Network Analyst: Creating High Density Routes with the VRP Solver

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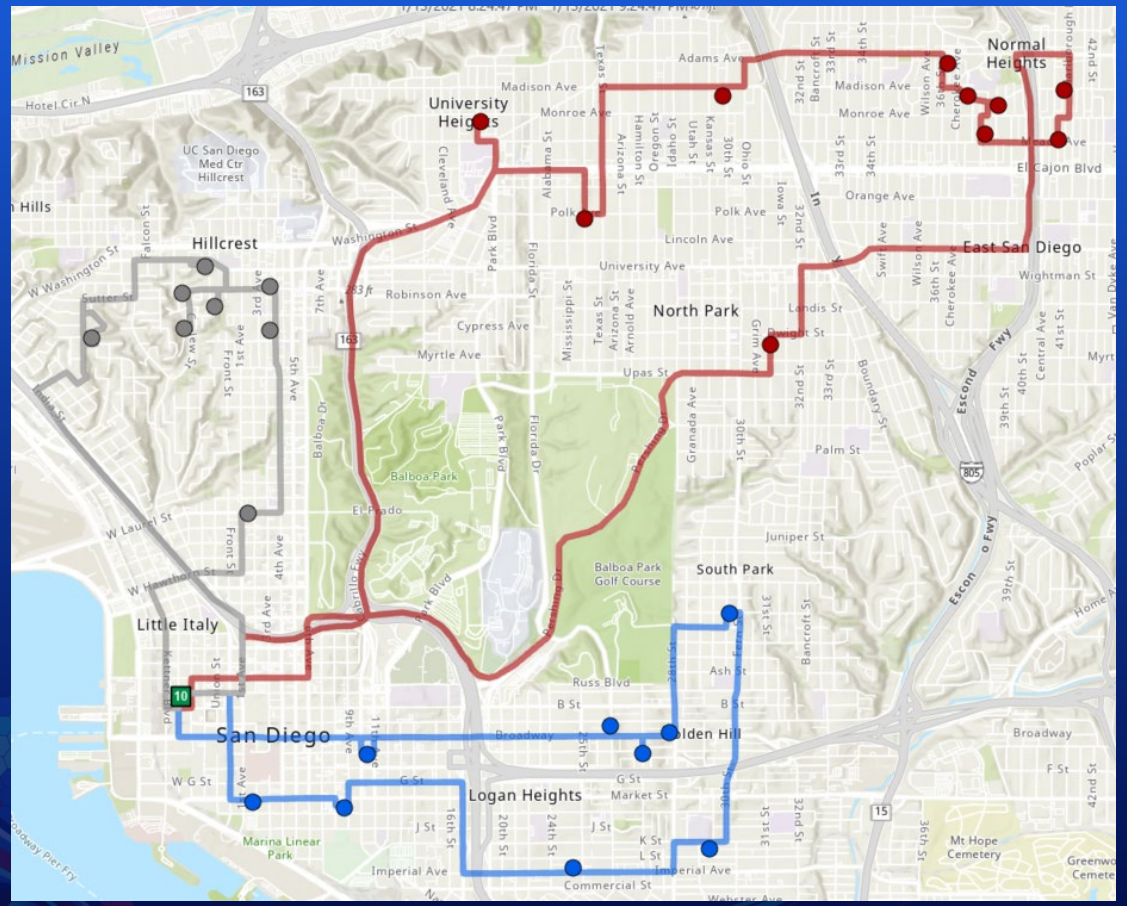
High Density Routing Problems

- Meter Reading
- Residential Waste Collection
- Snow Plowing
- Street Sweeping
- Fire hydrant inspections
- Coin collection from parking meters

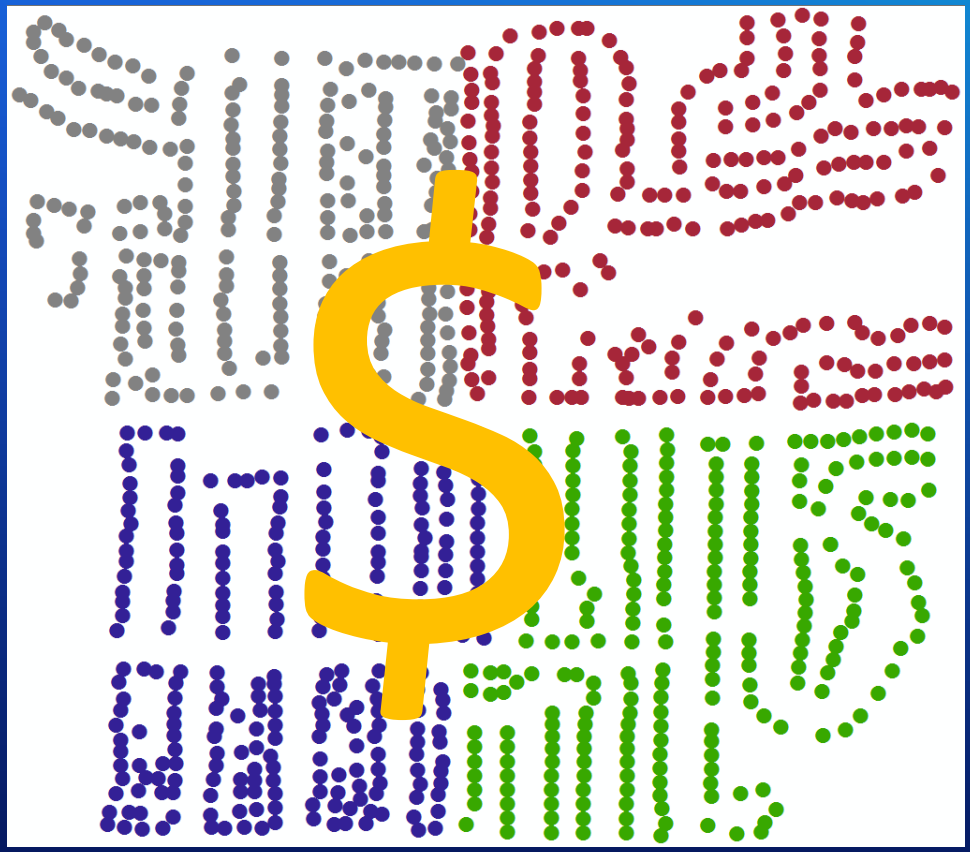
Typical VRP



High Density VRP

What makes a good solution for residential routing

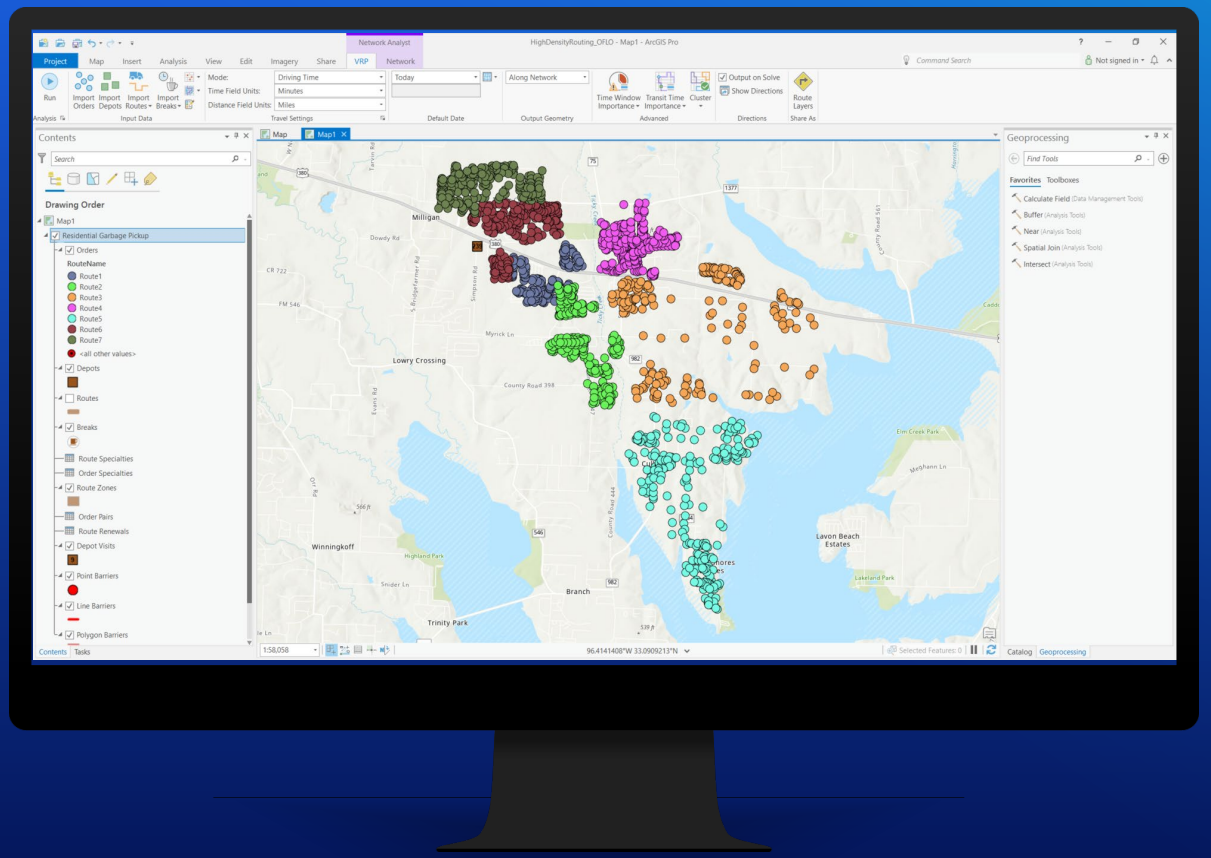
- Minimize distance and/or time
- Well-clustered routes
- Traverse street just once
- No U turns when driving large vehicles



Vehicle Routing Problem

Problem Inputs

- Orders
- Depots
- Routes
- Spatial Clustering
- Overrides



Creating High Density Routes with the VRP Solver

Overrides

OptimizeForLocalOrders

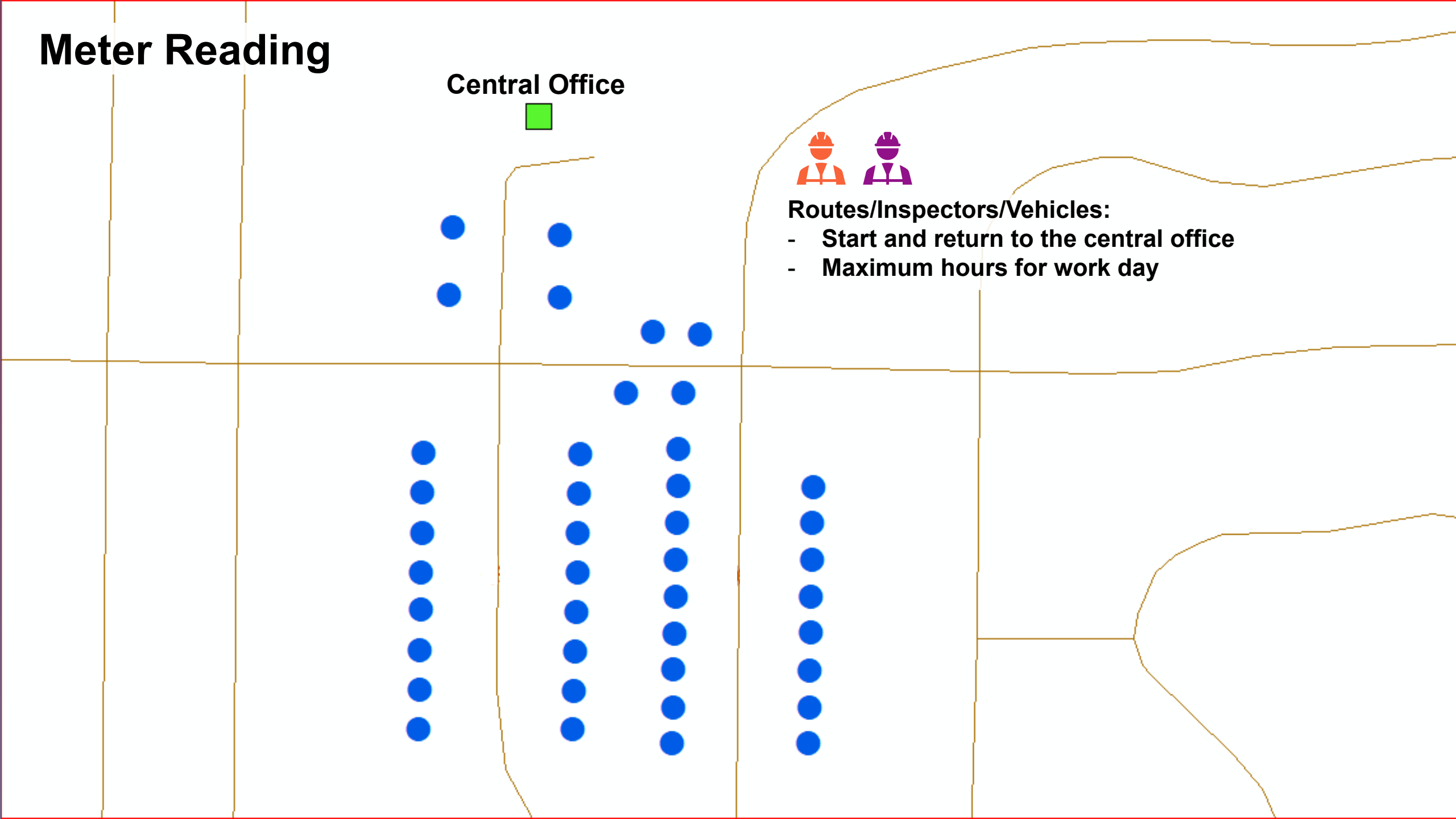
- Provides better route clustering, sequencing of orders within a route and solver performance
- Must meet a very specific set of VRP property requirements
  - Full requirements are at the end of the slide deck
- {"OptimizeForLocalOrders" : "1"}

RSPPenaltyFactor

- Places a higher priority on clustering routes
- {"RSPPenaltyFactor" : "10"}

Setting up the VRP Layer Demo

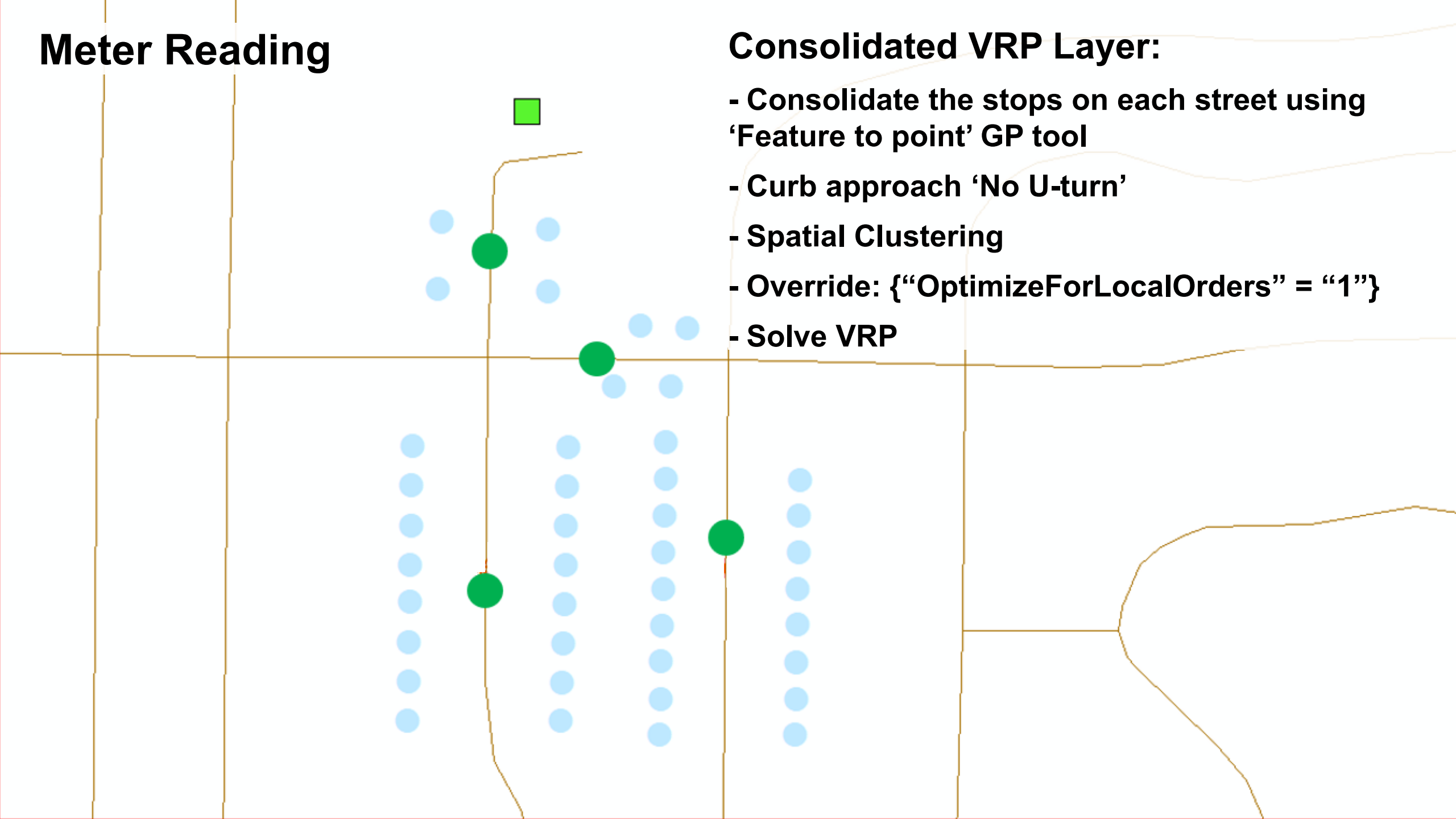
Meter Reading



Routes/Inspectors/Vehicles:

- **Start and return to the central office**
- **Maximum hours for work day**

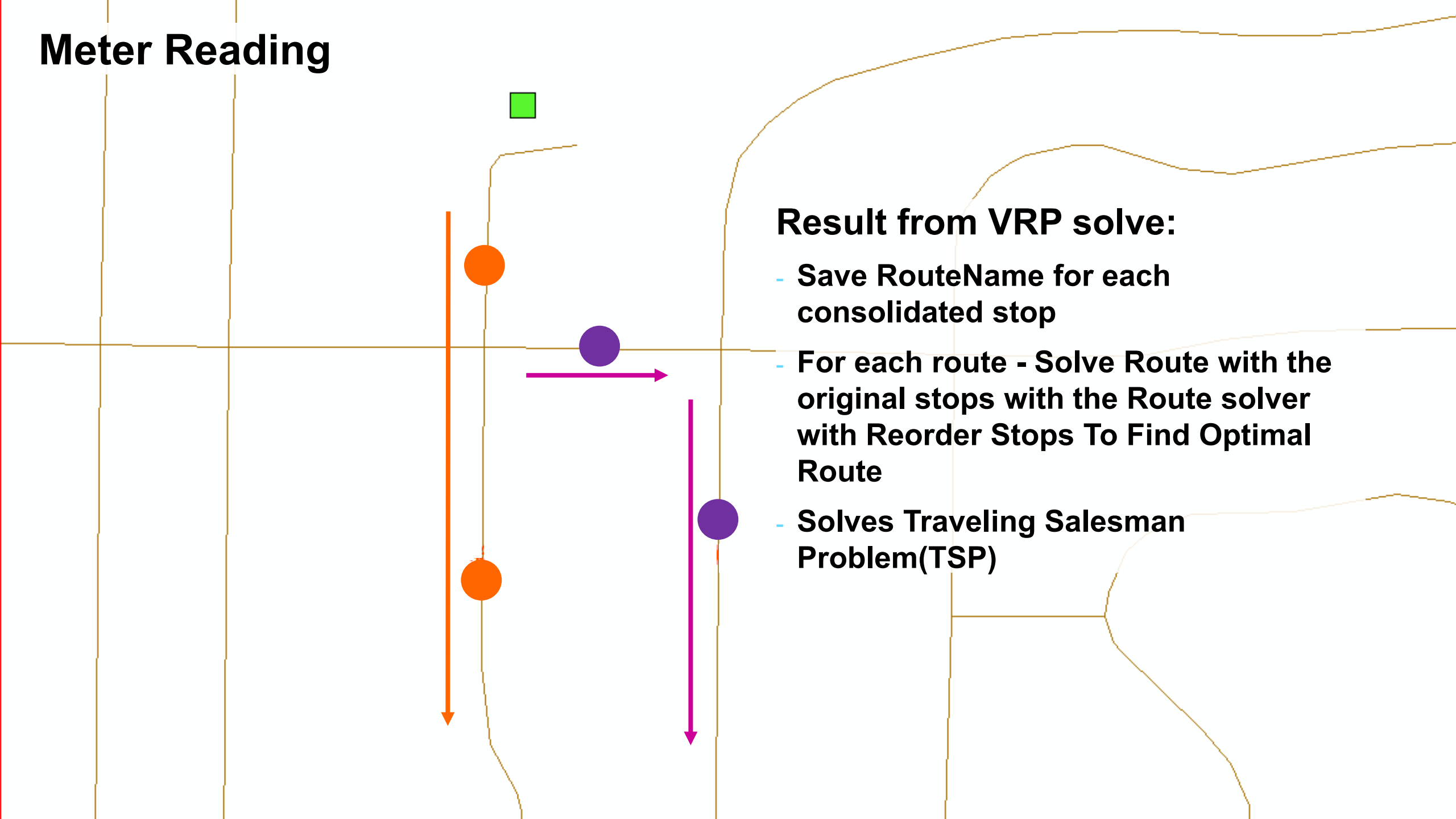
Meter Reading



Consolidated VRP Layer:

- Consolidate the stops on each street using ‘Feature to point’ GP tool
- Curb approach ‘No U-turn’
- Spatial Clustering
- Override: {“OptimizeForLocalOrders” = “1”}
- Solve VRP

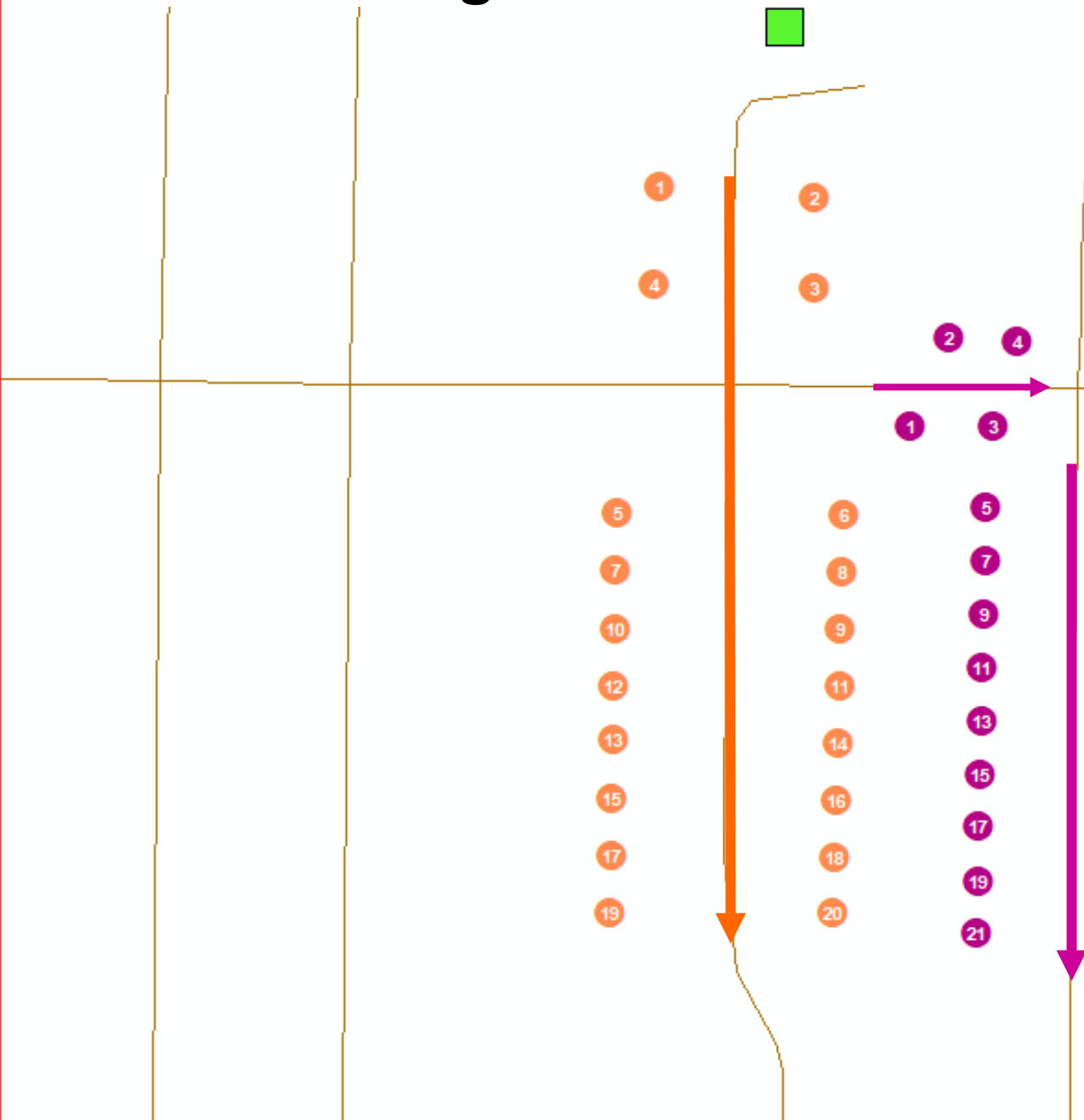
Meter Reading



Result from VRP solve:

- Save RouteName for each consolidated stop
- For each route - Solve Route with the original stops with the Route solver with Reorder Stops To Find Optimal Route
- Solves Traveling Salesman Problem(TSP)

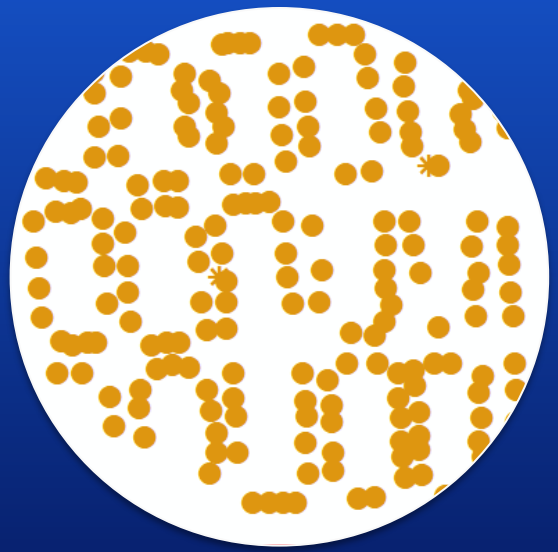
Meter Reading



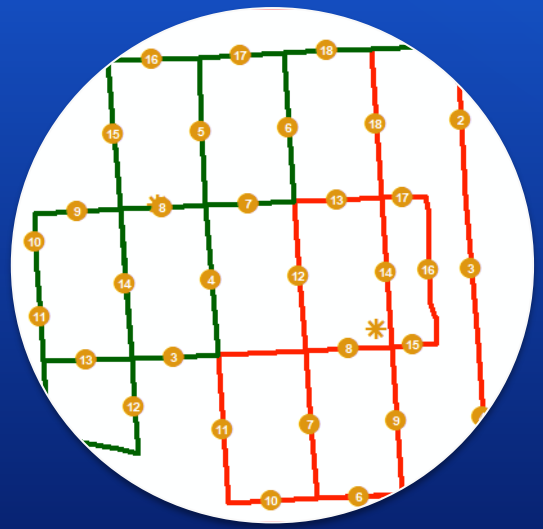
Results from Route solver :

- The new changes ensure a good sequencing with a near optimal solution on travel cost
- Override makes sure the routes are well clustered

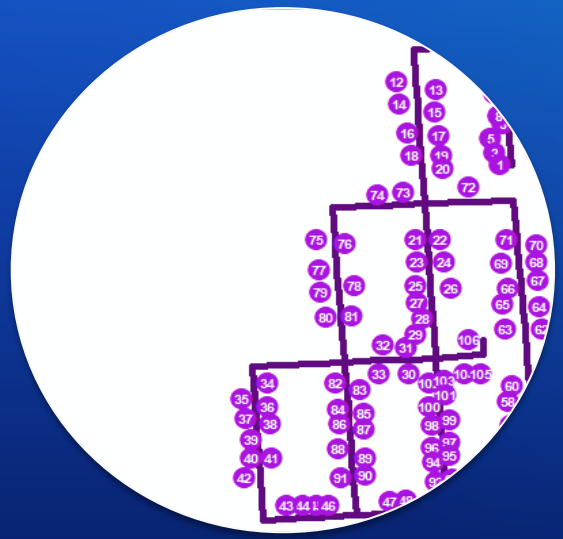
Original VRP Input Layer



Consolidated VRP Solve



Route Solve



Meter Routing Demo

Meter Reading

Total Time:

- 8.13 Minutes
- 8.92 Minutes

Are these routes good?

- Sequencing
- Clustering

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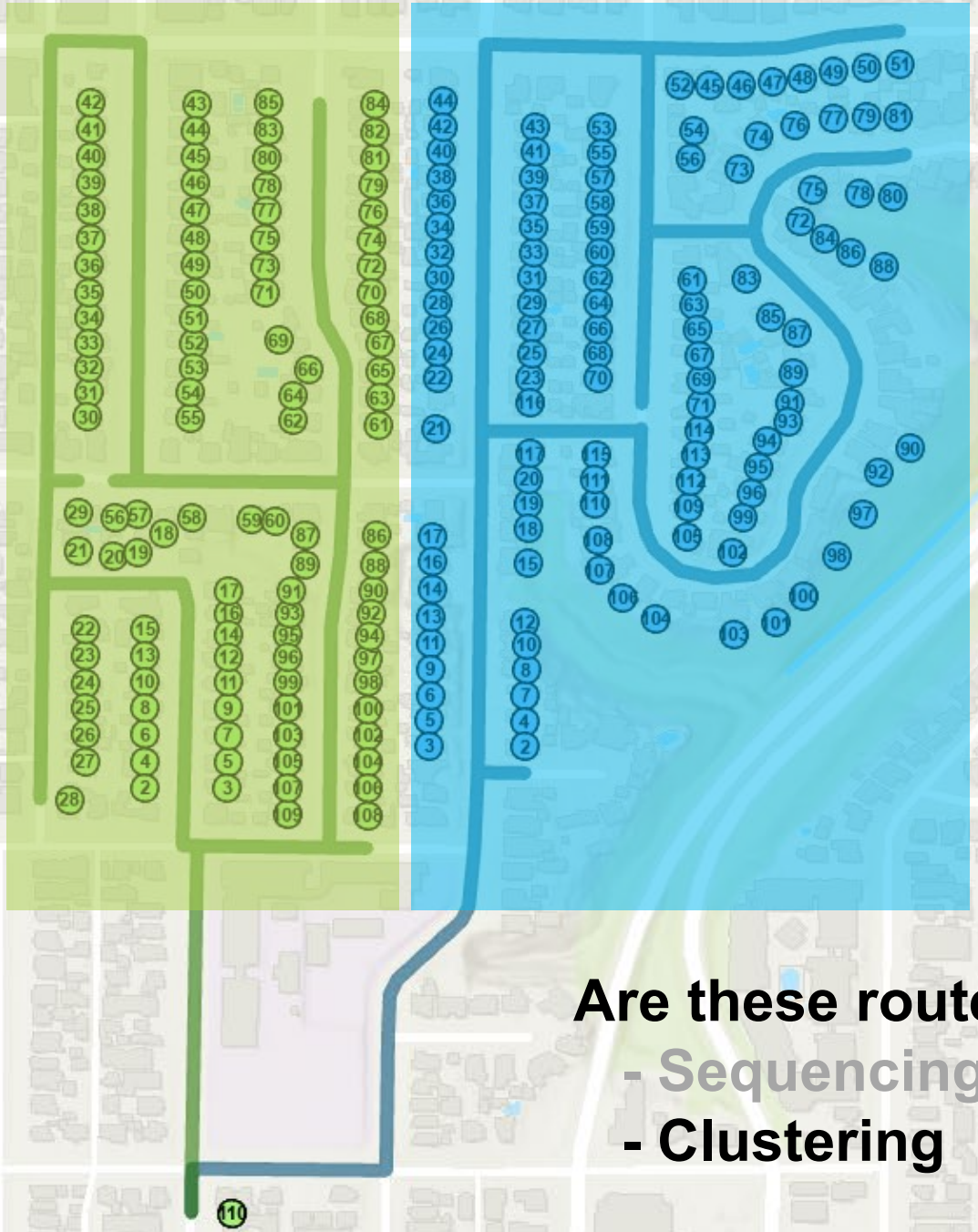

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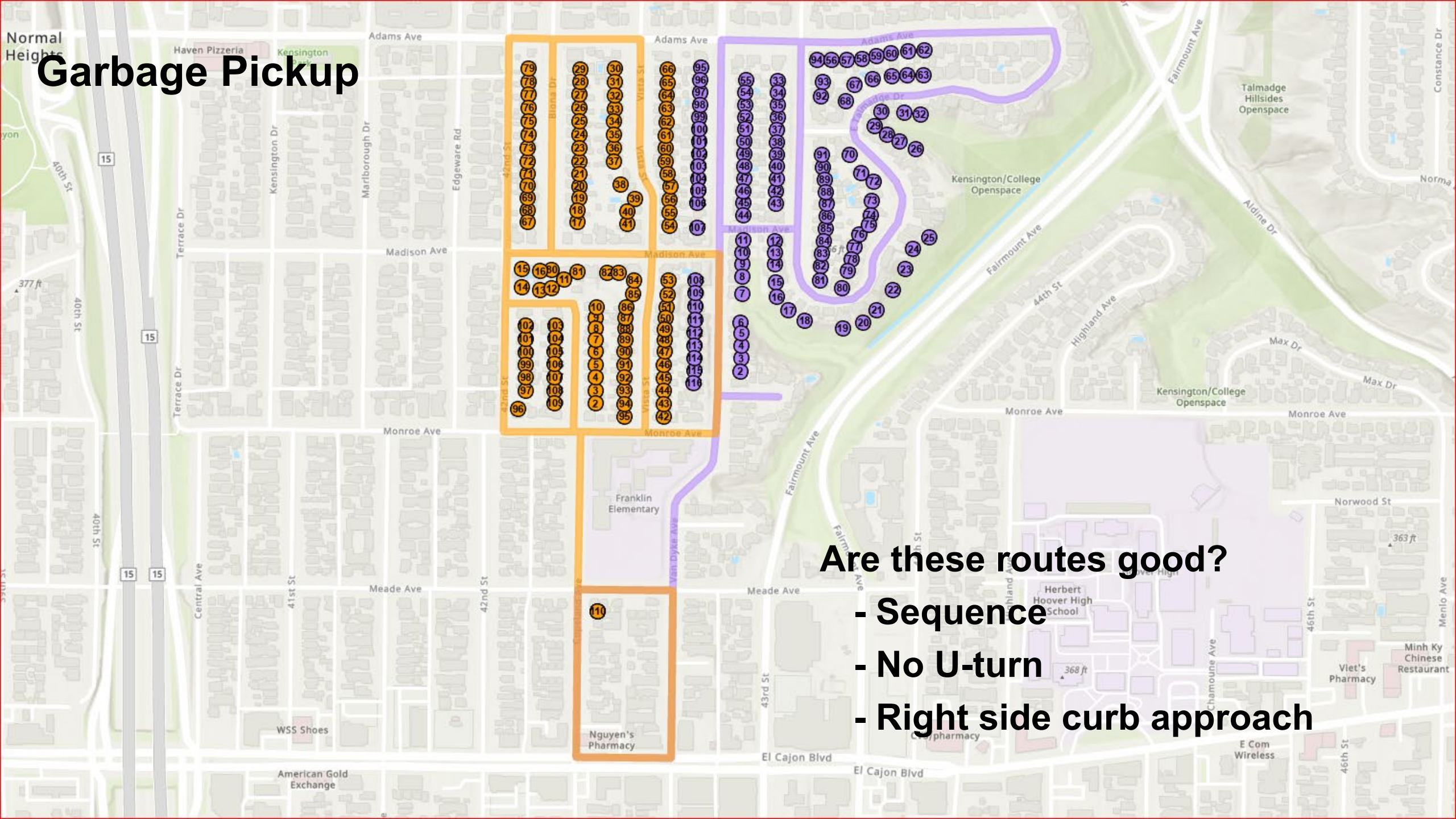
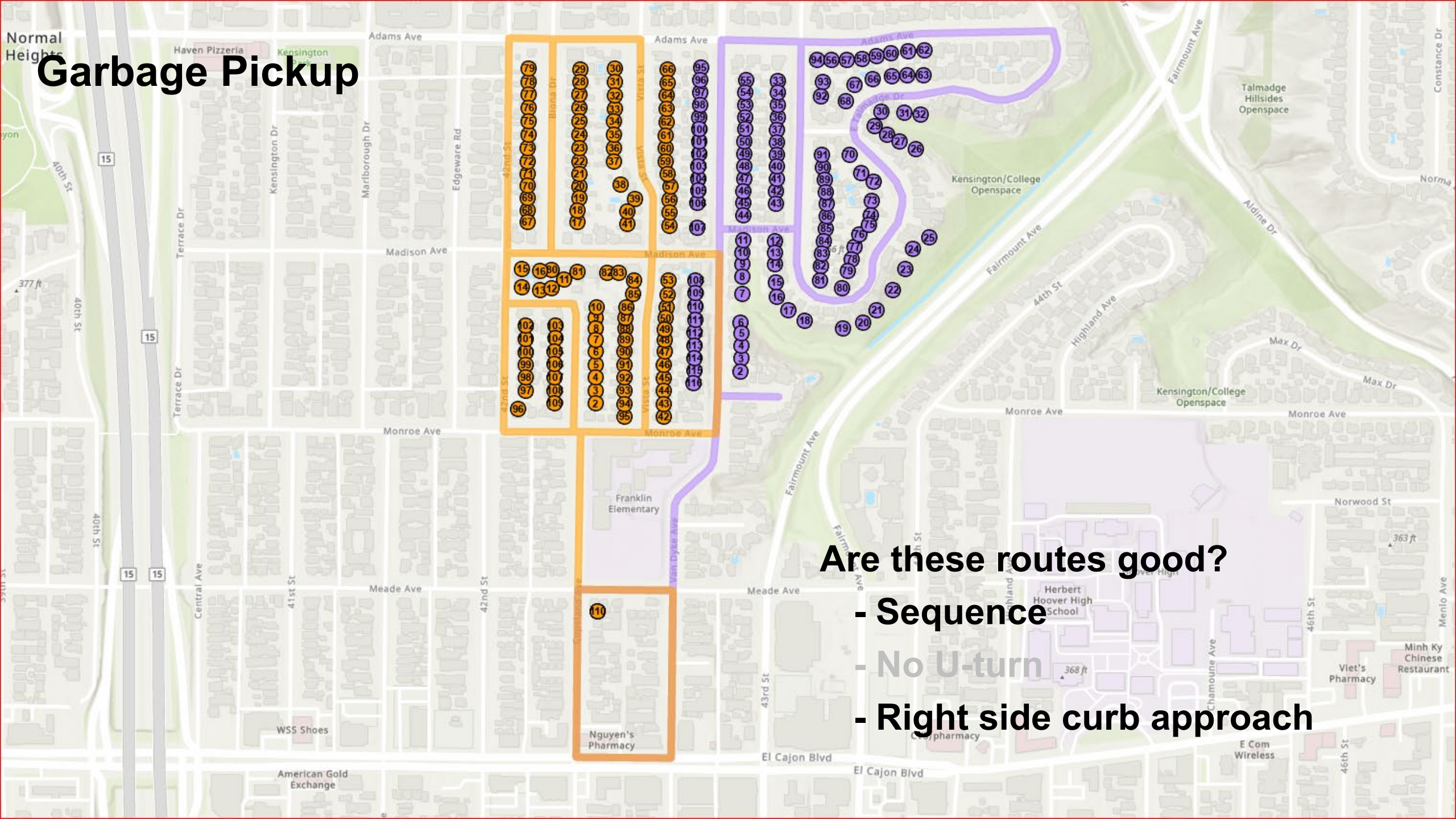
Garbage Pickup



Are these routes good?

- **Sequence**
- **No U-turn**
- **Right side curb approach**

Garbage Pickup



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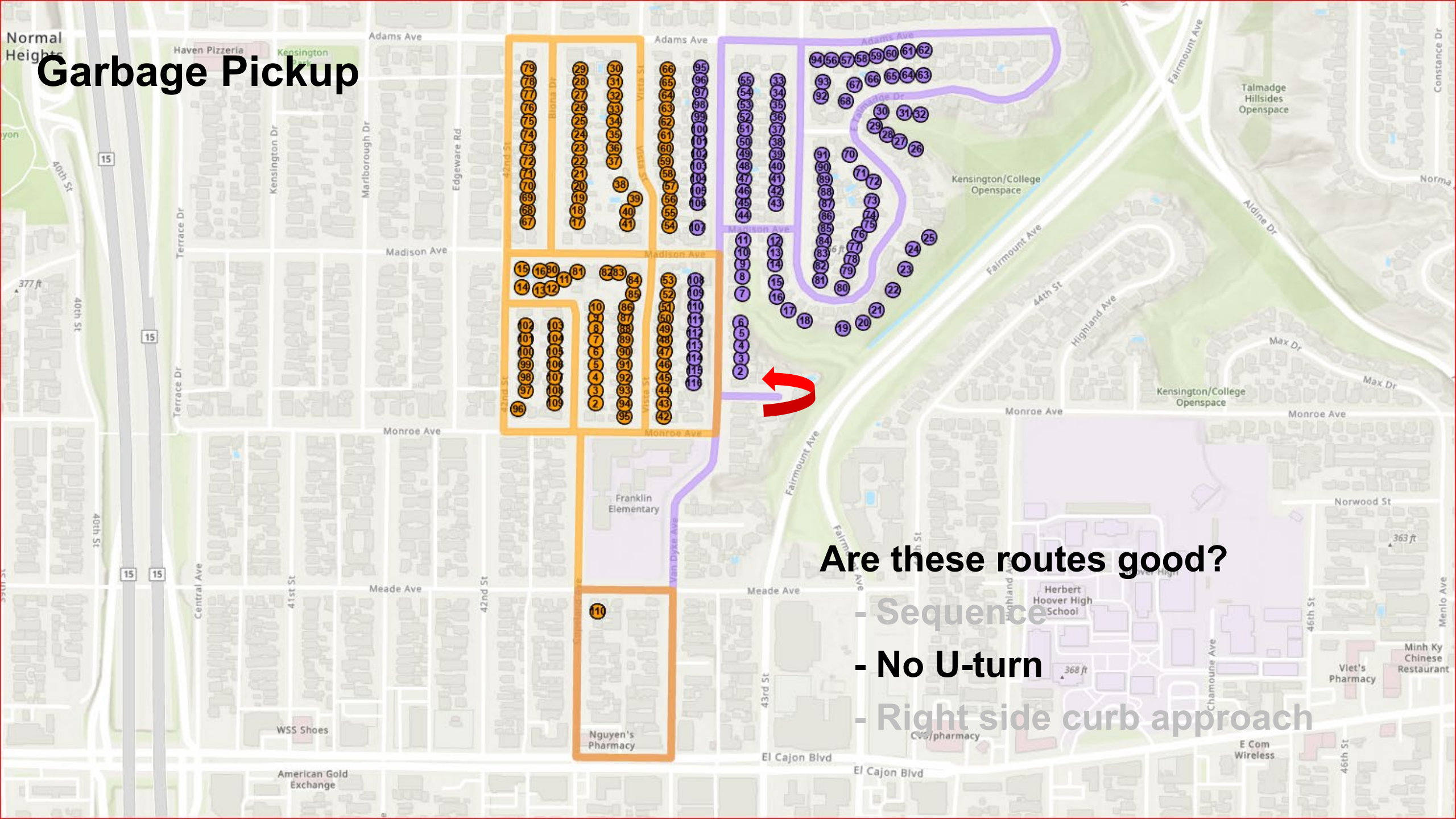

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Resources

Try it!

- •ArcGIS Pro Tutorial: https://pro.arcgis.com/en/pro-app/help/analysis/networks/service-a-set-of-orders-with-a-fleet-of-vehicles.htm
- •Vehicle routing problem properties: https://pro.arcgis.com/en/pro-app/latest/help/analysis/networks/vehicle-routing-problem-analysis-layer.htm
- •Vehicle Routing Problem REST API: https://developers.arcgis.com/rest/network/api-reference/vehicle-routing-problem-service.htm
- •Rest API Tutorial: https://developers.arcgis.com/documentation/mapping-apis-and-location-services/route-and-directions/fleet-routing/
- •ArcGIS API for Python notebook: https://developers.arcgis.com/python/sample-notebooks/finding-routes-for-appliance-delivery-with-vrp-solver/
- Community: https://geonet.esri.com/community/gis/analysis/network-analyst

http://esriurl.com/devsummit21hdr

OptimizeForLocalOrders

- Required VRP parameters for using Optimize for Local Orders
  - All routes are homogeneous, i.e., they all have the same settings except for Name
  - The routes start and stop at the same depot
  - Routes do not have MaxTotalTravelTime or MaxTotalDistance constraints
  - There must be enough routes to service all the orders
  - Only a single Depot
  - Orders do not have time windows
  - Order quantities are one-dimensional and only DeliveryQuantities
  - Orders cannot have inbound arrival times or outbound departure times
  - All orders must have an assignment rule of Override (3)
  - No Breaks, Renewals, Specialties, OrderPairs, or Route Zones
  - Must have dynamic seed points for all routes when using the ArcMap Layer or have "Spatially Cluster Routes" set to true when using the Solve VRP GP tool or service

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OptimizeForLocalOrders

- **Benefits: The Optimize for Local Orders solver override will help improve the route clustering, sequencing of orders within a route, and the solver performance (on average faster solve times).**

- **Set the Overrides Parameter: {"OptimizeForLocalOrders" : "1"}**

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