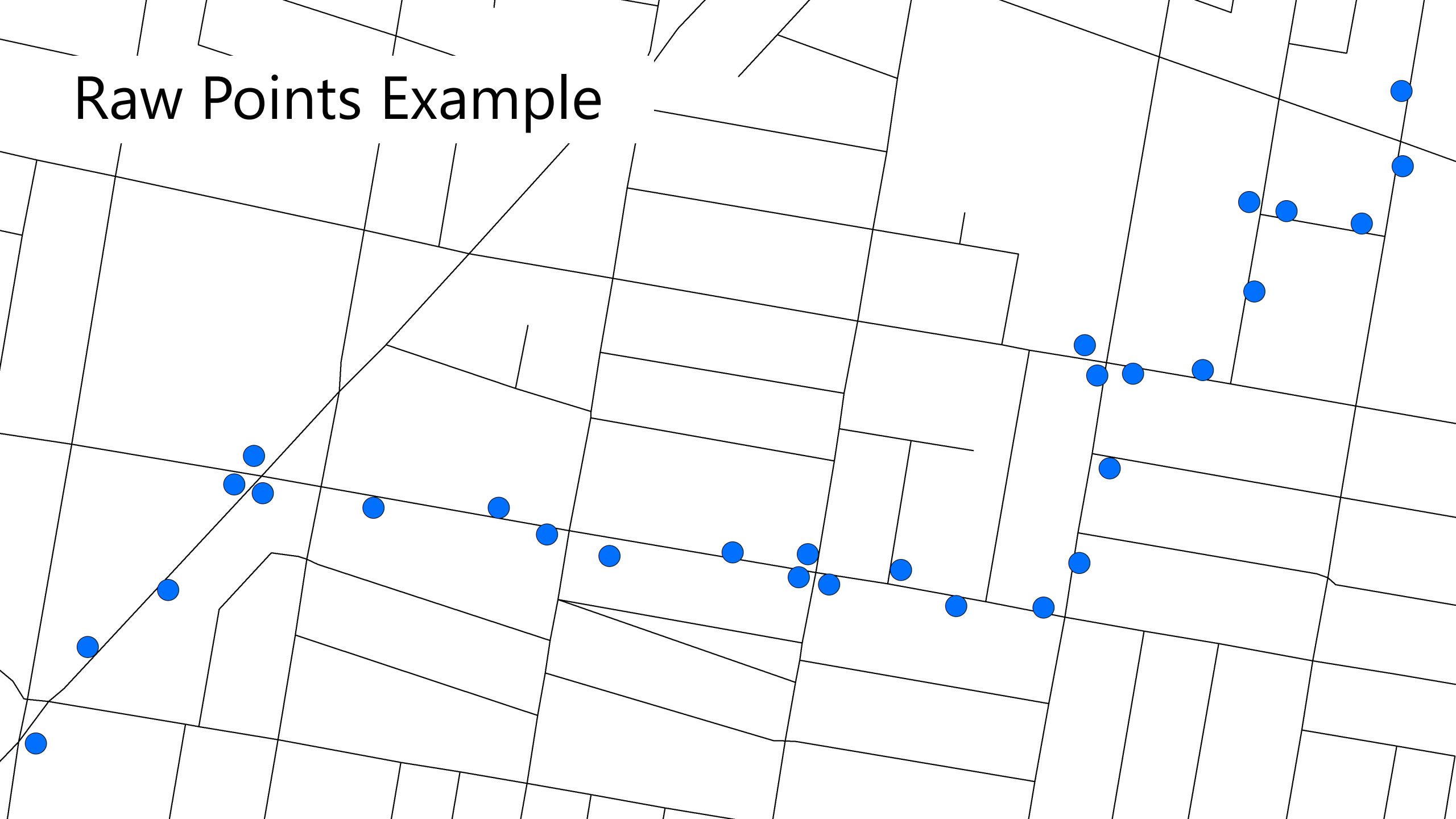
- Associate GPS points to street segments while retaining all associated vehicle information
- Maintain archive of fleet vehicle movements over time
- Make data more accessible for applications and reporting



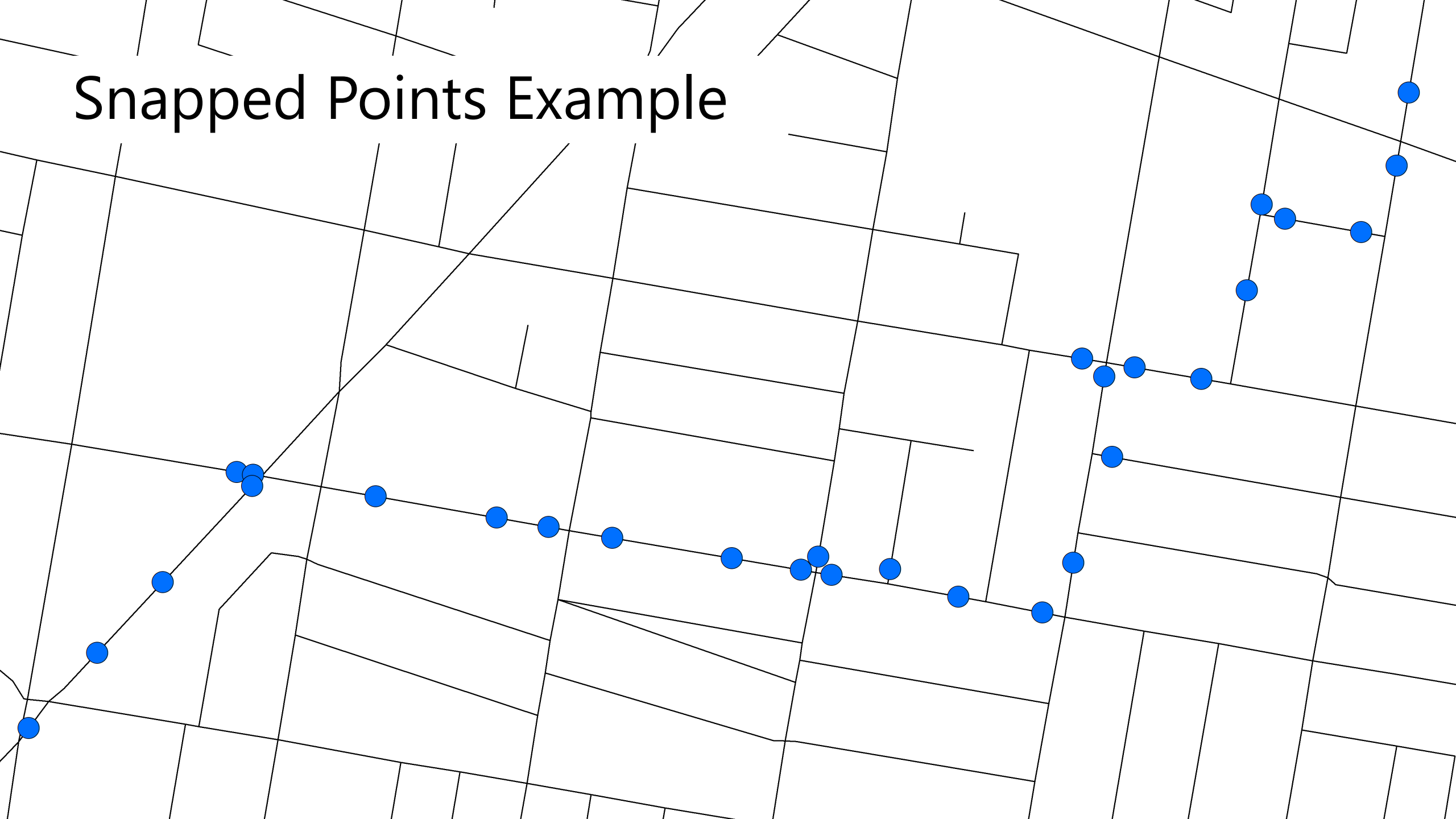
Challenges

- Out of the box solutions require intense processing and can introduce errors
  - False positives are common
- GPS points don’t exist for every segment that was visited
- A single vehicle can report many points on a single street segment
  - Duplicate records of segment visits leads to storage and processing issues
- GPS ‘bounce’ must be handled

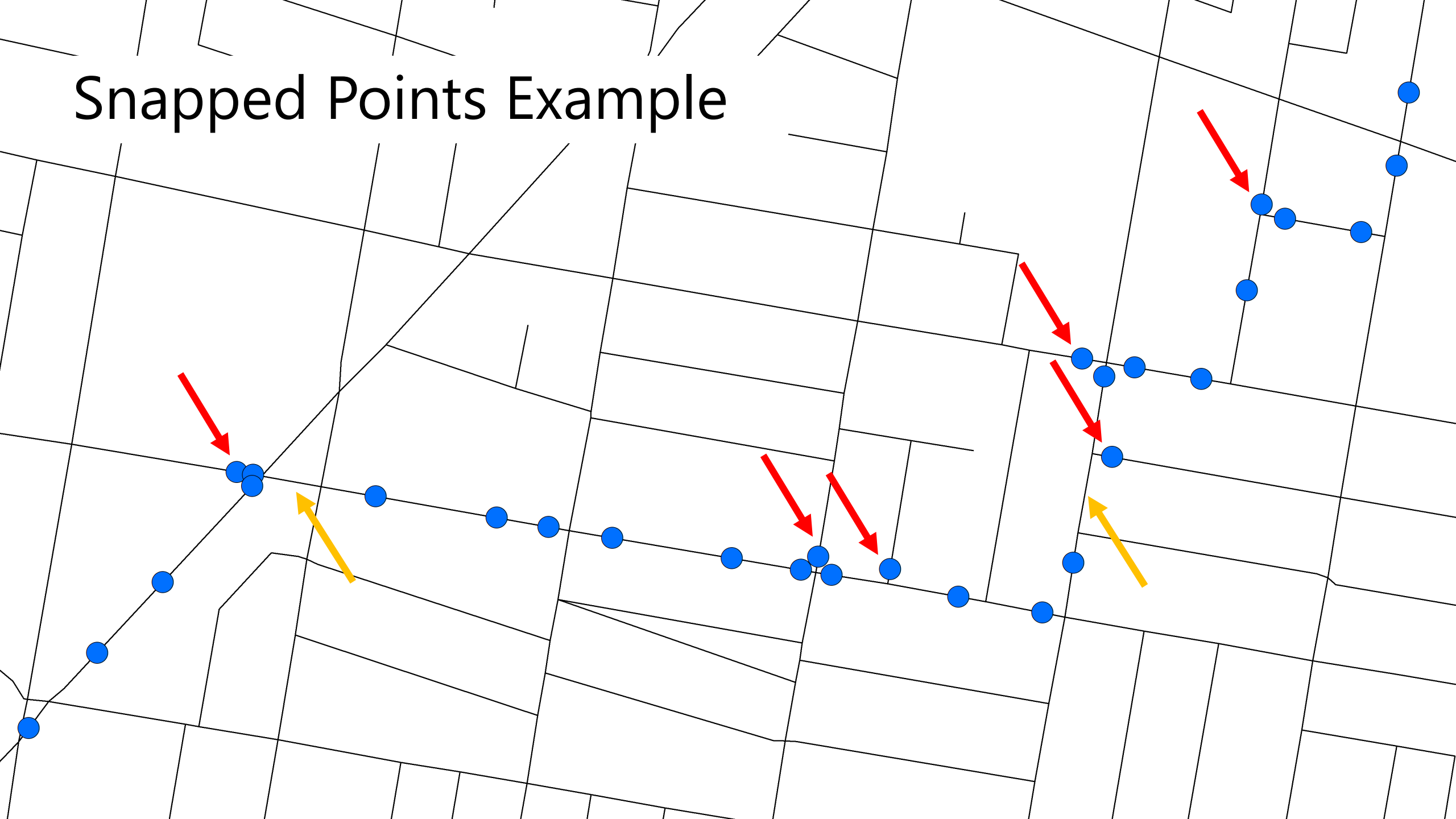
Raw Points Example



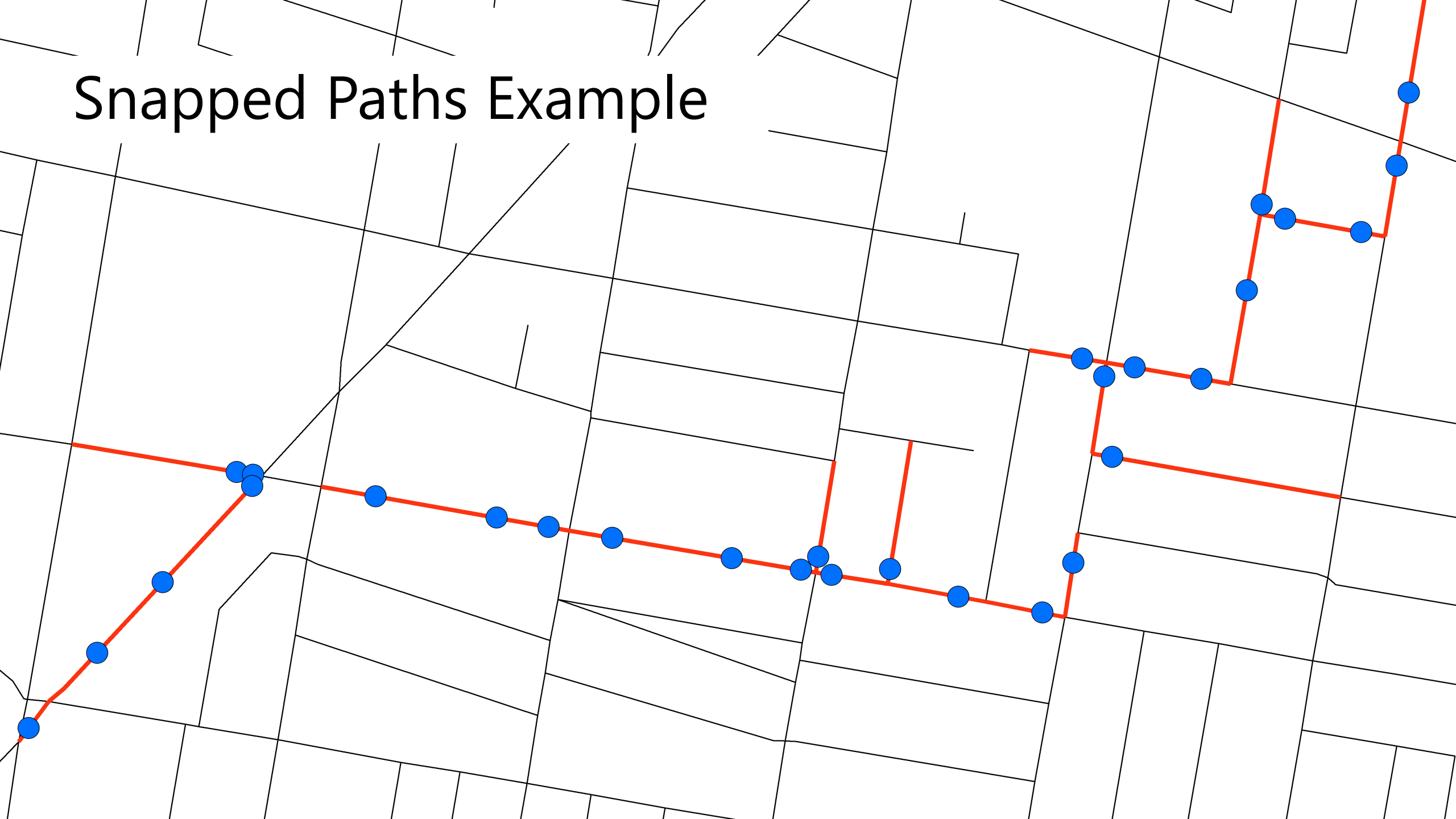
Snapped Points Example



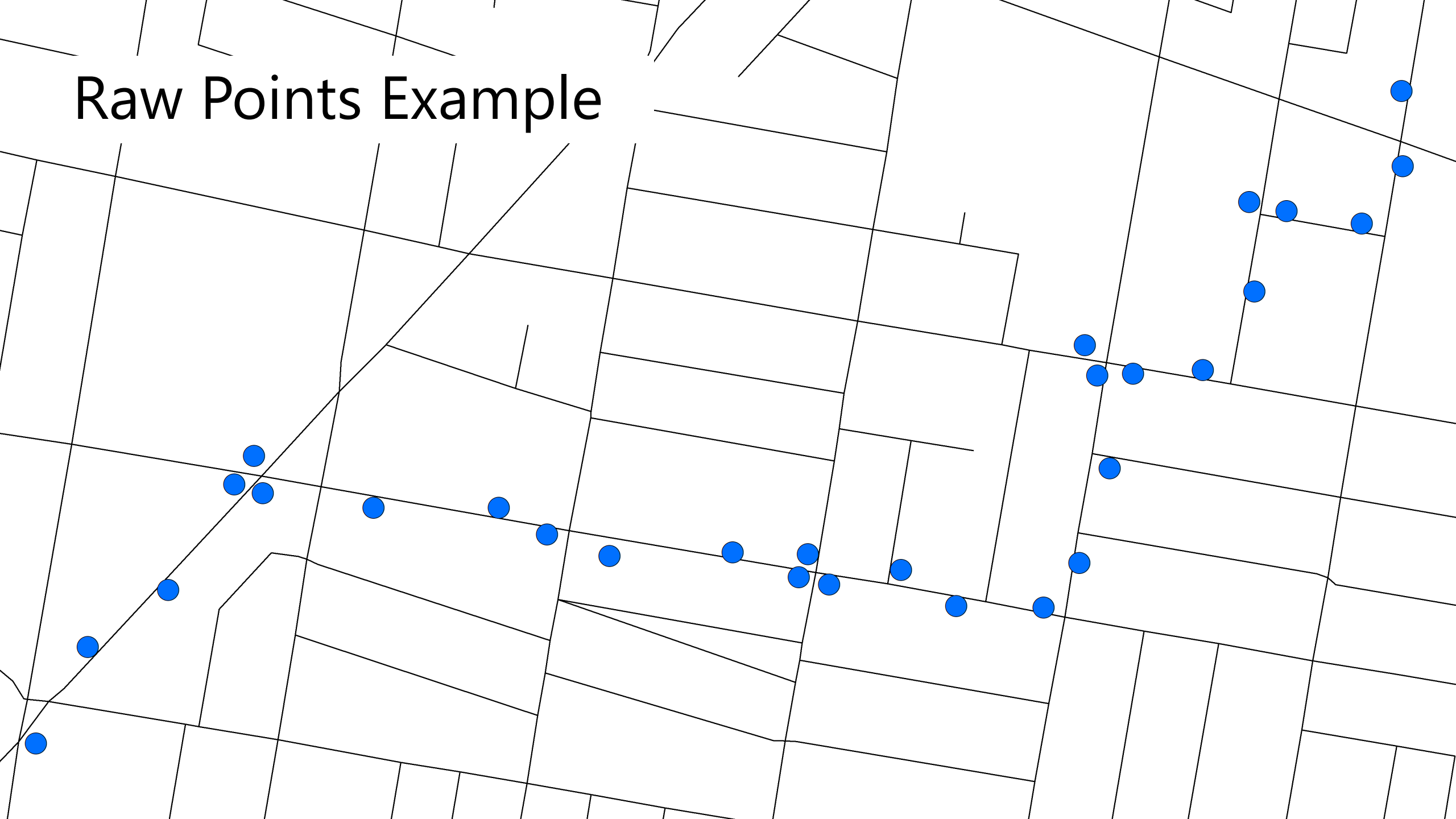
Snapped Points Example



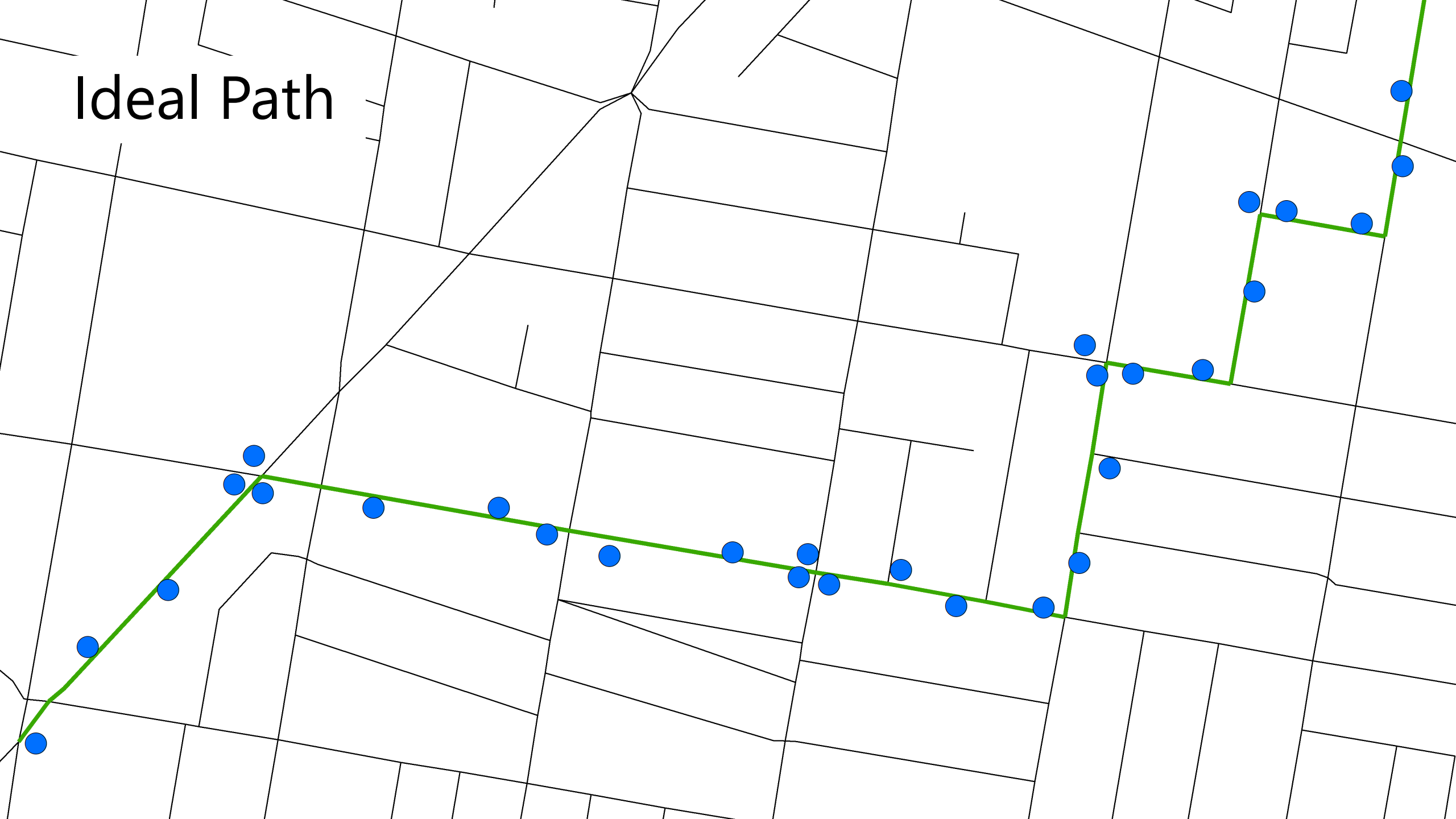
Snapped Paths Example



Raw Points Example



Ideal Path



Philly Vehicle Locator (PVL)

- Custom vehicle tracking solution:
  - Operationalize NetworkFleet data
    - Every day operations
    - Snow events
    - Historical archive
  - Enrich data with more useful attributes
  - Make data accessible for city staff and reporting

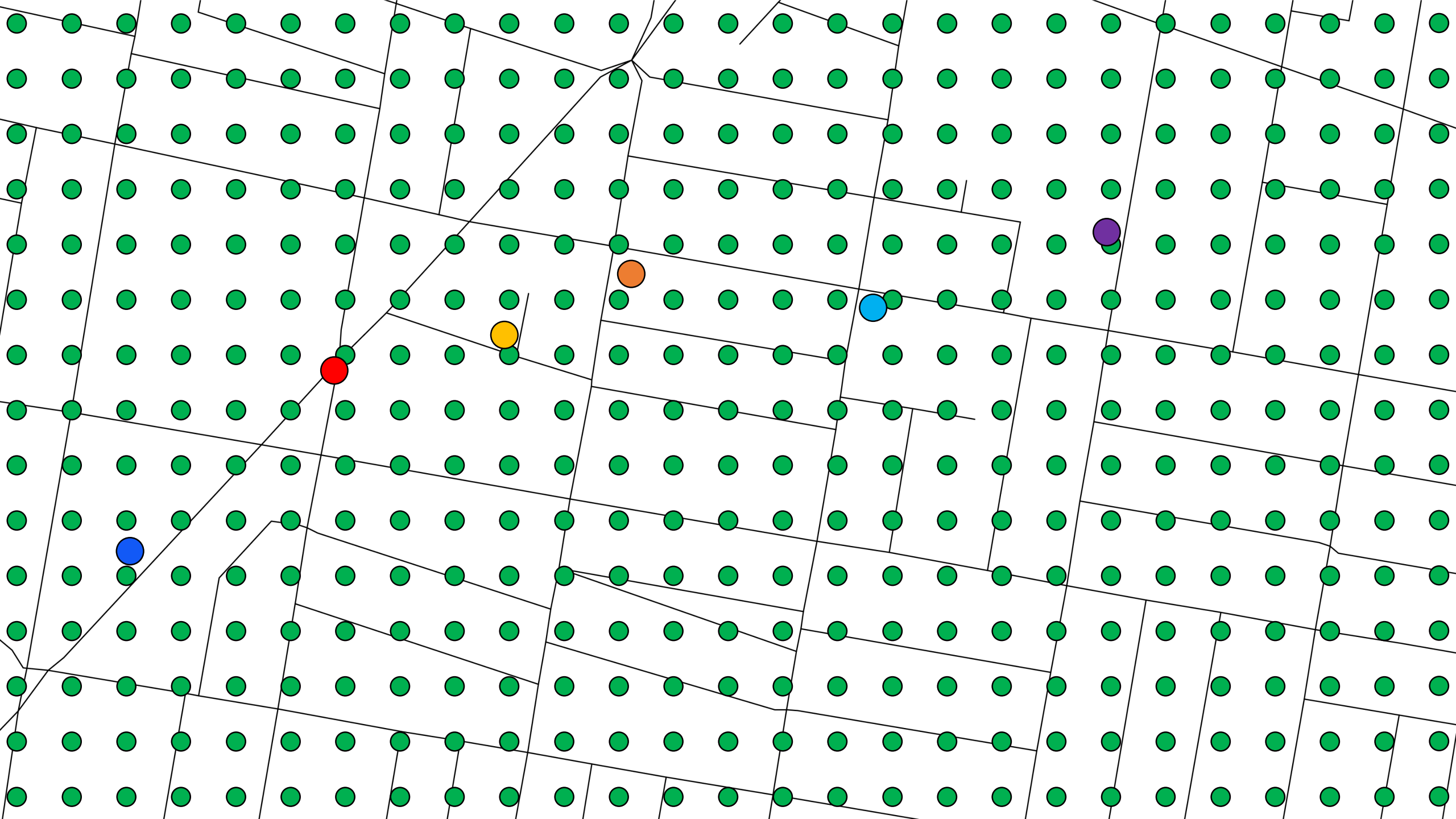
How does the PVL work?

1. Reads GPS data from NetworkFleet

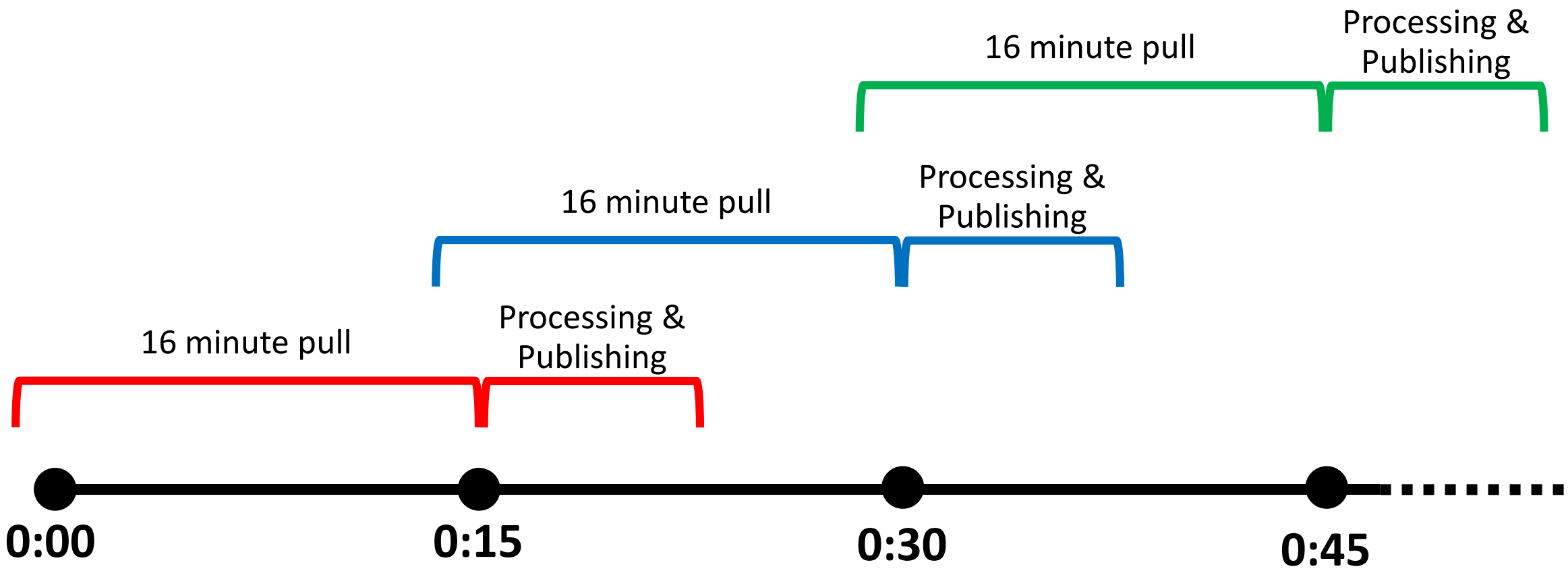
2. Identifies candidate street segments for each point using Euclidean (nearest) distance and probabilities

3. Runs candidates through advanced algorithms to find the most likely path along street network
   - Hidden Markov Model
   - Viterbi Algorithm

4. Writes outputs to tables in database that can support development and reporting

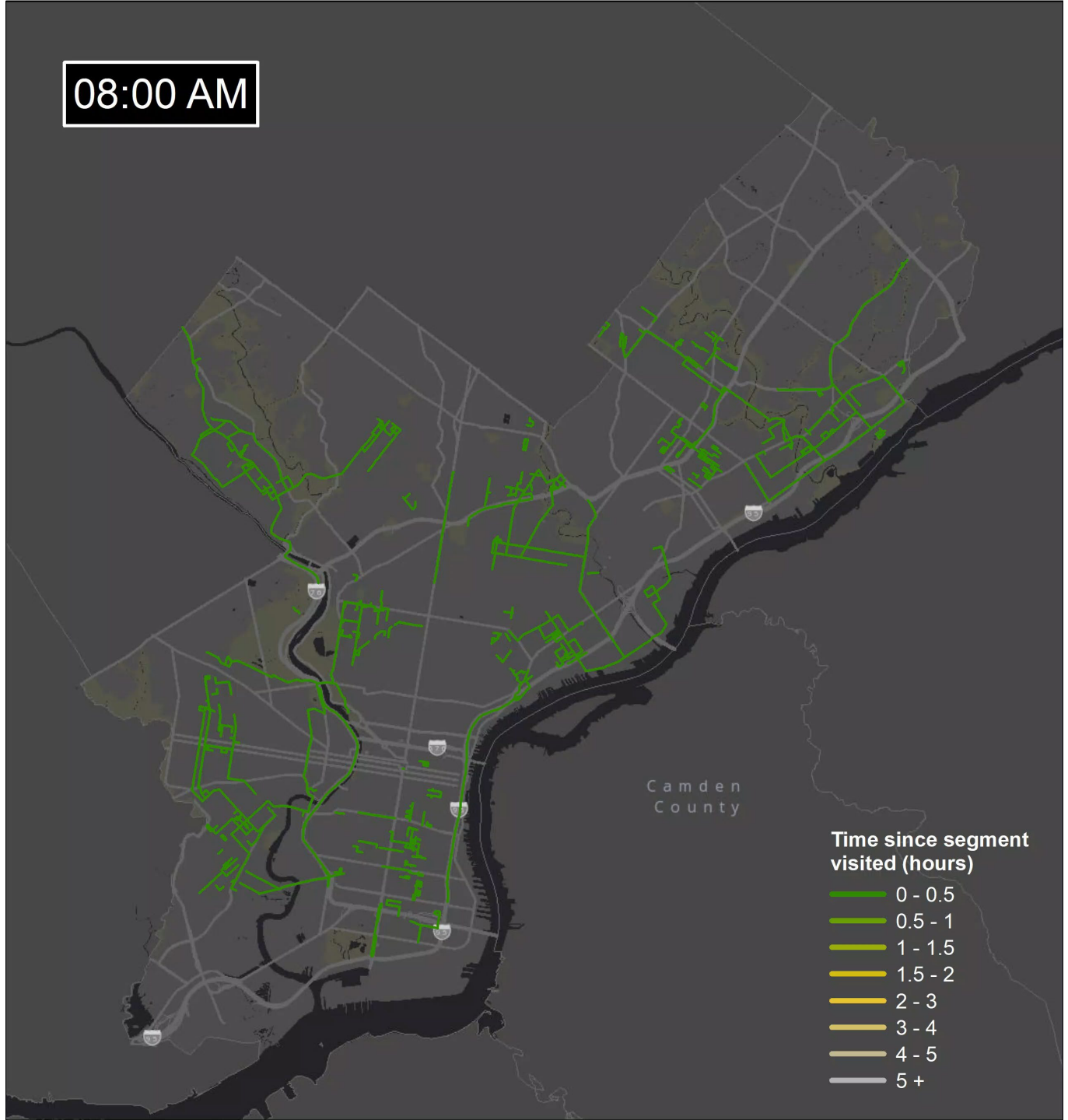


Update Schedule



Benefits

- Reduces output storage and record count by 70%
- Corrects and solves vehicle routes in less than 10% of the time compared to out-of-the-box tools
- Interpolates routes to include street segments missed by other AVL solutions
- Entirely developed and supported by city employees, minimizing city costs
- Puts information in the hands of more city employees


08:00 AM
Camden County
Time since segment visited (hours)
0 - 0.5
0.5 - 1
1 - 1.5
1.5 - 2
2 - 3
3 - 4
4 - 5
5 +


07:15 AM
Roxborough Reservoir
Wissahickon Valley Park
Carpenter's Woods Park
Gorgas Park
Clifford Park
Walnut Lane Golf Course
Henry Ave
Shawmont Ave
Ridge Ave
Umbria St
Levenington Ave
Green Ln
Walnut Ln
Main St
Shipps Ln
Hermit St
Lincoln Dr
W Allens Ln
Mc Callum St
W Mount Pleasant Ave
W Walnut Ln
Time since segment visited (hours)
0.0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
5.0 +

Potential Uses

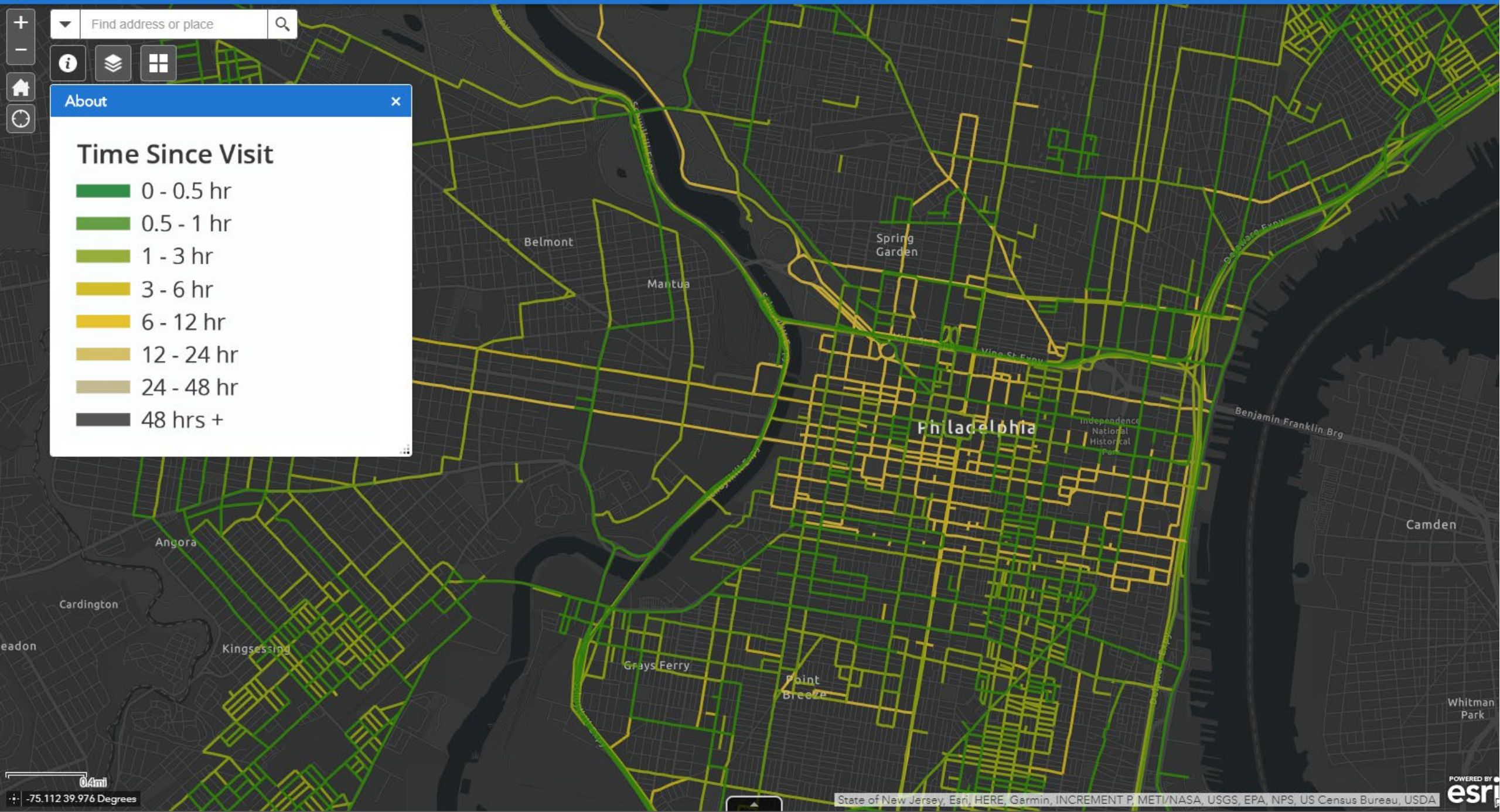
- Analytics
  - Can current truck routes be made more efficient?
  - What is the average visit time for each segment on collection day?
  - How many times has a street segment been visited since _____?

- Reporting
  - What vehicles have traveled outside of city?
  - Did any trucks drive over a bridge w/ weight limitations since _____?
  - Was a street segment missed on its last sanitation collection day?
  - Was trash picked up on the 7000 block of Hill Rd on October 18th?

Potential Uses - continued

- Applications & Dashboards
  - When was trash last picked up on a street?
  - How long has it been since a street has been plowed during a snow event?

DEMO - Internal Snow Plow Monitor



Supporting Technology

python™

aws

GitHub

esri

PostgreSQL

Future Products and Resources

- Planned suite of public Streets Department apps
  - Winter Weather Response
  - Trash Pickup
- Additional applications & reports
  - Public
  - Internal
- GitHub - https://github.com/CityOfPhiladelphia
  - ‘philly-vehicle-locator’ will be publicly available this afternoon!

Questions?

maps@phila.gov