NYC Multimodal Network

(Walking, Subway, and Ferry)

SAVI 805 – Final Project

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Introduction

- ArcGIS Network Analyst is a powerful set of tools that can run various analyses on transportation and other networks.
  - However, networks must be well built in order to work properly
  - Lines must properly connect
  - Points must reside at vertices or endpoints of lines
- NYC Open Data provides various shapefiles that map transportation networks
  - Maps of roads, railways, subways, waterways

Introduction

- NYC Open Data shapefiles may be difficult to use
  - LION
    - Contains properly-connected road-, rail-, and water-ways
    - Does not contain points (stations, terminals, etc.)
    - Subway lines not simple to use
    - Does not contain all waterway routes
  - Subway Shapefiles
    - Separate shapefiles for subway lines, stations, and entrances
    - Not formatted for network analysis
      - Works well for simple visualizations
      - Line segments often not connected
      - Stations do not sit on lines
      - Entrances not at line endpoints on LION file
- Project was split into sections to simplify tackling these issues

Procedure (Subway)

- Messiest dataset for network analysis
- Subway lines do not interconnect
  - Needed to find common connection points within system
  - Subway Entrances chosen as connection points
    - One entrance may connect to several stations on different networks

- Shapefiles needed cleanup for network use
  - arcpy scripts written to split shapefiles by line

Procedure (Subway)

- Tools used
  - Select (arcpy)
    - Split shapefiles by line
  - Add XY Coordinates (arcpy)
    - Add coordinates to entrances
  - Integrate (batch)
    - Connect disconnected line segments in each subway line
  - Snap (batch)
    - Snap stations to lines
  - Near (arcpy)
    - Find entrances closest to stations for each line (and transfer stations)
    - Save station location coordinates
  - XY to Line (arcpy)
    - Create line segments connecting entrances to stations (and transfers)

Procedure (Subway)

- Tools used (cont.)
  - Merge
    - Combine multiple shapefiles into individual files per network segment
    - Lines, Stations, Entrances, Entrance Paths, Transfers
  - Find Identical
    - To determine whether there are overlapping lines or points
  - Delete Identical
    - Delete overlapping features
  - Split Line at Point
    - Split subway line segments at each station to ensure an endpoint
    - MUST SET SEARCH RADIUS!
      - Although this is an optional parameter, not setting it only splits the line segment at a single (nearest) point
      - Many line segments in data have multiple points on them
      - Setting search radius splits at all points within the radius

Procedure (Subway)

- Staten Island Railway
  - Entrances are in the Subway shapefile
  - Route is in LION
    - Selected and exported “FeatureTyp” = ‘1’ (Railroad)
    - Selected individual route and exported
  - Manually created feature set for stations
    - Placed points at station locations
      - Near entrances
      - Snapped to line segment endpoints
  - Add XY Coordinates, Near, and XY to Line
    - Connected entrances to stations

Procedure (Subway)

- Five merged shapefiles used to create subway network
  - Network was tested to connect internally

Procedure (Walking)

- LION Database
  - Walking routes extracted
    - Selected "FeatureTyp" fields '0', '6', and 'W'
      - '0' = Street other than vehicle only street
      - '6' = Private Street (physically existing)
      - 'W' = Path, Non-Vehicular, Addressable
    - Exported selected features to new shapefile
  - Snap
    - Snapped copy of entrances layer to walking routes
    - Shapefile of nearest points on routes to entrances
  - Split Line at Point
    - Split walking routes at points nearest to entrances
  - Add XY Coordinates, Join by FID, and XY to Line
    - Connected near points to entrances with lines

Procedure (Walking)

- Edited walking paths shapefile used in network

Procedure (Ferry)

- Most sparse dataset
  - A lot of manual reconstruction
- Sources: LION and GTFS Data
  - LION maps various ferry routes
    - However, several new routes have been added recently
    - Only looked at NYC Ferry and Staten Island Ferry routes
    - Manually selected and exported applicable routes
  - General Transit Feed Specifications
    - Exported position data for ferries on various routes
    - Used Points to Line tool to reconstruct routes
      - Manually adjusted issues
      - Manually snapped endpoints at terminals to walking paths
  - Manually created terminal (points) feature set
    - Snapped to endpoints of routes at terminal locations

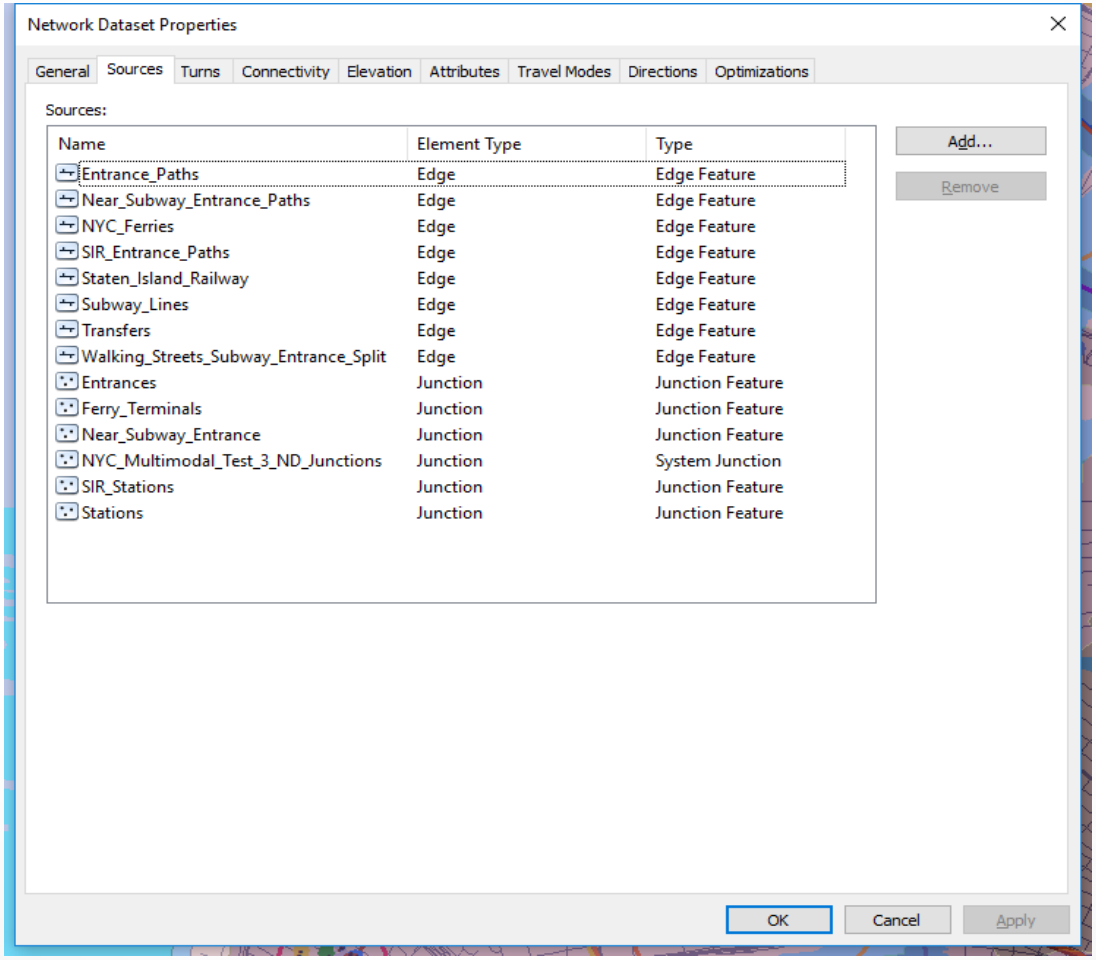
Procedure (Ferry)

- Ferry routes were checked versus the 2017 NYC Ferry map

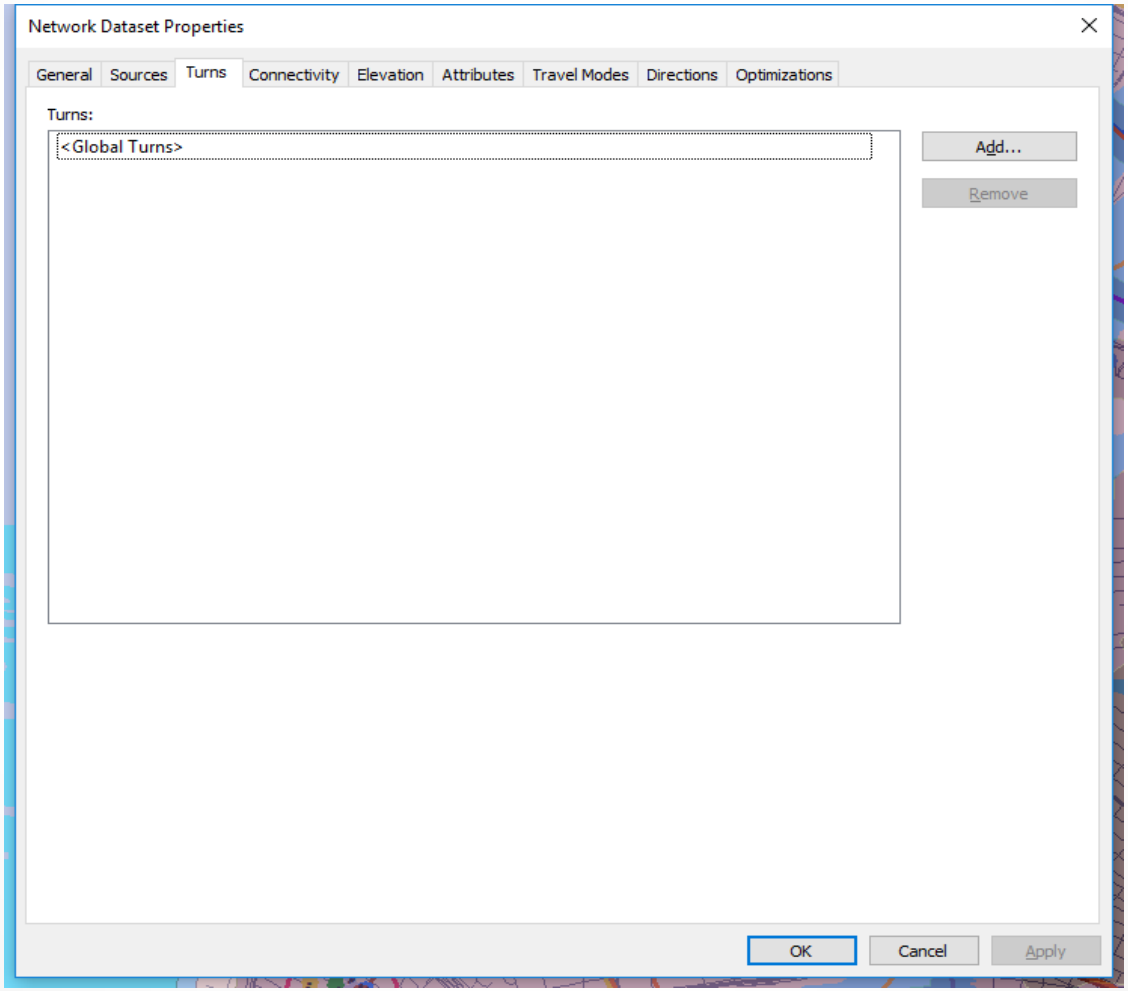
Completed Network

- Close-up of completed and stacked network layers

Creating Network Dataset



Creating Network Dataset



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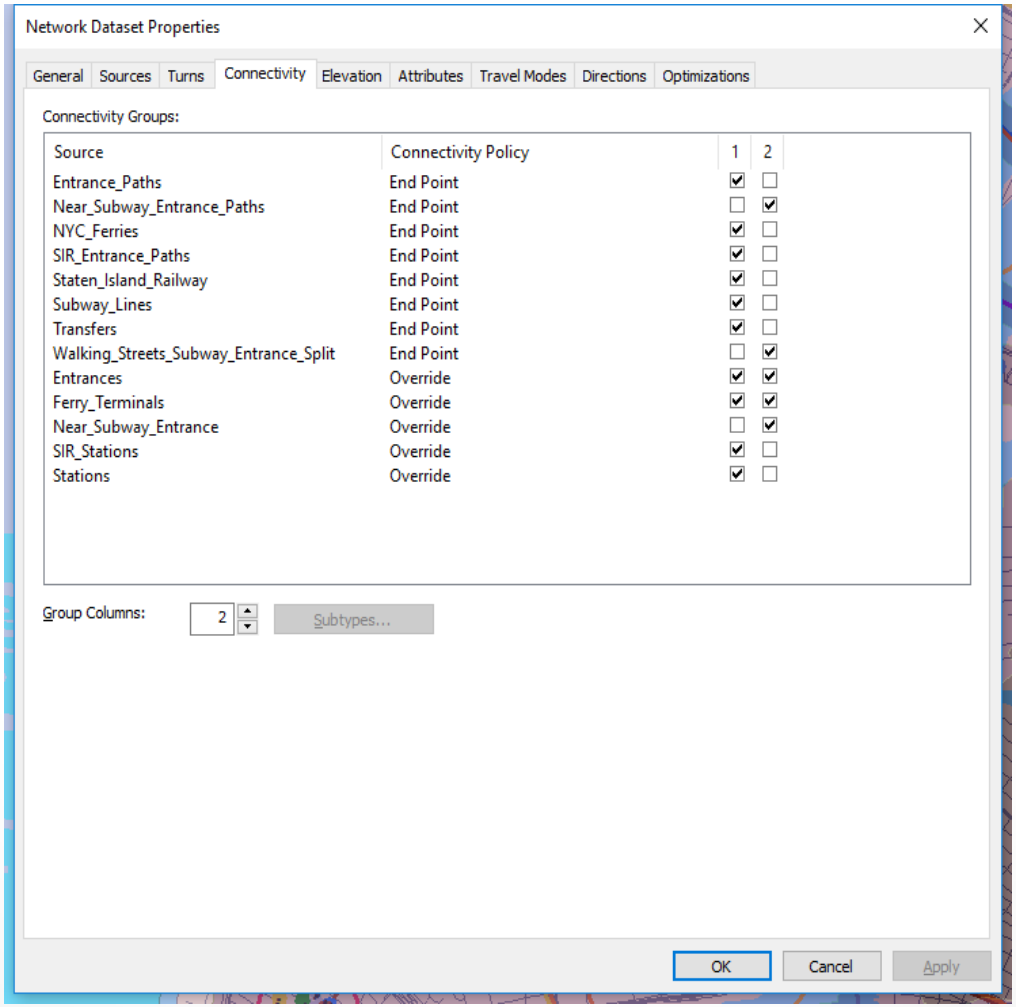

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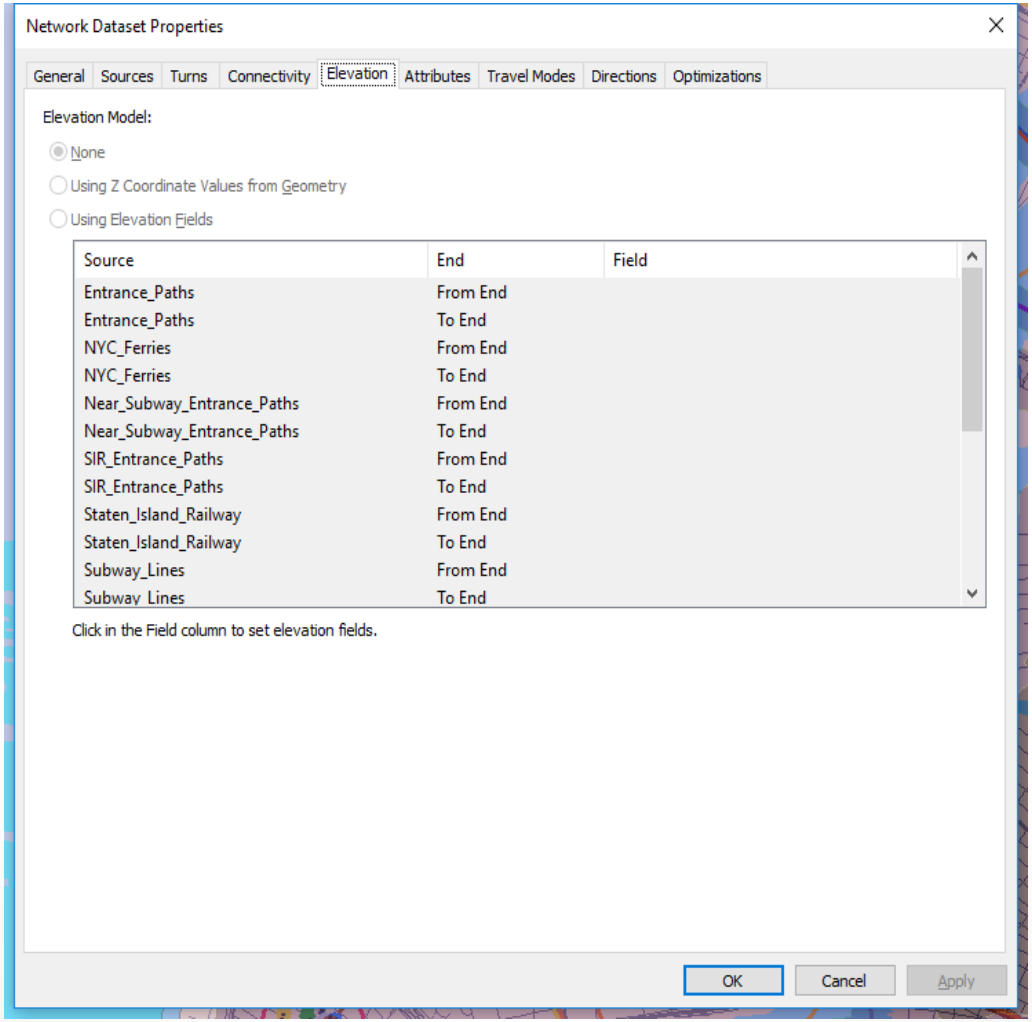

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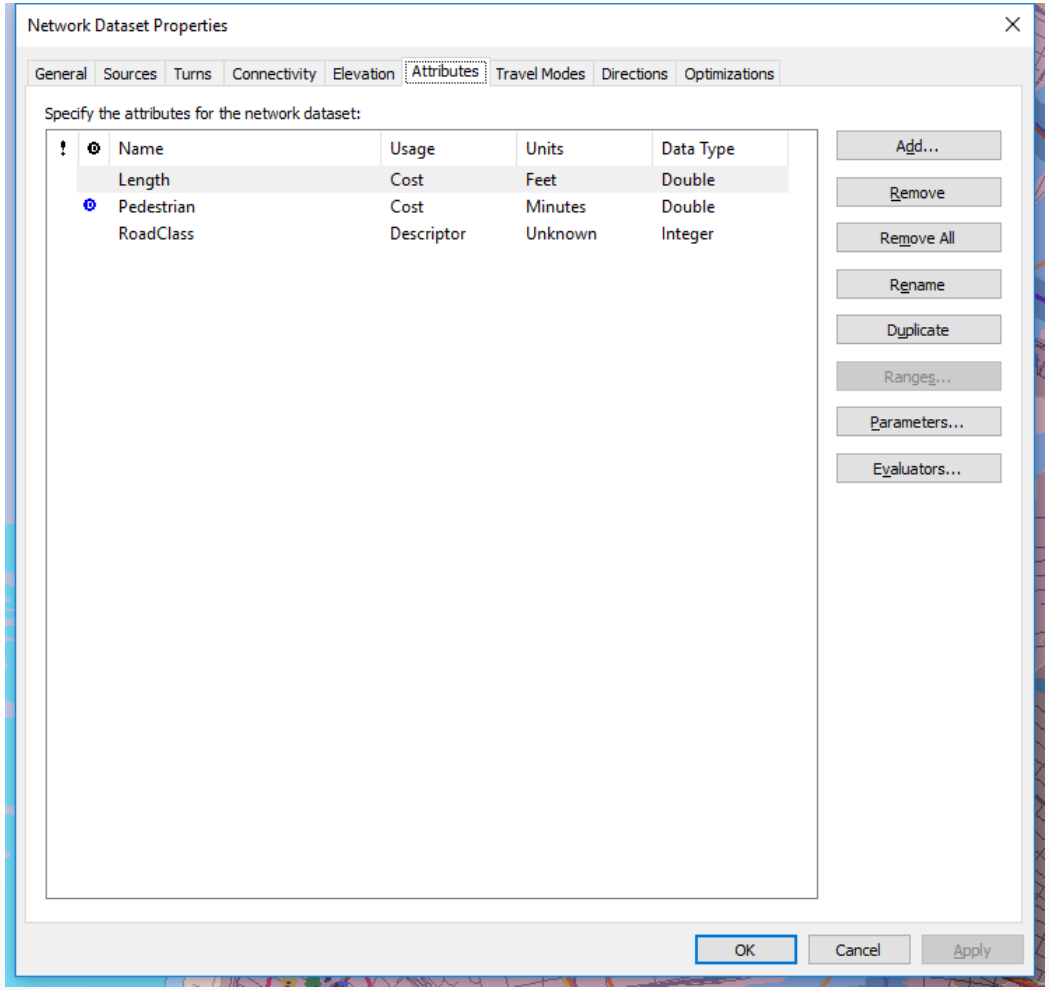

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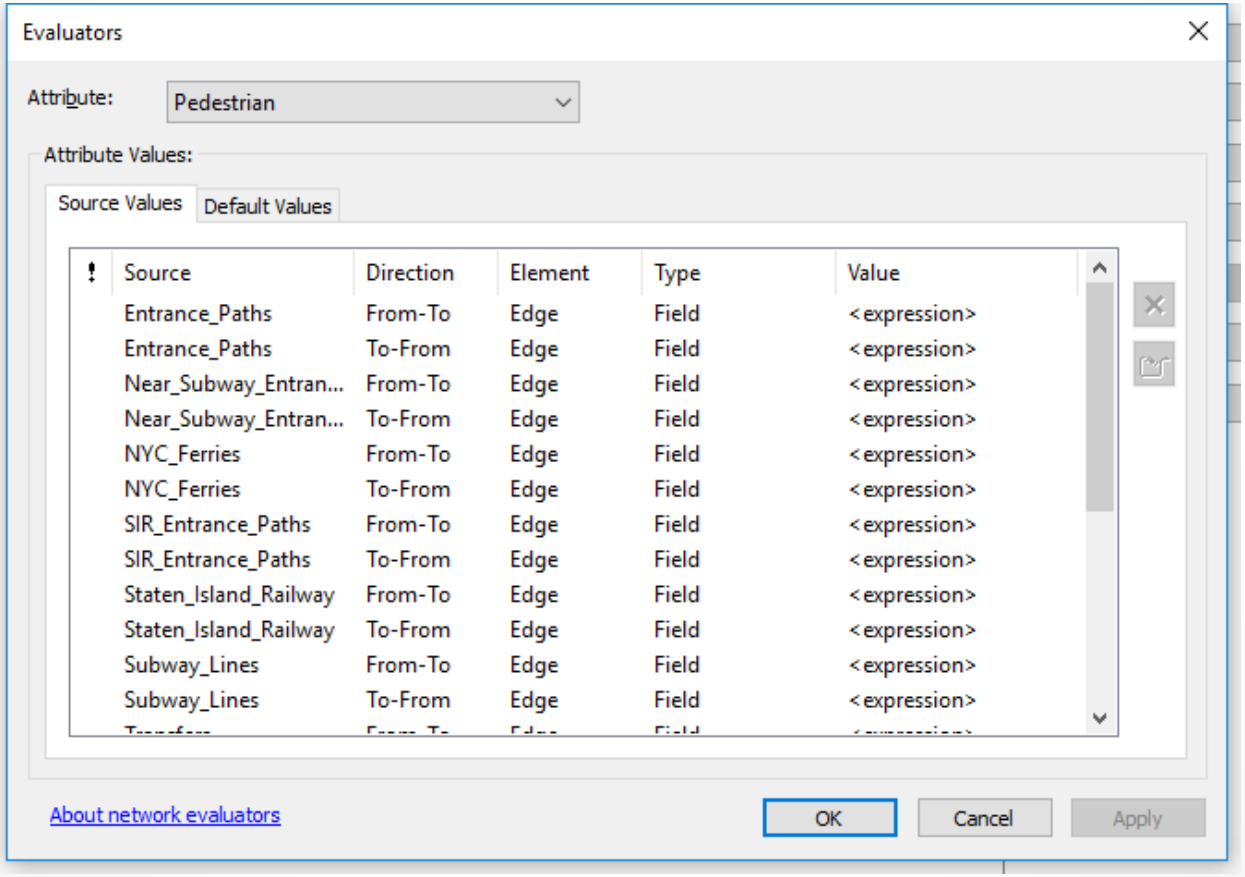

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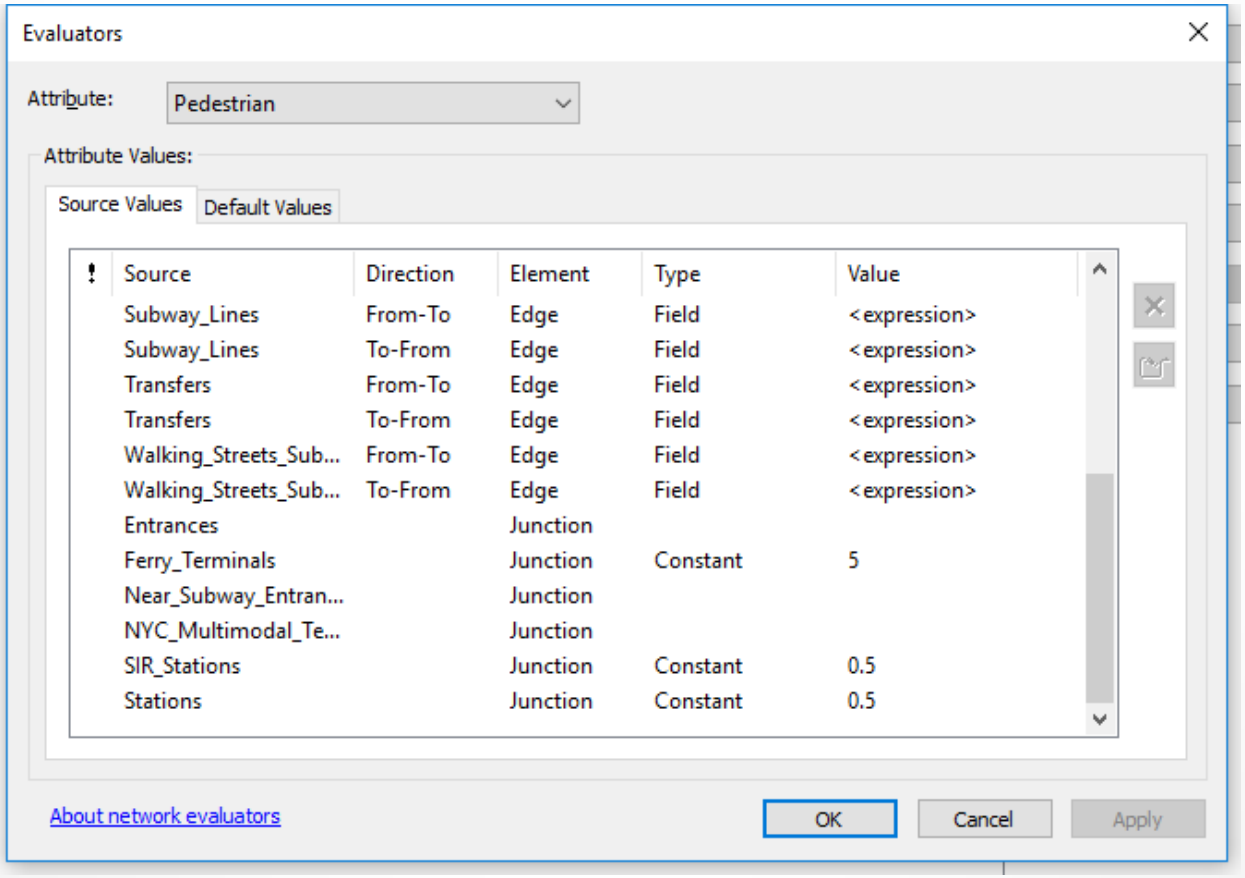

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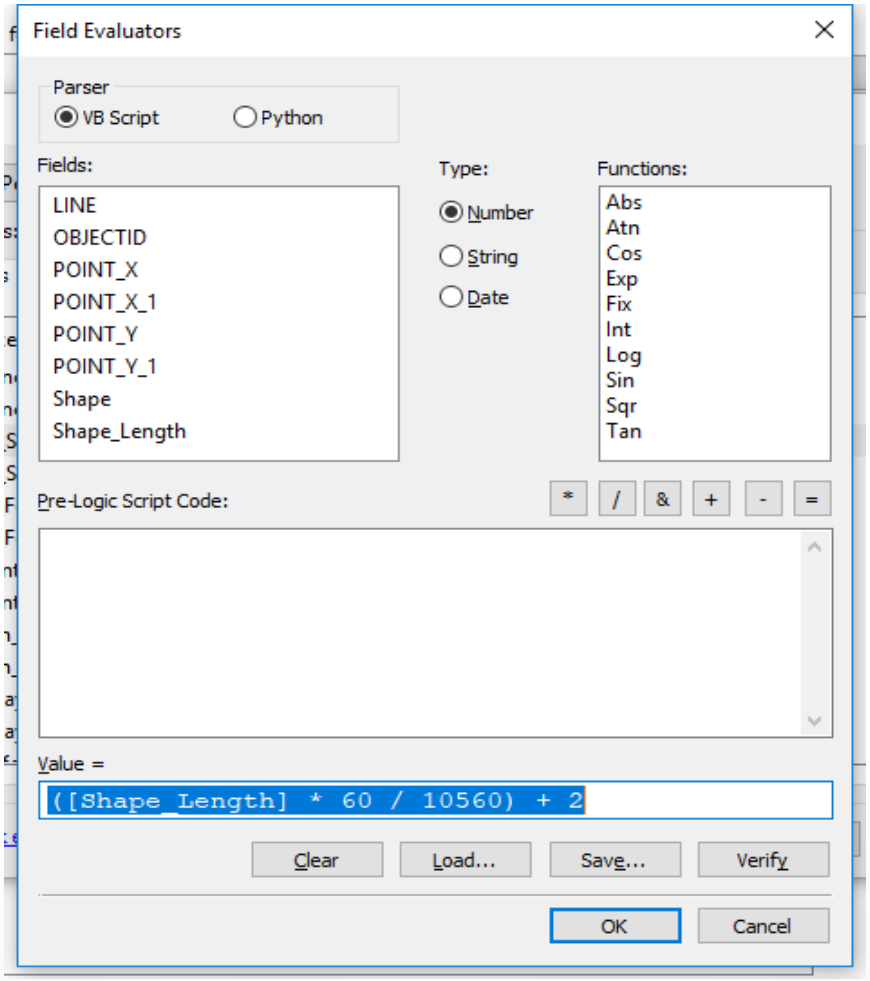

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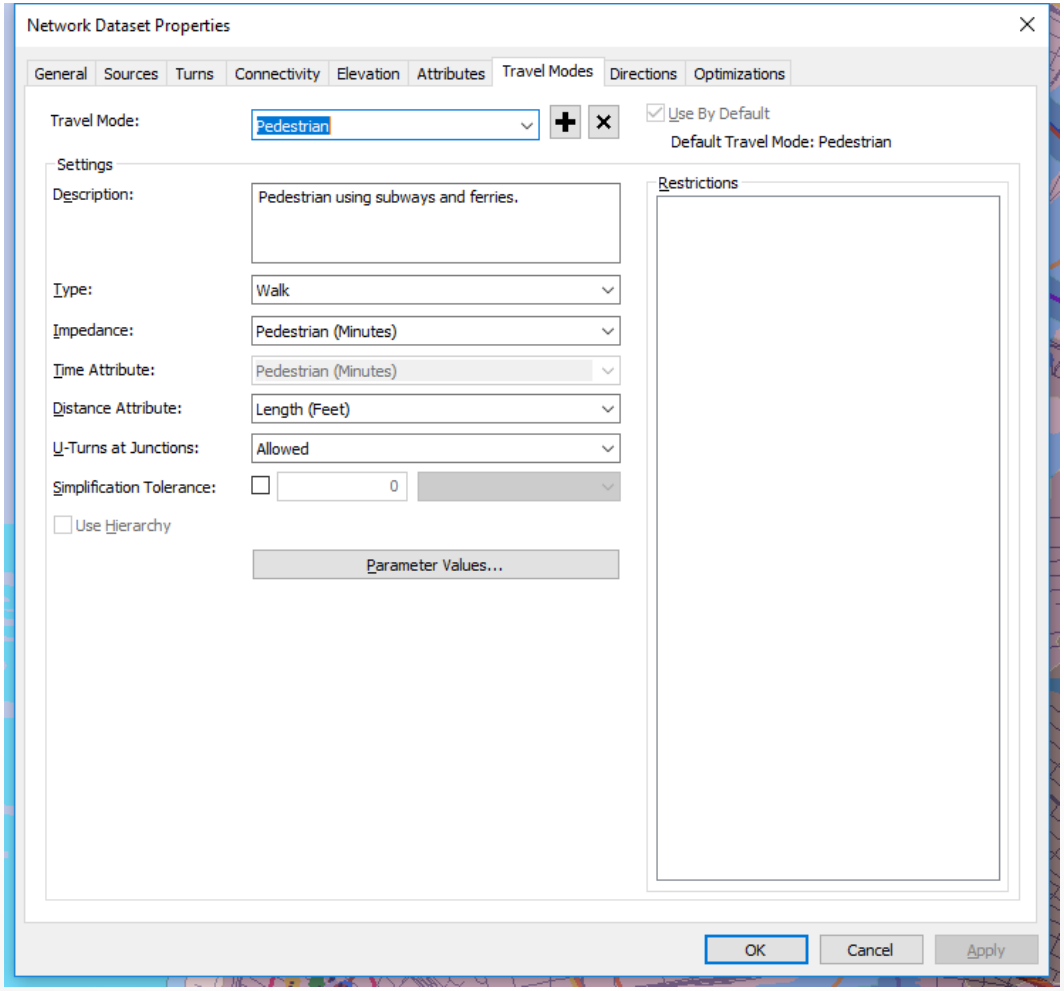

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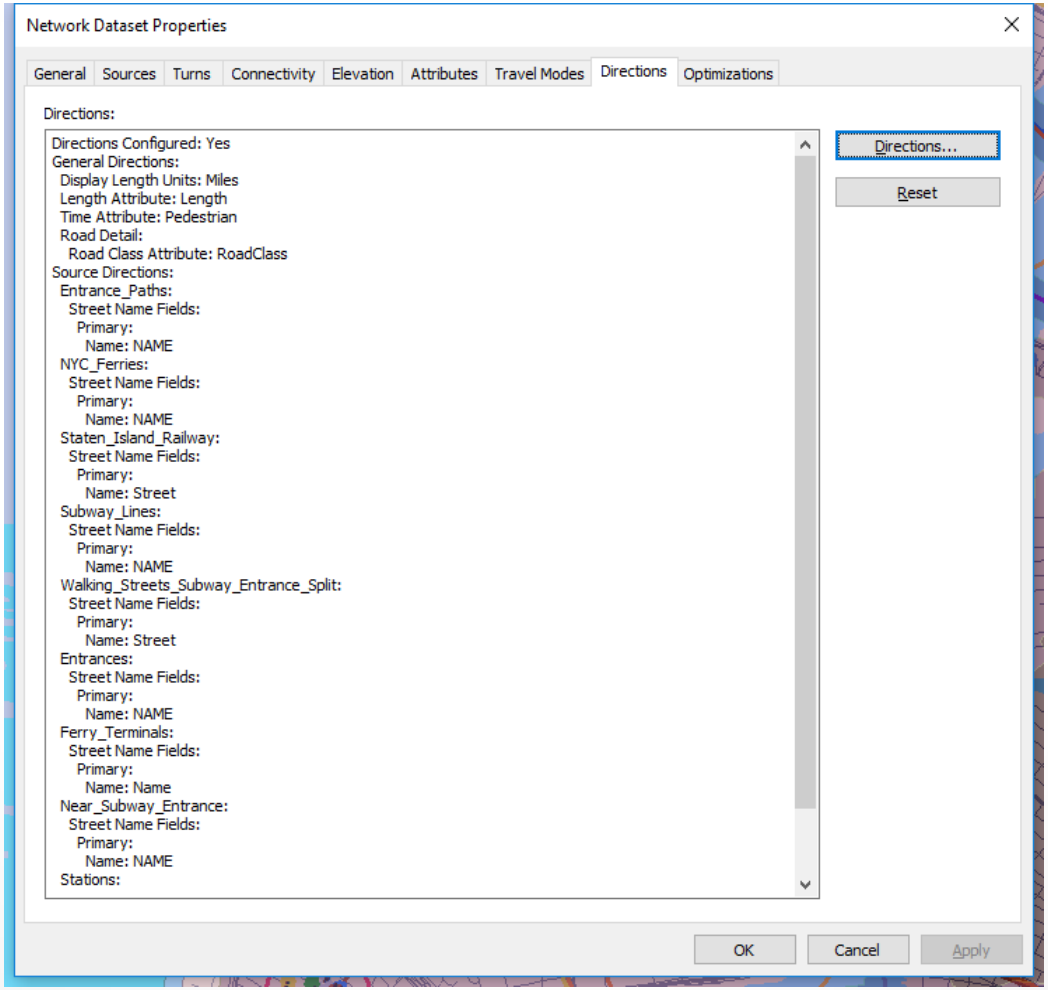

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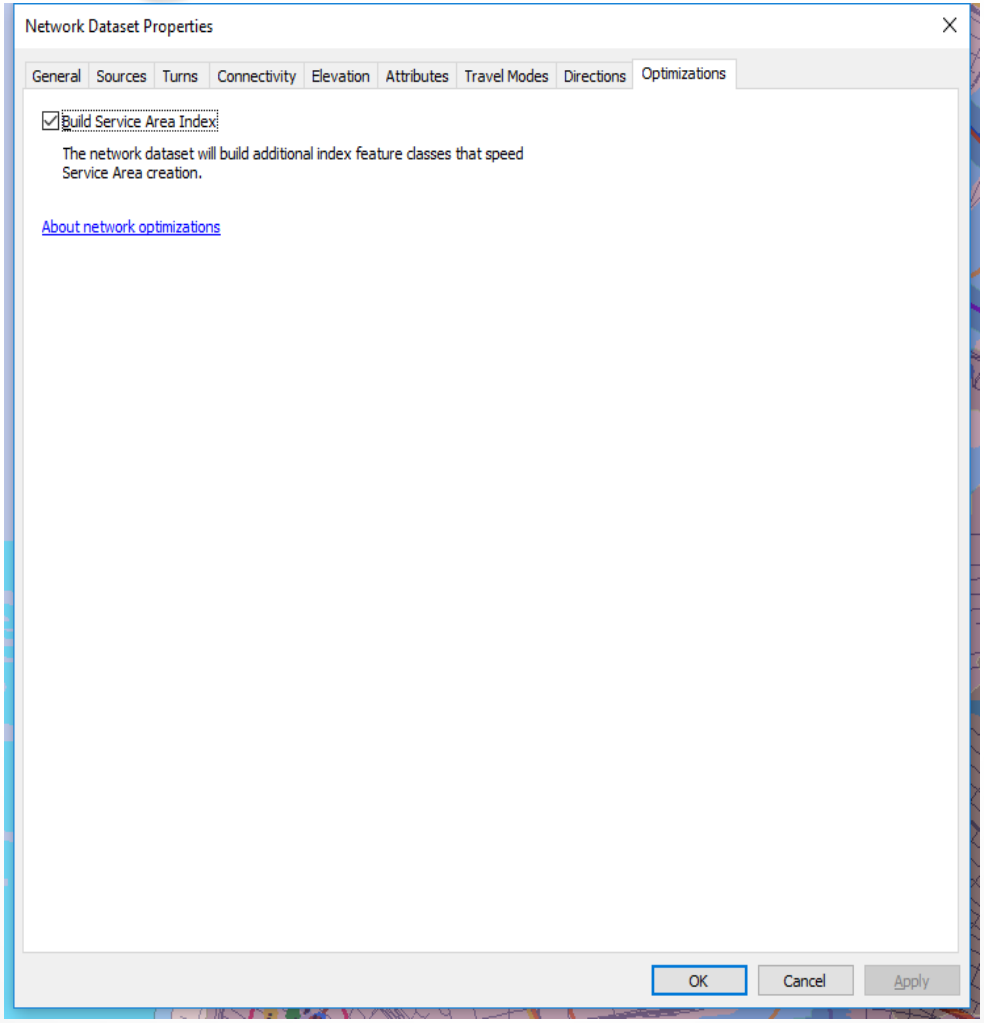
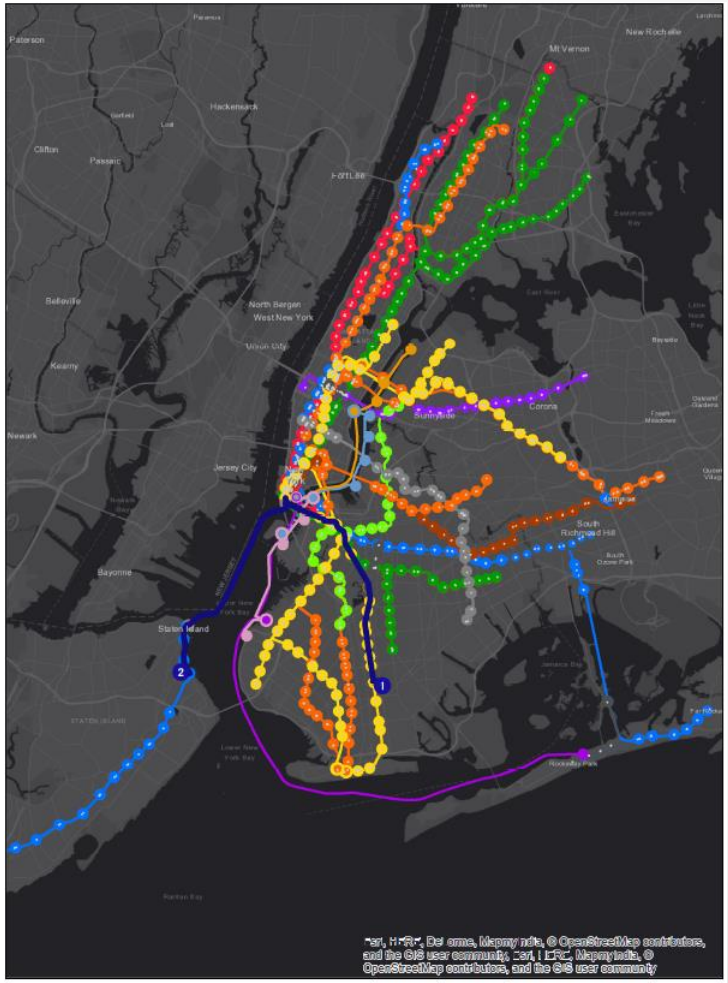


Creating Network Dataset

- Evaluator Assumptions
  - Walking Speed on Streets = 3mph
  - Walking Speed on Subway Paths = 2mph
    - For transfers, add additional 2 minutes
    - For entrance from street, add additional 2 minutes
  - Subways travel at 25 mph
    - Additional 30 seconds at each stop
  - Ferries travel at 30 mph
    - Additional 5 minutes per stop
- These evaluators gave time estimates similar to personal experience and Google Maps
  - Other sources may be used for more precision
    - Set specific routes for various times (express, rush-hour, etc.)
    - Used GTFS live data

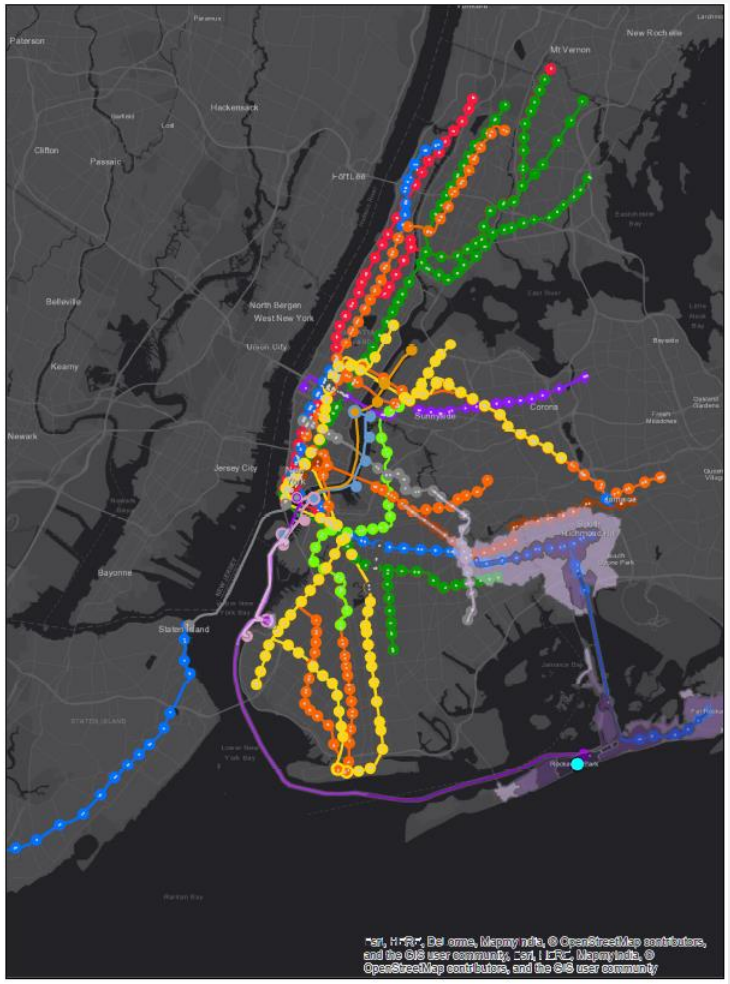
Using Network for Analysis

- Find most efficient route
  - Graphic Pick 1 - Graphic Pick 2
  - Total time: 1 hr 25 min
  - Total distance: 16 mi



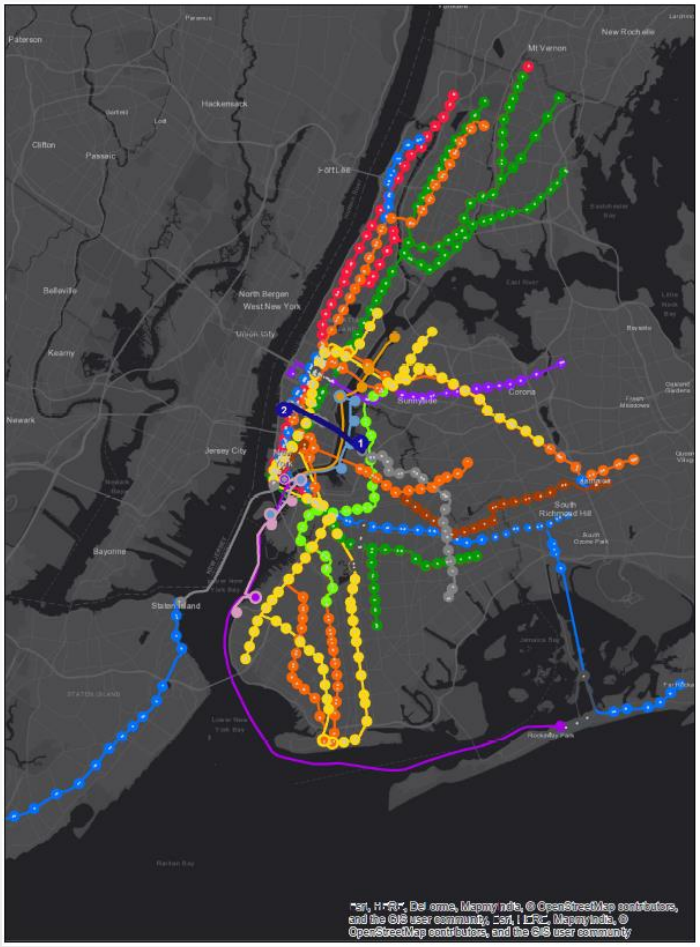
Using Network for Analysis

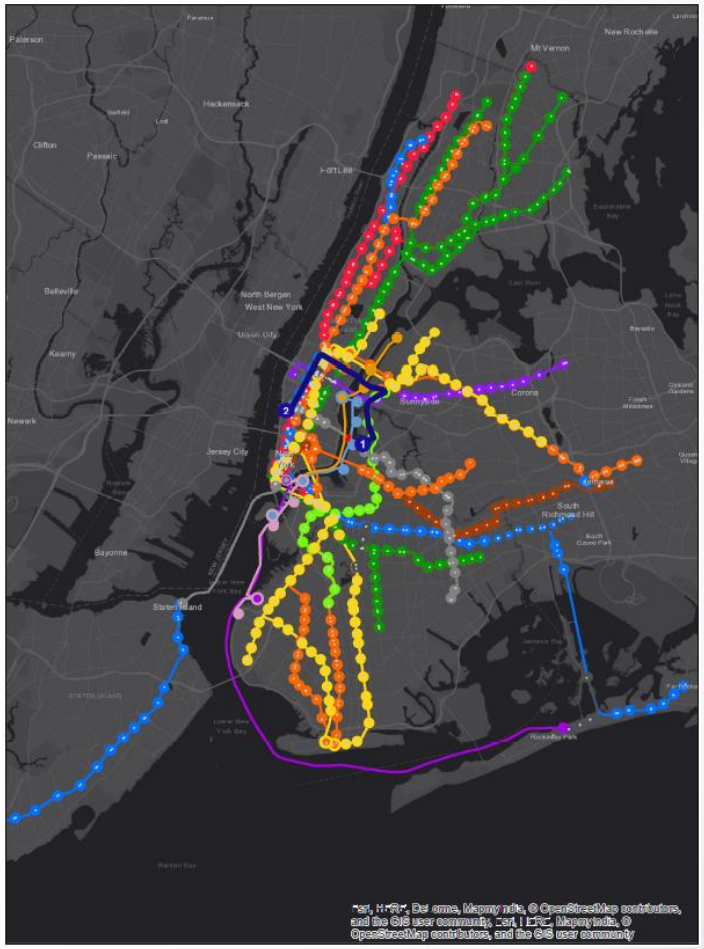
- Time of travel



Using Network for Analysis

- Difference between routes (L-Train shutdown)





Using Network for Analysis

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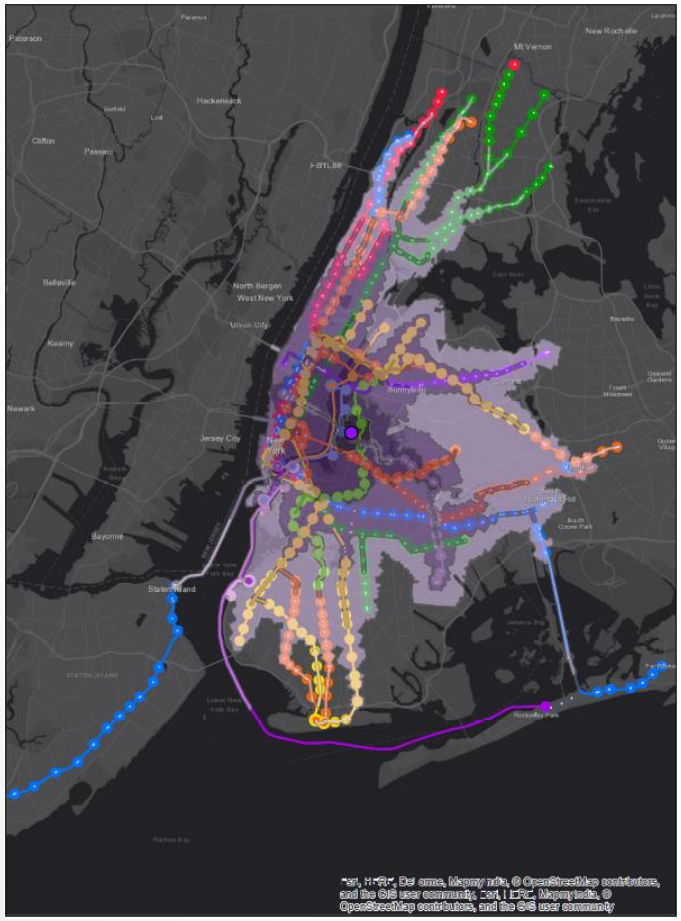

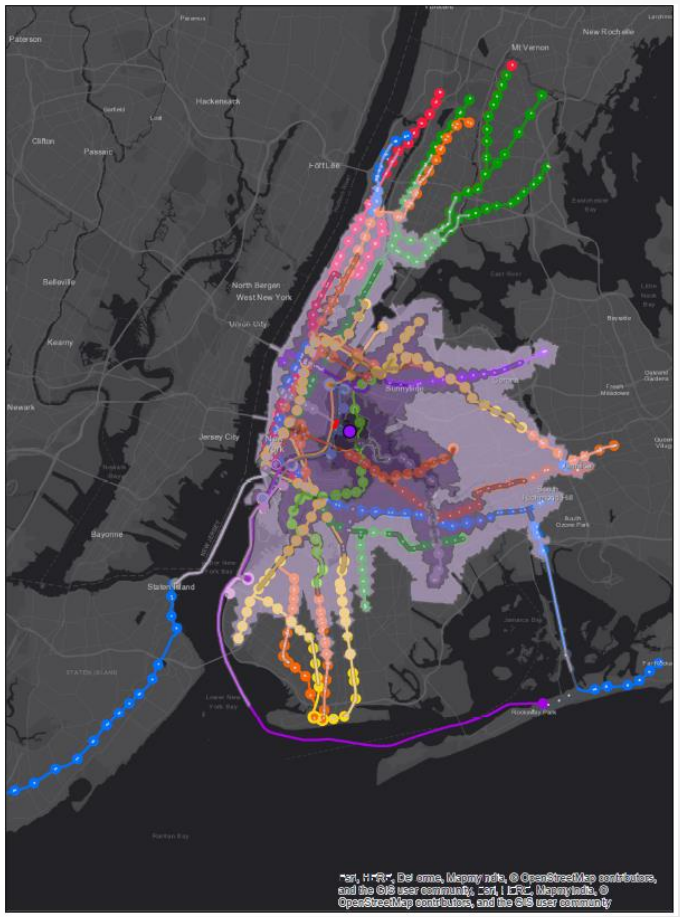

Thank You!

Questions?