

Network Analyst Creating Network Datasets

Jay Sandhu

Frank Kish

Agenda

- Preparing Street Data for use in a network dataset
 - One-way streets
 - Hierarchy
 - RoadClass attribute
- Using turns, signposts, and historical traffic data
- Parameterized attributes
- Travel Modes
- Support & Resources
- Questions

Do I need to create my own network dataset?

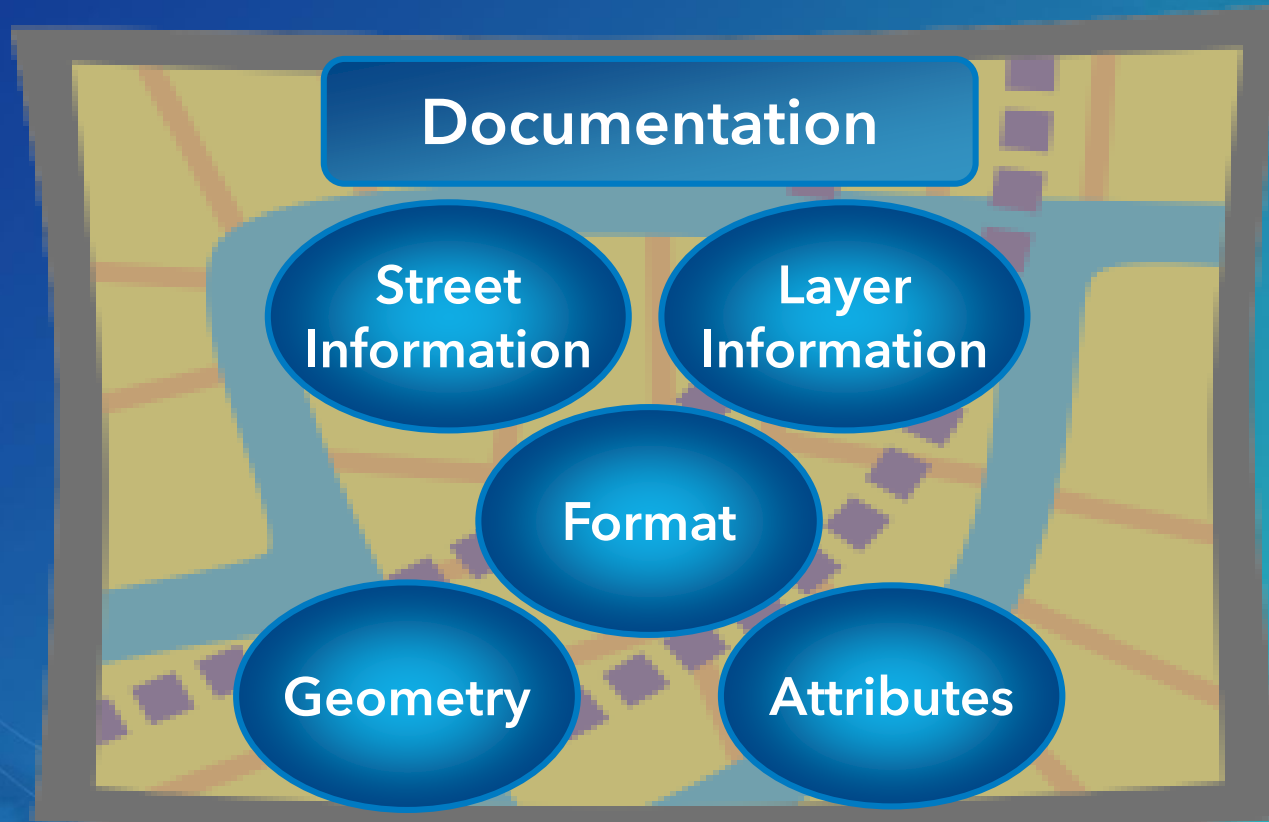
- Network analysis services on ArcGIS Online
 - Route, Closest Facility, Service Area, OD Cost Matrix, Location-Allocation and VRP
 - Generates Driving Directions
 - Analysis performed on up-to-date street data
 - Much of the world is covered
 - Incorporates historical, live, and predicted traffic where available
 - No network dataset required
 - No extension is needed, pay as go
 - Use the map viewer online

Do I need to create my own network dataset?

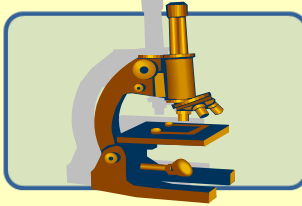
- StreetMap Premium network datasets available
 - Compressed File Geodatabase format
 - Ready to use
 - Network dataset already created
 - More information at <http://www.esri.com/data/streetmap>
- ArcGIS Editor for OpenStreetMap (OSM)
 - Free tools for downloading OSM data to a File Geodatabase
 - Create a network dataset using the Create OSM Network Dataset tool
 - More information at <http://www.esri.com/software/arcgis/extensions/openstreetmap>

Know Your Street Data

- What information can be used as a setting in the network dataset?



Know Your Street Data



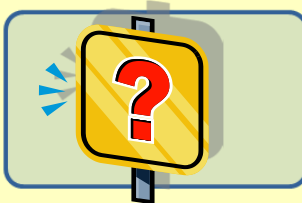
View data – geometry and attributes



Read the documentation for data



How is street geometry represented?
What street information is provided?
In what layers is this information located?
How is this information formatted?



**What information can be used as
a setting in the network dataset?**

Review – What is a Network Dataset?

Sources

- Line features
- Point features
- Turn features

Connectivity

- End Point / Any Vertex
- Z-Elevation fields
- Connectivity groups

Attributes

- Cost
- Descriptor
- Restriction
- Hierarchy

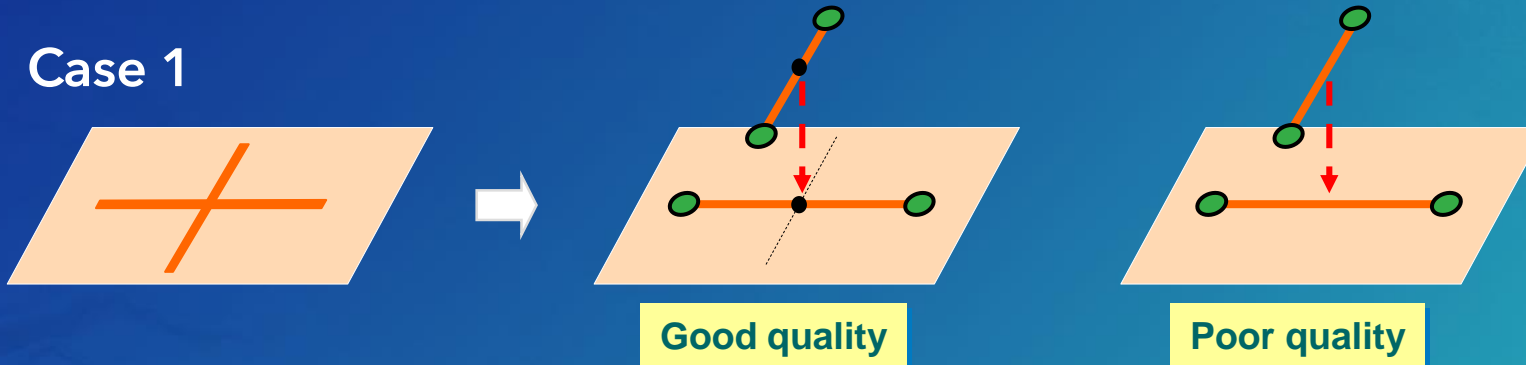
Directions

- Primary street names
- Alt. street names
- Highway shields
- Boundary field
- Signpost data

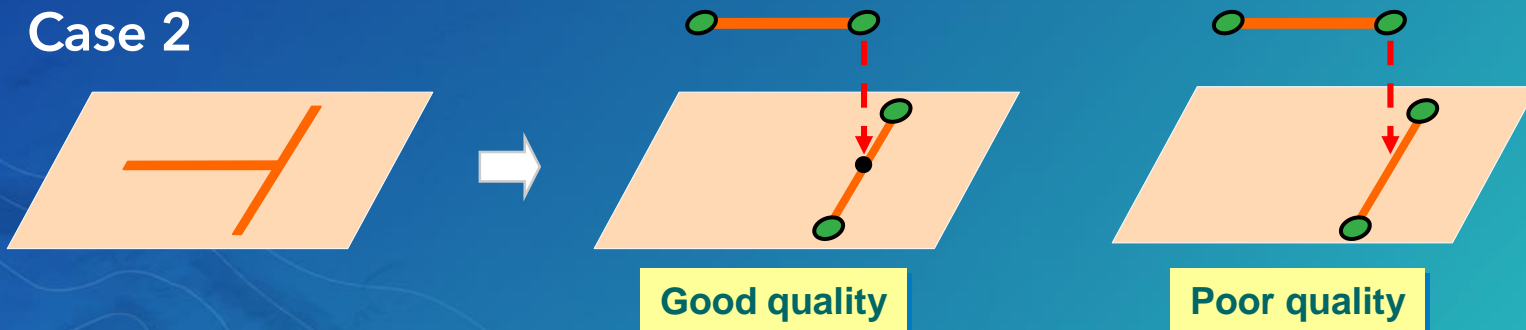
Coincident Geometries

- To enable network connectivity to be modeled
 - Points of coincidence should exist where line features cross or intersect

Case 1



Case 2



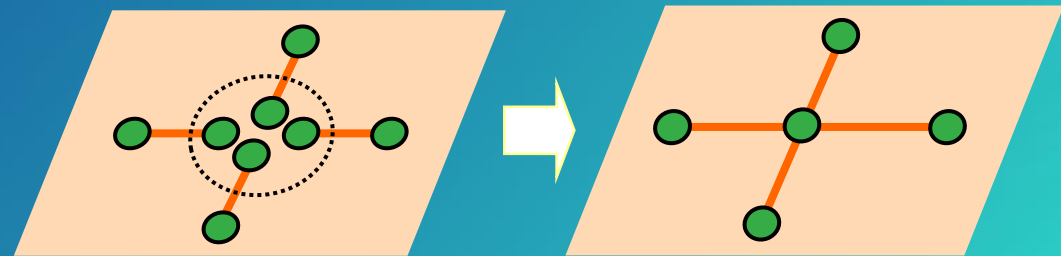
Creating Coincident Geometry

- Include sources in a Topology
- Use the Integrate Tool (Geoprocessing)
- Both methods compare features and makes all vertices within the cluster tolerance coincident

- Inserts vertices where features intersect



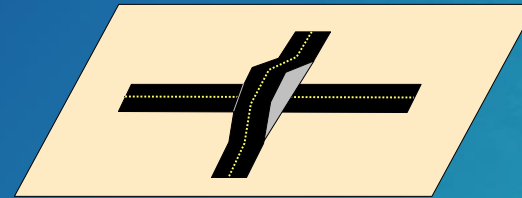
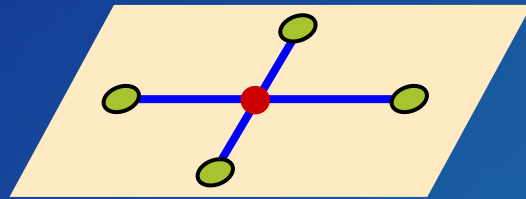
- Snaps features that are not coincident



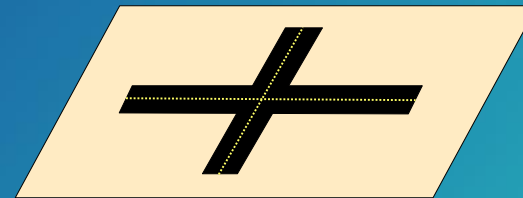
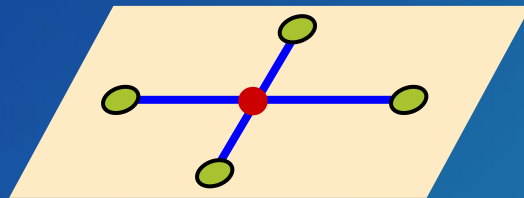
Connectivity Policies

- Edge Connectivity Policies

- End Point:



- Any Vertex:



- Junction Connectivity Policies

- Honor
 - Override

Connectivity using Elevation Fields

- Attribute that enables network dataset to represent multiple “levels” for line features
- Applied to line features with coincident endpoints
- Planar and non-planar features are supported
- Commonly called z-elevation or z-levels

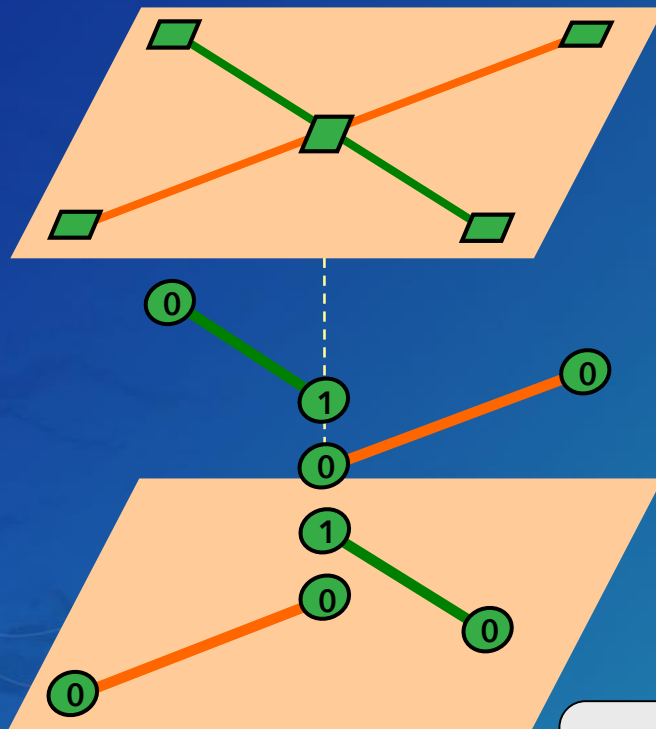




NAME	F_ZLEV	T_ZLEV
State St	0	0

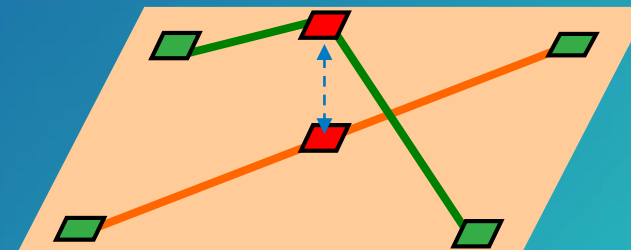
Endpoint 
Line feature 

Elevation Fields - Overpass/Underpass Scenario

- Four lines with coincident endpoints



Junction 
Endpoint 



0-1 lines do not intersect 0-0 lines at the same junction

Common Fields for Street Data

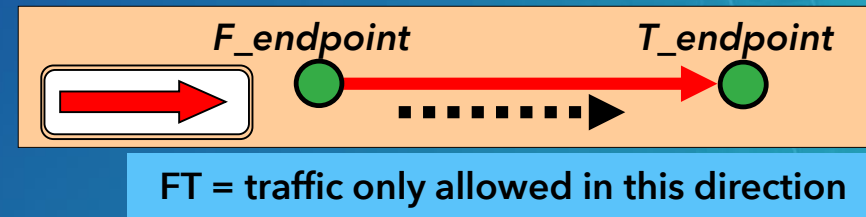
Field	Data Type	Application
Elevation	Integer	Ensures proper connectivity
Oneway	Text	Helps determine one way streets
Length	Double	Calculate the shortest route
Travel time	Double	Calculate the fastest route
Hierarchy	Integer	Ranking of streets for routing on large network datasets
Speed	Integer	May be used to calculate travel time
Road class	Integer	Classification of roads - used for formatting directions text
Street name or address data	Text	Helps generate network locations and directions

Oneway field

The most common method for creating Oneway restriction attribute

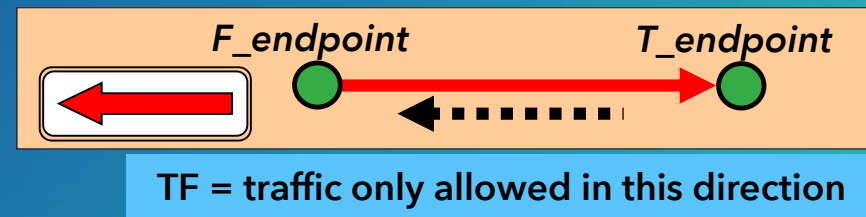
- Text field containing values: FT, TF, < >, N
 - "FT" - one-way in digitized direction

NAME	Oneway
State St	FT



- "TF" - one-way against digitized direction

NAME	Oneway
State St	TF



- <empty> - two way street

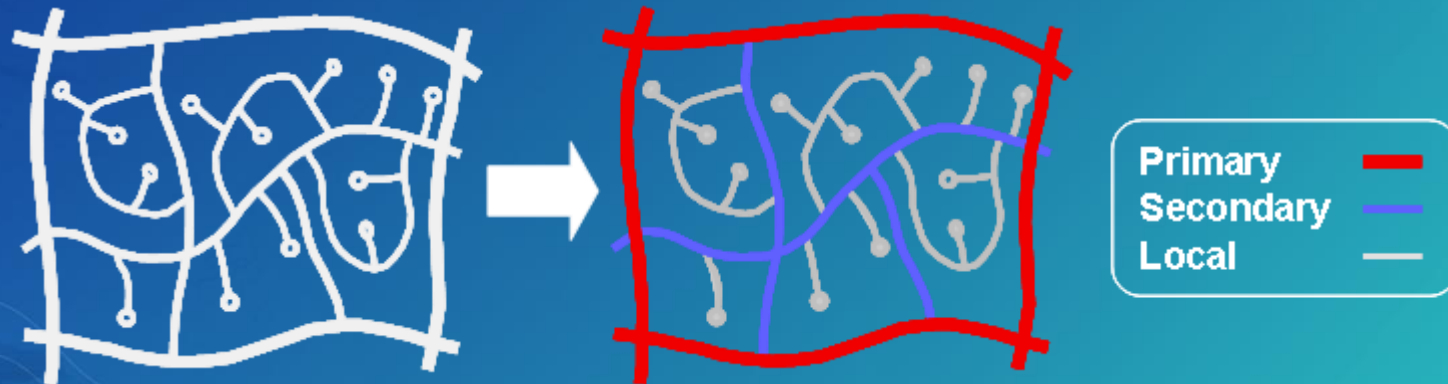
NAME	Oneway
State St	

"N" - No travel

NAME	Oneway
State St	N

Hierarchy Attribute

- Minimizes impedance while favoring higher order roads
- Basic assumption:
 - Higher order roads are “faster” (time), not necessarily “shorter” (distance)
- Hierarchy classifies network edges into multiple levels when the network dataset is built
 - Levels: lower numeric value = higher order road



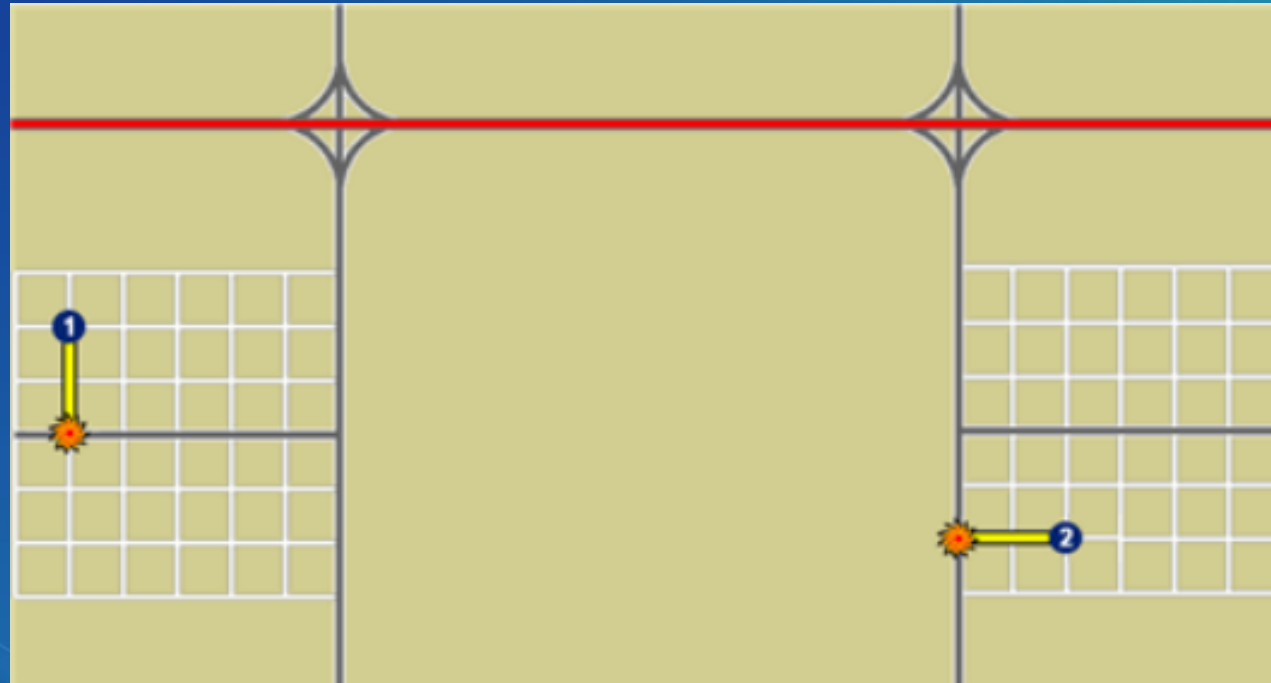
Hierarchy considerations

- Highest level needs to be connected to each other
 - Take restrictions into consideration
- Composition of highest level hierarchy dictates performance vs. accuracy of route returned
 - Larger: more optimal routes, but is slower
 - Smaller: faster performance, but route is less optimal
- Values derived from road classification (e.g., CFCC)
- Guide for Edges per Hierarchy:

Hierarchy	Regional % of Edges	National % of Edges	Edge count <i>better guide</i>
1	5%	3%	~100,000 max
2	15%	17%	Percentage of total
3	80%	80%	Percentage of total

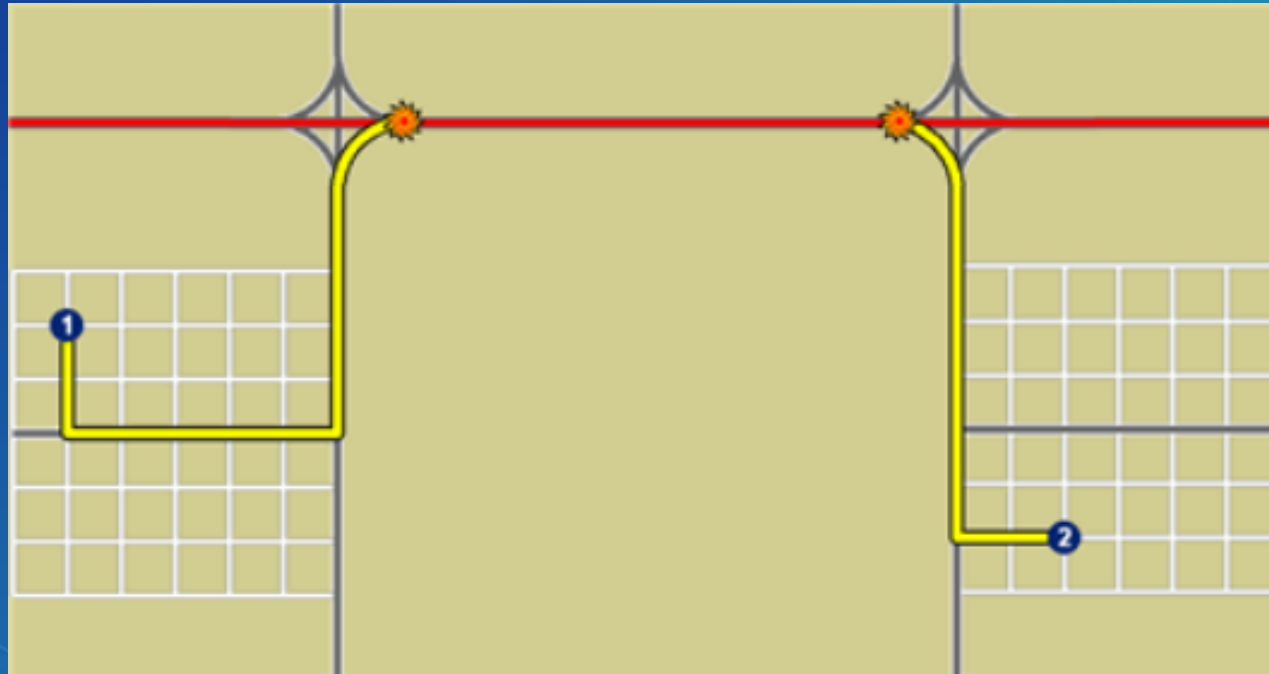
How does Hierarchy work?

- First, search Local roads for Secondary road candidates
 - Searching occurs from both starting and ending Stops



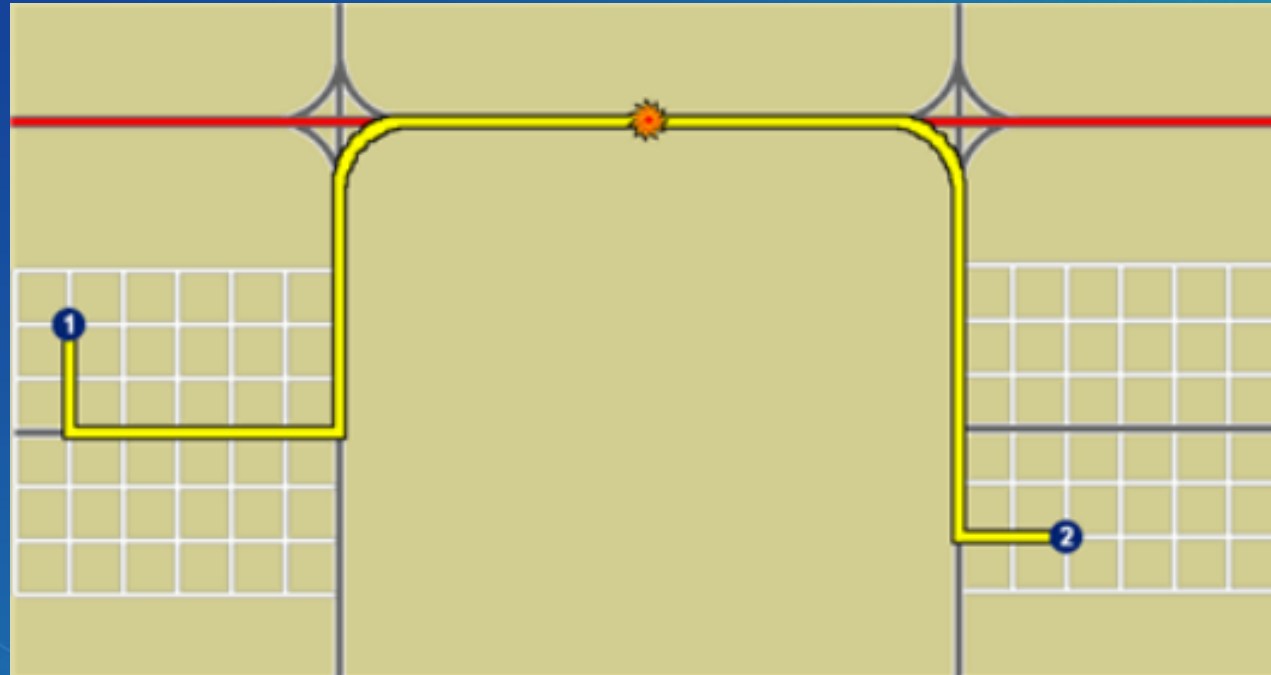
How does Hierarchy work?

- Next, search Secondary roads for Primary road candidates
 - Note: Local roads are no longer searched!



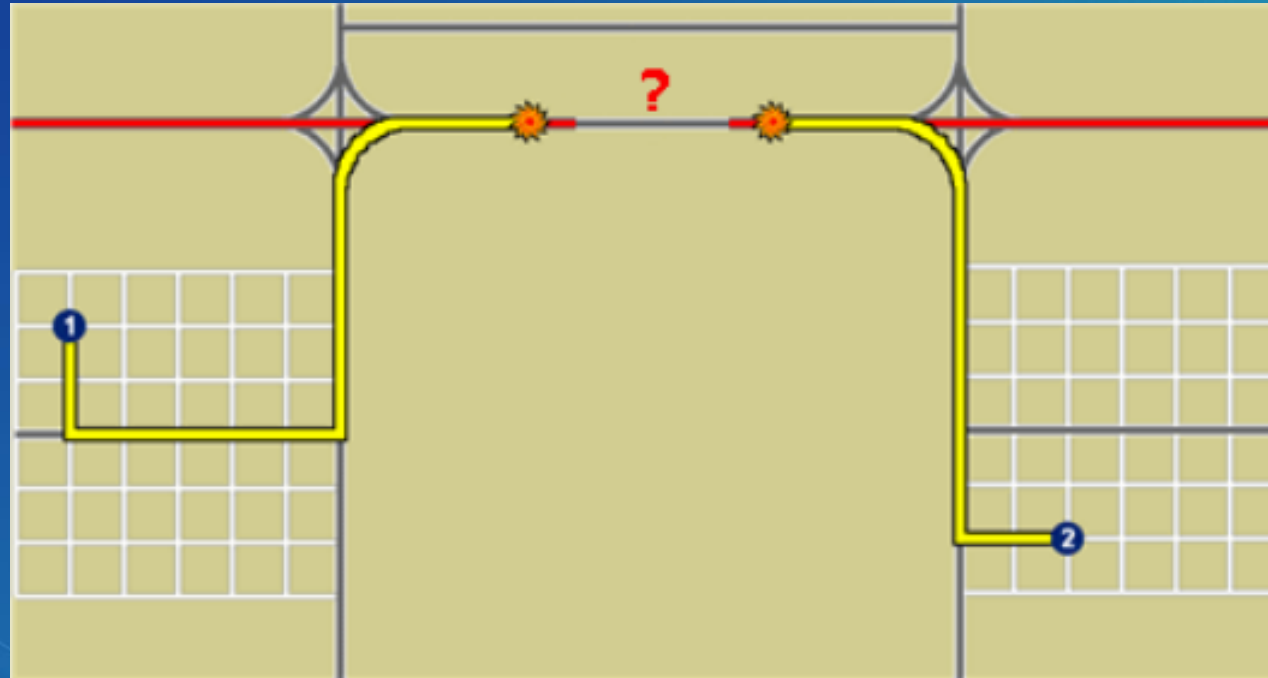
How does Hierarchy work?

- Finally, search Primary roads to complete the route
 - Note: Secondary and Local roads are no longer searched!



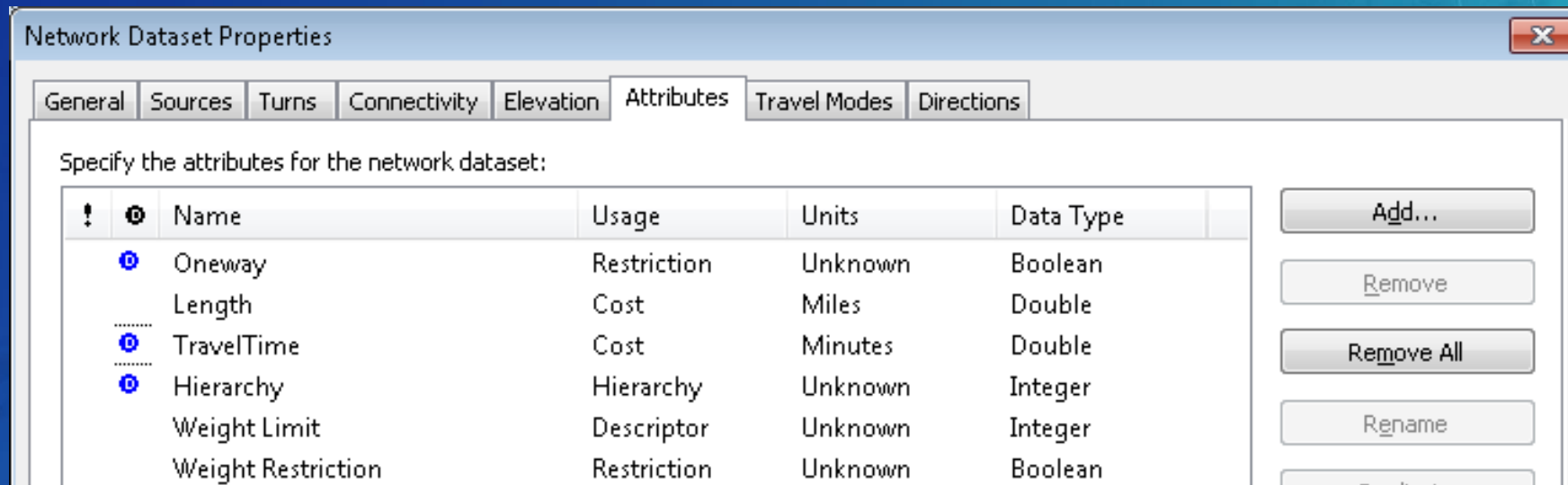
Gap in the Highest Level?

- What happens if there's a gap in the highest level of the hierarchy?



Attributes in the Network Dataset

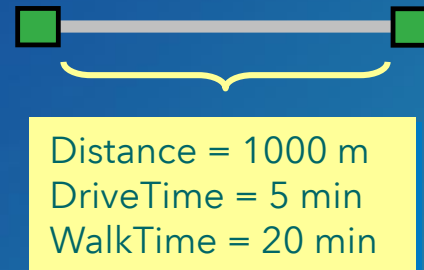
- Used to control navigation through the network



- Four types of network attributes:
 - Cost Restriction Hierarchy Descriptor

Cost Attributes

- Value that is accumulated as you traverse a network element
 - Example: Distance, driving, walking time



- Values are apportioned along edges



Restriction Attributes

- A Boolean condition that has one of two values:
 - Restricted (true) or Unrestricted (false)
- Model one-way streets, prohibited turns, etc.



Descriptor Attributes

- Description that is true for the entire length of the network element
- Used for detailed driving directions or to help derive other attributes



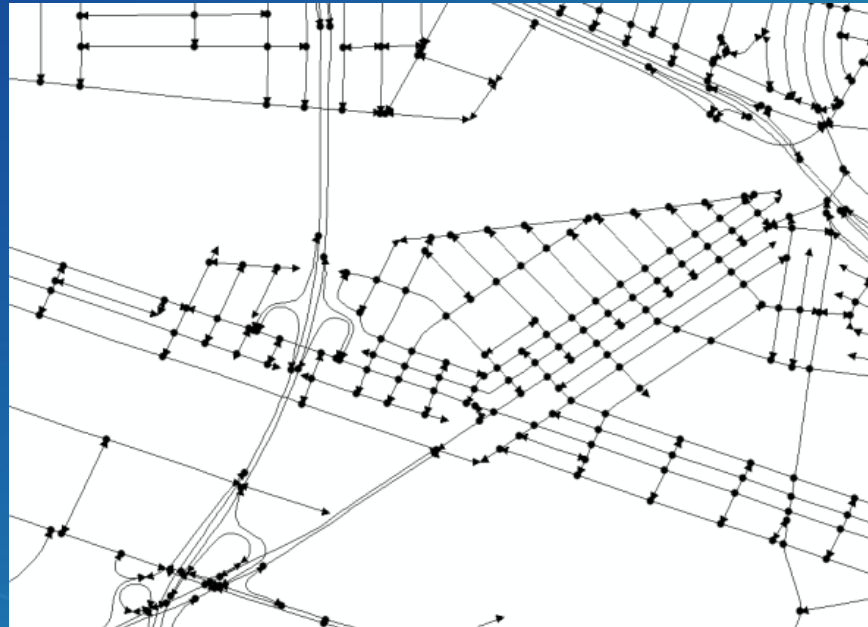
RoadClass attribute

- Used for formatting the text of driving directions
- Has no effect on network analysis
- Descriptor attribute, five possible integer values:

RoadClass Value	RoadClass Description	Driving Directions Text
1	Local road	"Turn left on Main St"
2	Limited access highway	"Go East on I-44"
3	Ramp	"Take ramp and go on US-7 N"
4	Ferry	"Take Lake Expy ferry"
5	Roundabout	"Take roundabout and proceed South on Main St"

Dissolve Network

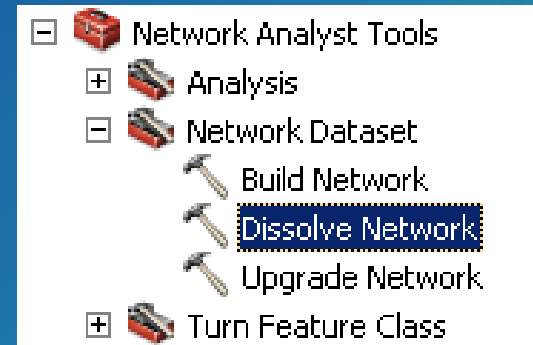
- Input: Network dataset
- Output: New network dataset with fewer line features
 - North America: 43.8 million lines --» 15.7 million lines

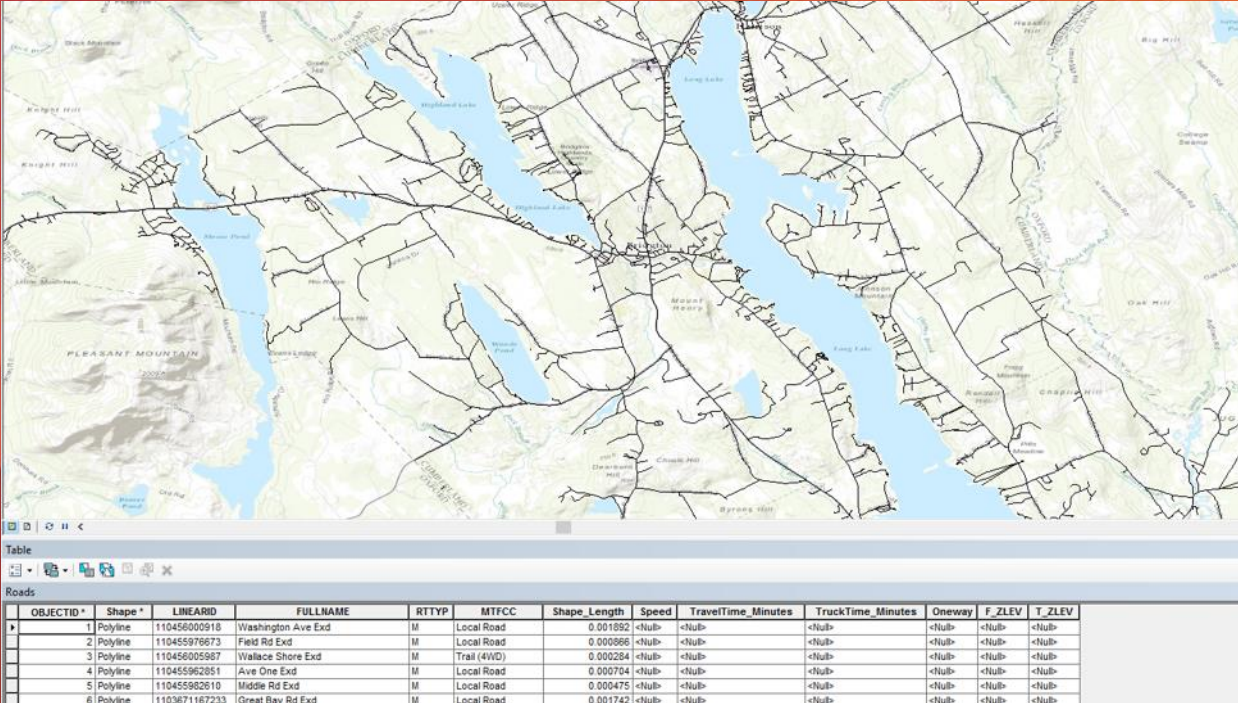


Dissolve Network

- Speeds up network analysis for large networks
- Geoprocessing tool in Network Dataset toolset

- Creates a new dissolved network dataset
 - Original network dataset is unedited
- Only fields used by network dataset are present in dissolved data
 - Use dissolved dataset for network analysis
 - Keep original data for maintenance and other work



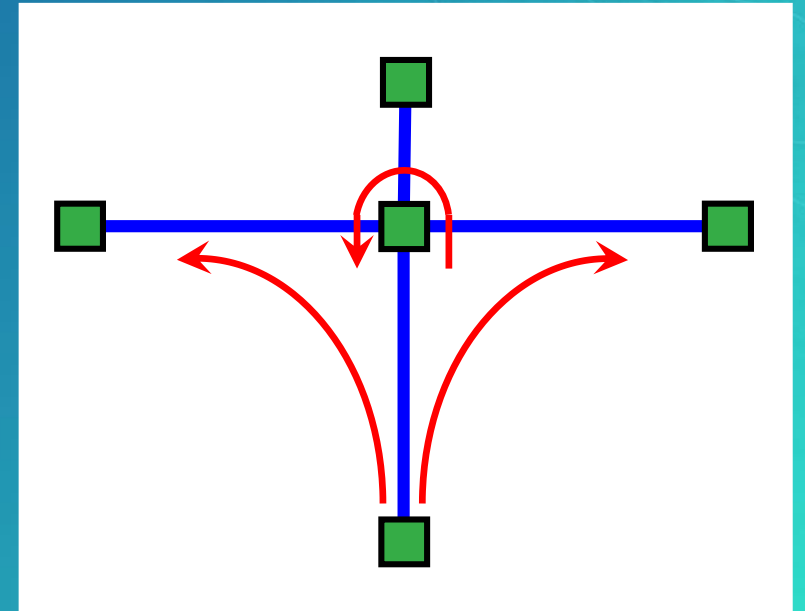


Demo

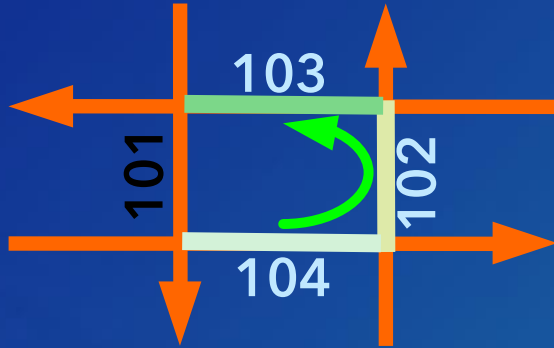
Adding fields for routing to
TIGER/LINE® street data

Turns in the Network Dataset

- Describe transitions between two or more edges
- Used to model cost and/or restrictions in the network
- Incorporating turn elements – more realistic network solver results
- Two options:
 - Turn features
 - Global (default) turns
 - Or Both



Turn Feature

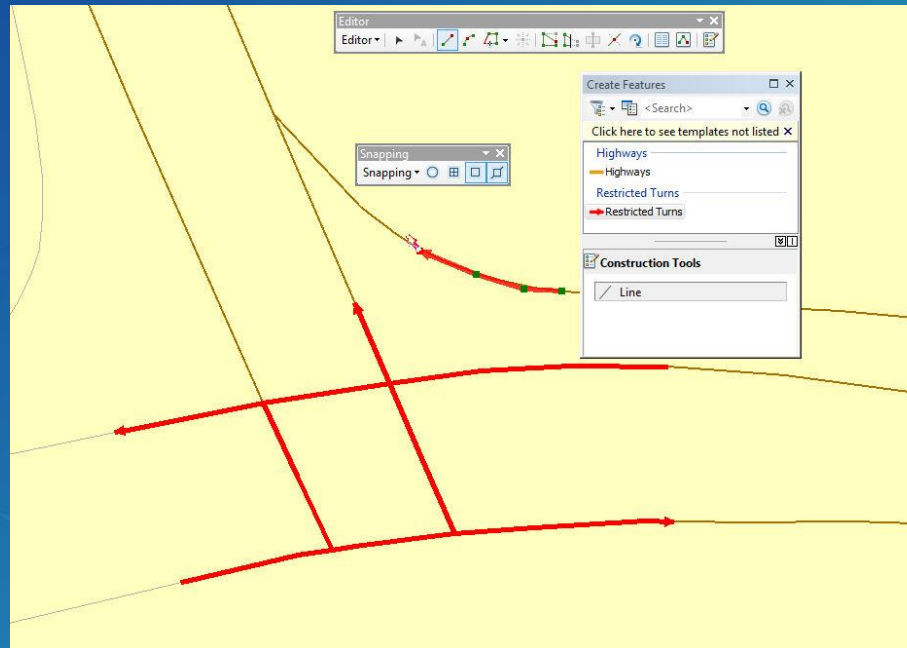


- Polyline geometry
- Turn references edges by:
 - Feature class ID
 - Feature ID
 - Position
- Turn elements built by edge references

Field	Value
ObjectID	1
Shape	<i>Polyline</i>
Edge1End	Y
Edge1FCID	42
Edge1FID	104
Edge1Pos	0.5
Edge2FCID	42
Edge2FID	102
Edge2Pos	0.6
Edge3FCID	42
Edge3FID	103
Edge3Pos	0.4

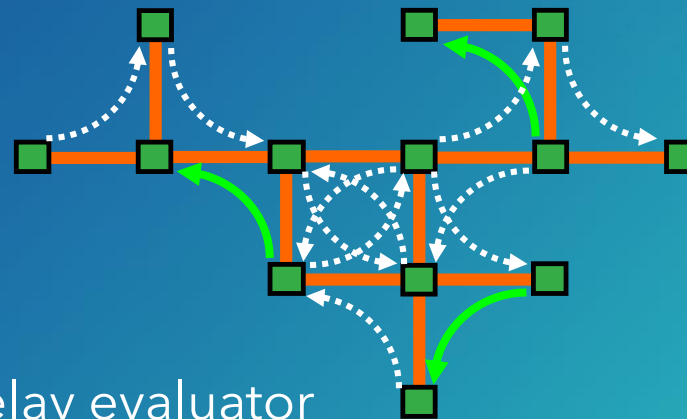
Editing Turn Features

- Create and edit turn features in the ArcMap Editor
- Edit as you would any other line feature
- Snap geometry to each street in turn
- Network dataset must be built before editing turn features



Global Turns

- For example – adding a penalty for all left turns
- Consist of:
 - All implied two-edge turning sequences in network
 - No need to create a turn feature for every two-edge sequence in the network



- Specify attribute values for global turns
- VB Script evaluator -or- Global Turn Delay evaluator

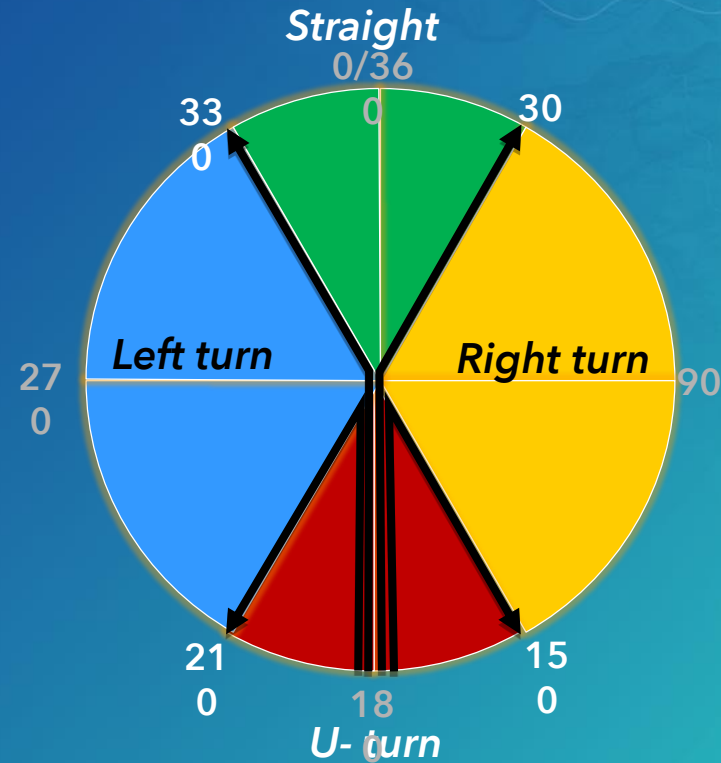
Sample VB Script code for Global Turn Penalty

Pre-Logic VB Script Code:

```
a = Turn.Angle  
If a > 210 And a < 330 Then  
    turnTime = 0.5  
Else  
    turnTime = 0  
End If
```

Expression:





turnTime




...or use the Global Turn Delay evaluator

Global Turn Delay Evaluator [?] [X]

Turn Angles

Direction	Width (degrees)
 Straight	60
 Reverse	60
 Right Turn	120
 Left Turn	120



OK
Cancel
Load From Default
Load From File...
Save To Default
Save To File...

Road Classes

Hierarchy Attribute: Hierarchy

☐ Only Show Turn Categories for Local Roads

Road Classes...

Direction	Description	Seconds
Straight	From Local To Local Road Across No Roads	0
Straight	From Local To Local Road Across Local Road	2
Straight	From Local To Local Road Across Secondary or Primary Road	15
Straight	From Local To Secondary Road	3

Signposts

- Text seen on highway signs
 - Typically includes exit number, street name, and/or destination
- Has no effect on network analysis
- Enhances text of driving directions:
 - Example: "At exit 73B, take ramp to US-421 North toward N Wilkesboro"



Signpost data - Two tables

- Signpost feature class

- Actual text on sign

Exit number	73 B
Street name(s)	US-421
Direction	North
Destination(s)	N Wilkesboro

- Signpost streets table

- Streets traversed when following the sign

Feature class ID	12
Feature ID	41
Positions	0.0 to 1.0



Adding Signposts to the Network Dataset

- Signpost tables specified in the Network Directions Properties

Network Directions Properties

General | Shields | Road Detail

Directions Settings

Display Length Units	Miles
Length Attribute	Meters
Time Attribute	Minutes
Signpost Feature Class	Signposts
Signpost Streets Table	Signposts_Streets

Street Name Fields

Source: Streets

Rank	Prefix	Prefix ...	Name	Suffix ...	Suffix	Full N...	Hwy Dir	Language
Primary			NAME					

Historical Traffic

- Travel time varies by time of day and/or day of week

- Travel at 8 AM:



- Travel at 5 PM:



- Used by Network Analyst when a Start Time is specified for the route

Historical Traffic Data – Two Tables

- Traffic Profiles Table

- Contains free-flow speed multipliers by time of day

Profile	1 am	5 am	9 am	1 pm	5 pm	9 pm
16	×1.0	×1.1	×2.3	×1.2	×1.4	×1.1

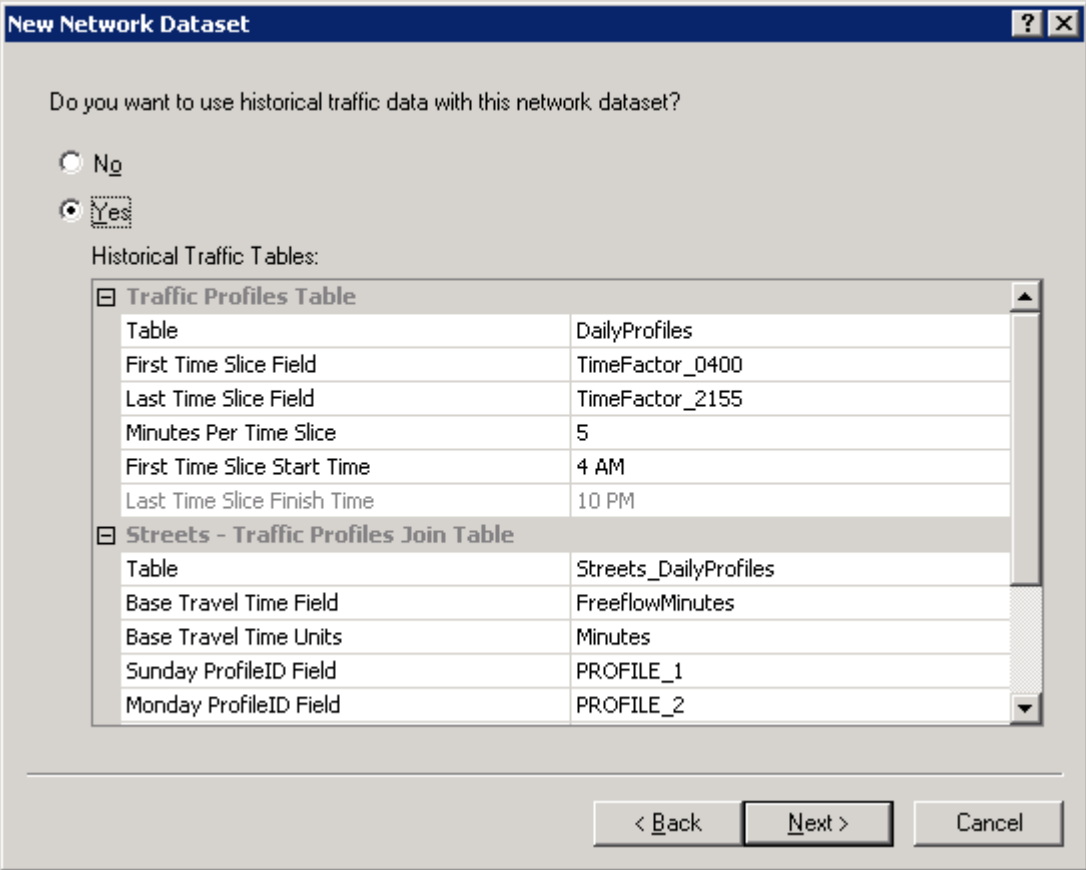
- Streets-Traffic Profiles join table

- Specifies free-flow travel times and profiles to use

Feature class ID	12
Feature ID	41
Positions	0.0 to 1.0
Free-flow travel	10 seconds
Sunday Profile	Profile 10
Monday Profile	Profile 16
...	...

Historical Traffic in the Network Dataset

- Must be specified when **creating** the network dataset



The screenshot shows a Windows-style dialog box titled "New Network Dataset". It contains a question "Do you want to use historical traffic data with this network dataset?" with two radio buttons: "No" and "Yes". The "Yes" button is selected. Below this is a section titled "Historical Traffic Tables:" which contains two expandable tables. The first table, "Traffic Profiles Table", is expanded and shows fields like "Table", "First Time Slice Field", "Last Time Slice Field", "Minutes Per Time Slice", "First Time Slice Start Time", and "Last Time Slice Finish Time" with their respective values. The second table, "Streets - Traffic Profiles Join Table", is also expanded and shows fields like "Table", "Base Travel Time Field", "Base Travel Time Units", "Sunday ProfileID Field", and "Monday ProfileID Field" with their respective values. At the bottom of the dialog are three buttons: "< Back", "Next >", and "Cancel".

Do you want to use historical traffic data with this network dataset?

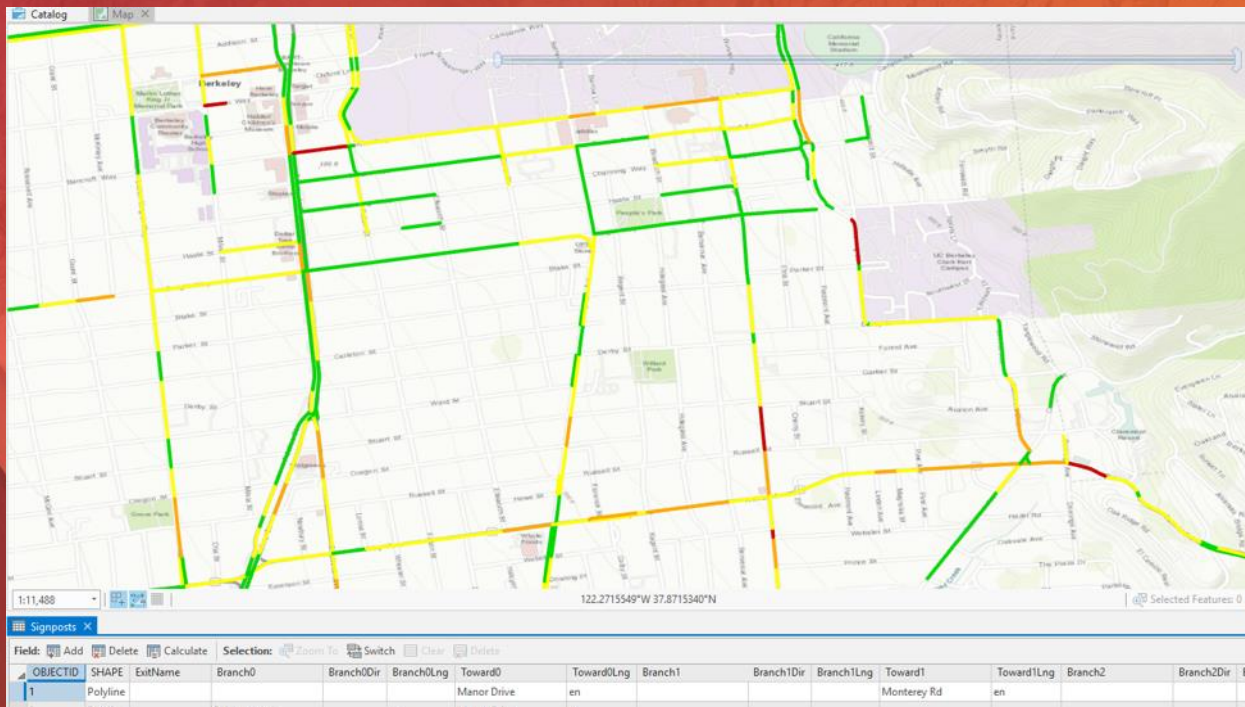
☐ No
☒ Yes

Historical Traffic Tables:

Traffic Profiles Table	
Table	DailyProfiles
First Time Slice Field	TimeFactor_0400
Last Time Slice Field	TimeFactor_2155
Minutes Per Time Slice	5
First Time Slice Start Time	4 AM
Last Time Slice Finish Time	10 PM

Streets - Traffic Profiles Join Table	
Table	Streets_DailyProfiles
Base Travel Time Field	FreeflowMinutes
Base Travel Time Units	Minutes
Sunday ProfileID Field	PROFILE_1
Monday ProfileID Field	PROFILE_2

< Back Next > Cancel



Demo

Turns, Signposts and Historical
Traffic Data &
Editing network features

Parameterized Attributes

- Network attribute that accepts a parameter
- Used to model dynamic aspect of an attribute's value

Parameterized attribute

Input Parameter value(s)

(Optional)
Other Network Attribute(s)



Example – implementing a height limit

- Requires both a Descriptor and a Restriction attribute
- Descriptor attribute
 - Specifies the height limit for each road
- Restriction attribute
 - Stores the vehicle height parameter
 - Performs the appropriate restriction
 - May use Function evaluator or VB Script evaluator
 - Function evaluator – faster & easier



Function Evaluators [?] [X]

Attribute or Constant:	Operator:	Parameter or Constant:
MaxHeight	<	VehicleHeight

OK Cancel

Pre-Logic VB Script Code

```
restricted = false  
height = ParameterValueByName("VehicleHt")  
if height > 0 then  
    maxHeight = Edge.AttributeValueByName("MaxHeight")  
    if maxHeight > 0 then  
        restricted = height > maxHeight  
    end if  
end if
```

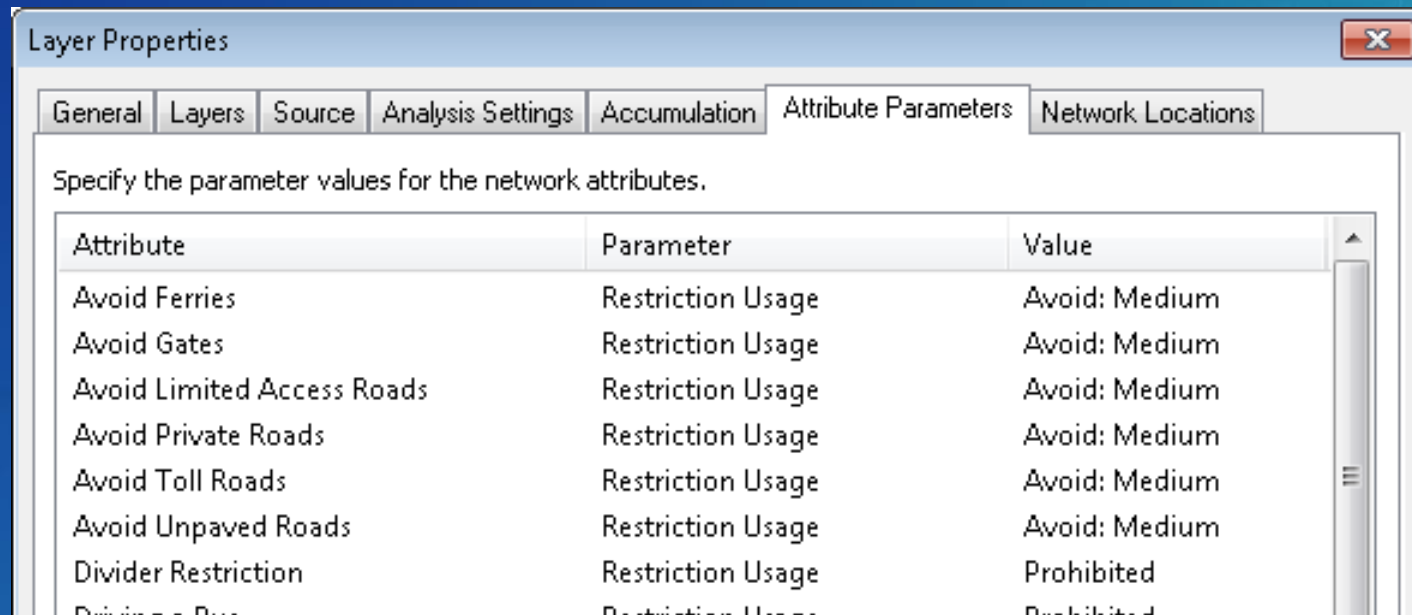
Using Height Restriction During Solve

- When using solver:
 - Set attribute restriction on Analysis Settings tab
 - Specify actual vehicle height on Attribute Parameters tab
- Solver Result:
 - Street is prohibited when the actual Vehicle Height is greater than street's MaxHeight attribute value



Restriction Usage Parameter

- Allows for restriction attributes to be used as “hard” (Prohibited) or “soft” (Avoid)



Travel Modes

In a Network dataset



What is a Travel Mode?

- A collection of settings that define how to move through a network
- A car has different driving speed and road restrictions than a bicycle
 - Different settings can be grouped together and given a name like Driving Time with a car or Walking Time
- Travel modes make it easy to use the network dataset without knowing all the details of its cost attributes, restrictions and parameters

Creating a travel Mode in a Network Dataset

- A travel mode has:
 - Name – such as Fire Truck
 - Description – a textual description
 - Type – such as Driving or Walking
- Create/update travel modes using Catalog
 - Network Dataset Properties page

The screenshot shows the 'Network Dataset Properties' dialog box with the 'Travel Modes' tab selected. The 'Travel Mode' dropdown is set to 'Trucking Distance'. The 'Settings' section includes a 'Description' text box, 'Type' (Truck), 'Impedance' (Kilometers (Kilometers)), 'Time Attribute' (TruckTravelTime (Minutes)), 'Distance Attribute' (Kilometers (Kilometers)), 'U-Turns at Junctions' (Not Allowed), and 'Simplification Tolerance' (checked, 10 Meters). The 'Restrictions' list on the right contains various options, many of which are checked, such as 'Avoid Carpool Roads', 'Avoid Express Lanes', 'Avoid Gates', 'Avoid Private Roads', 'Avoid Roads Unsuitable for Pedestrians', 'Avoid Stairways', 'Avoid Toll Roads', 'Avoid Toll Roads for Trucks', 'Avoid Truck Restricted Roads', 'Avoid Unpaved Roads', 'Avoiding a Bus', 'Driving a Taxi', 'Driving a Truck', 'Driving an Automobile', 'Driving an Emergency Vehicle', 'Height Restriction', 'Kingpin to Rear Axle Length Restriction', 'Length Restriction', 'Preferred for Pedestrians', 'Riding a Motorcycle', 'Roads Under Construction Prohibited', 'Semi or Tractor with One or More Trailers', 'Single Axle Vehicles Prohibited', and 'Tandem Axle Vehicles Prohibited'. The 'Use By Default' checkbox is unchecked, and the 'Default Travel Mode' is 'Driving Time'. The 'Use Hierarchy' checkbox is checked. The 'Parameter Values...' button is visible at the bottom of the settings section. The dialog has 'OK', 'Cancel', and 'Apply' buttons at the bottom right.

Network Dataset Properties

General Sources Turns Connectivity Elevation Traffic Attributes Travel Modes Directions Optimizations

Travel Mode: Trucking Distance + -

☐ Use By Default
Default Travel Mode: Driving Time

Settings

Description: Models basic truck travel by preferring designated truck routes, and finds solutions that optimize travel distance. Routes must obey one-way roads, avoid illegal turns, and so on.

Type: Truck

Impedance: Kilometers (Kilometers)

Time Attribute: TruckTravelTime (Minutes)

Distance Attribute: Kilometers (Kilometers)

U-Turns at Junctions: Not Allowed

Simplification Tolerance: ☒ 10 Meters

☒ Use Hierarchy

Parameter Values...

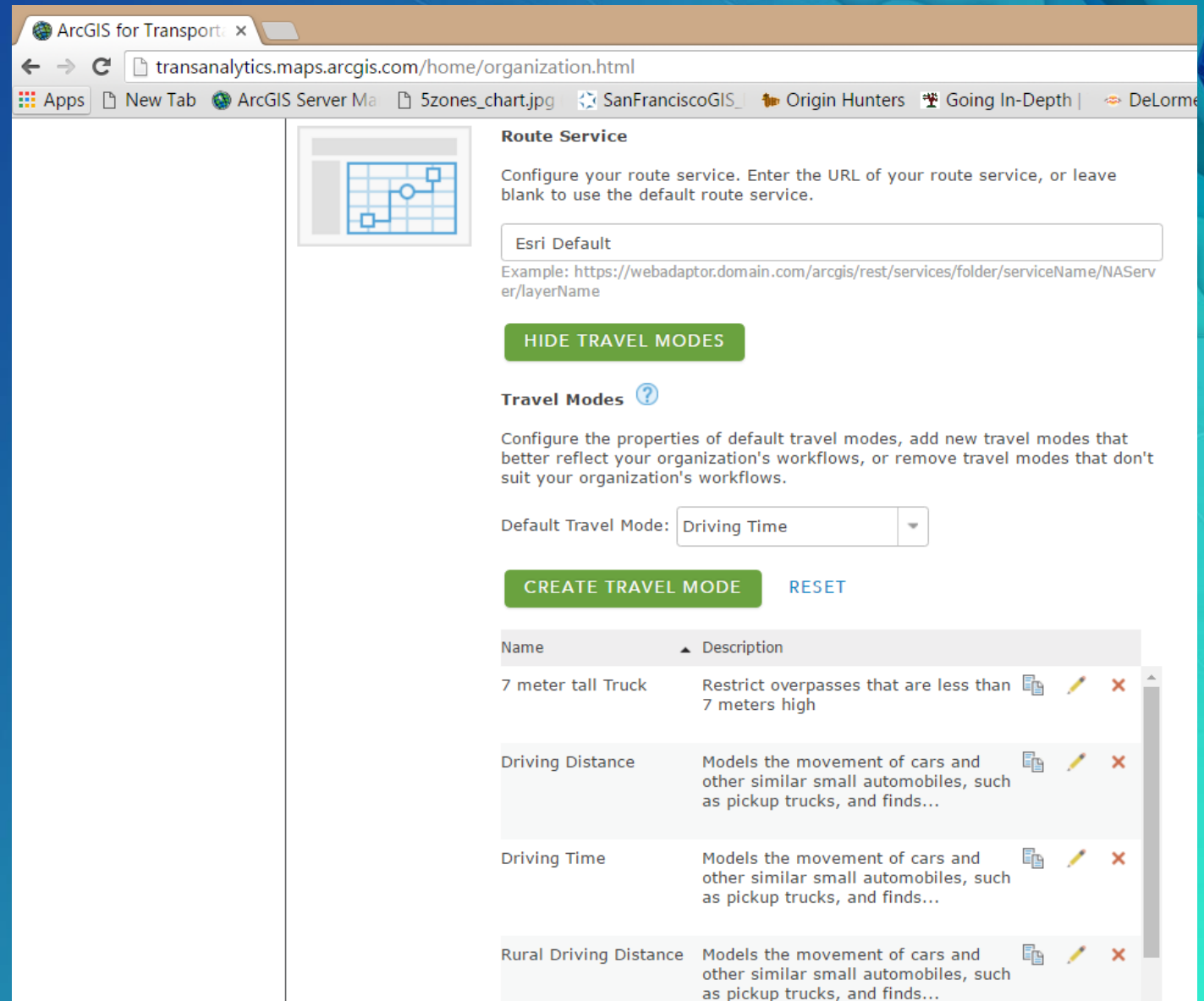
Restrictions

- ☐ Any Hazmat Prohibited
- ☒ Avoid Carpool Roads
- ☒ Avoid Express Lanes
- ☐ Avoid Ferries
- ☒ Avoid Gates
- ☐ Avoid Limited Access Roads
- ☒ Avoid Private Roads
- ☐ Avoid Roads Unsuitable for Pedestrians
- ☐ Avoid Stairways
- ☐ Avoid Toll Roads
- ☐ Avoid Toll Roads for Trucks
- ☒ Avoid Truck Restricted Roads
- ☒ Avoid Unpaved Roads
- ☐ Axle Count Restriction
- ☐ Driving a Bus
- ☐ Driving a Delivery Vehicle
- ☐ Driving a Taxi
- ☒ Driving a Truck
- ☐ Driving an Automobile
- ☐ Driving an Emergency Vehicle
- ☐ Height Restriction
- ☐ Kingpin to Rear Axle Length Restriction
- ☐ Length Restriction
- ☐ Preferred for Pedestrians
- ☐ Riding a Motorcycle
- ☒ Roads Under Construction Prohibited
- ☐ Semi or Tractor with One or More Trailers
- ☐ Single Axle Vehicles Prohibited
- ☐ Tandem Axle Vehicles Prohibited

OK Cancel Apply

Creating a Travel Mode in ArcGIS Online

- Organizational administrators create and update travel modes for ArcGIS Online



The screenshot displays the ArcGIS for Transport web interface. The browser address bar shows the URL `transanalytics.maps.arcgis.com/home/organization.html`. The interface is divided into two main sections: 'Route Service' and 'Travel Modes'.

Route Service

Configure your route service. Enter the URL of your route service, or leave blank to use the default route service.

Esri Default

Example: `https://webadaptor.domain.com/arcgis/rest/services/folder/serviceName/NAServer/layerName`

HIDE TRAVEL MODES

Travel Modes ?

Configure the properties of default travel modes, add new travel modes that better reflect your organization's workflows, or remove travel modes that don't suit your organization's workflows.

Default Travel Mode: Driving Time

CREATE TRAVEL MODE **RESET**

Name	Description	
7 meter tall Truck	Restrict overpasses that are less than 7 meters high	
Driving Distance	Models the movement of cars and other similar small automobiles, such as pickup trucks, and finds...	
Driving Time	Models the movement of cars and other similar small automobiles, such as pickup trucks, and finds...	
Rural Driving Distance	Models the movement of cars and other similar small automobiles, such as pickup trucks, and finds...	

Creating a Travel Mode in Network Dataset in ArcGIS Pro

- Create/update travel modes in Pro
 - Network Dataset Properties page

Layer Properties: Routing_ND

General
Metadata
Source
Elevation
Cache
Travel Modes

Driving Time

Description
Models the movement of cars and other similar small automobiles, such as pickup trucks, to optimize travel time. Travel obeys one-way roads, avoids illegal turns, and follows the direction of traffic. Dynamic travel speeds based on traffic are used where it is available when driving. 688 characters remaining

Type
Driving

Costs

Impedance
TravelTime minutes

Time Attribute
TravelTime minutes

Distance Attribute
Kilometers kilometers

Restrictions and Parameters

Select a row to view or update the parameter values of an attribute. The checked restriction attributes are applied to the active travel mode.

	Attribute	Parameters
<input type="checkbox"/>	Any Hazmat Prohibited	Prohibited
<input checked="" type="checkbox"/>	Avoid Carpool Roads	Prohibited
<input checked="" type="checkbox"/>	Avoid Express Lanes	Prohibited
<input type="checkbox"/>	Avoid Ferries	Avoid

[Learn more about travel mode settings](#)

OK Cancel

Inspecting/updating Travel Modes in Analysis Layer in ArcGIS Pro


- Inspect and update travel mode properties on the Network Analysis layer in ArcGIS Pro

Layer Properties: Route

General
Metadata
Source
Travel Mode

Name
Trucking Distance

Description
Models basic truck travel by preferring designated truck routes, and finds solutions that optimize travel distance. Routes must obey one-way roads, avoid illegal turns, and so on.
845 characters remaining

Type
Trucking 

Costs

Impedance
Kilometers kilometers ▾

Time Attribute
TruckTravelTime minutes ▾

Distance Attribute
Kilometers kilometers ▾

Restrictions and Parameters
Select a row to view or update the parameter values of an attribute. The checked restriction attributes are applied to the network analysis layer.

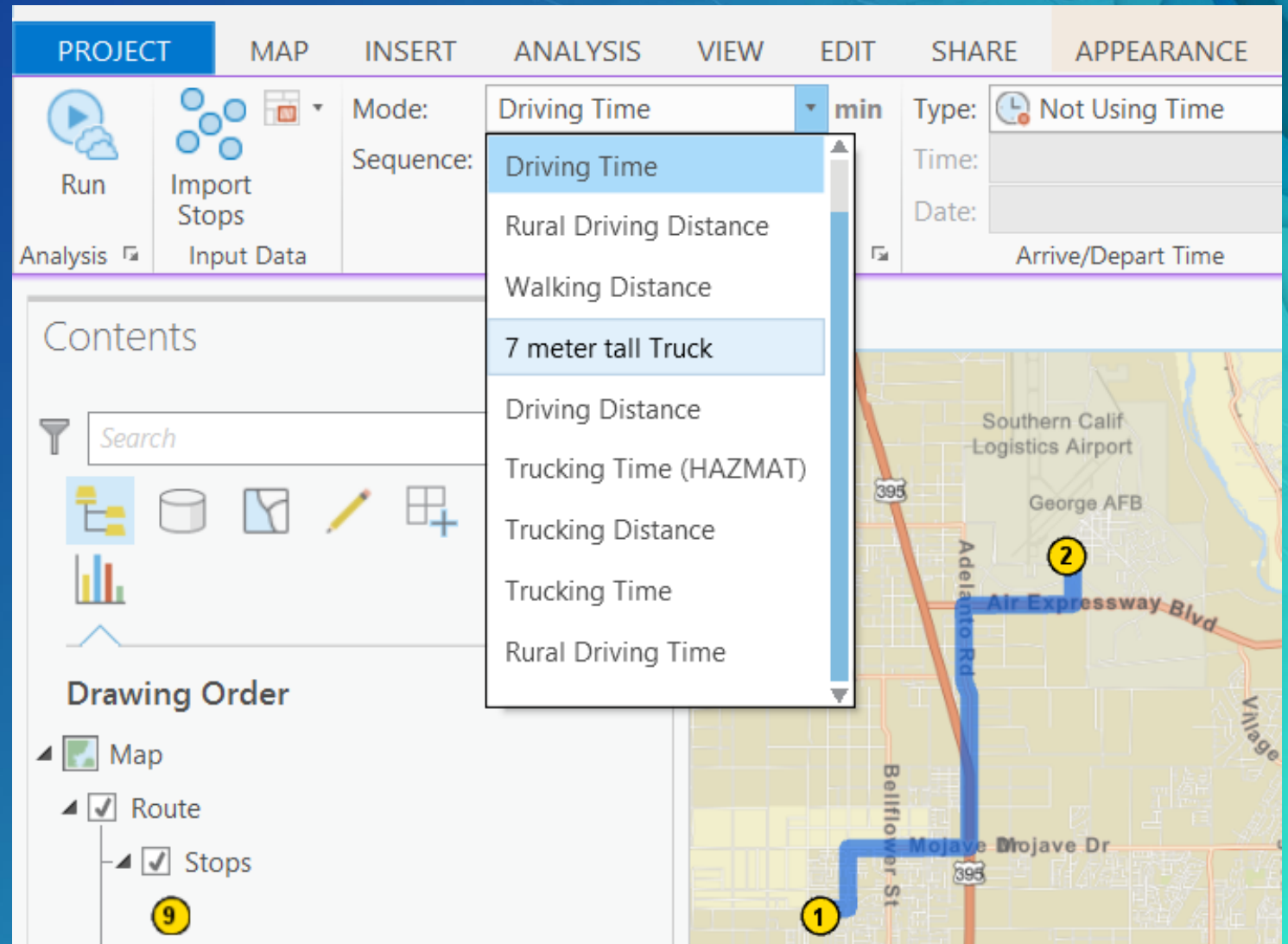
	Attribute	Parameters
<input type="checkbox"/>	Any Hazmat Prohibited	Prohibited
<input checked="" type="checkbox"/>	Avoid Carpool Roads	Prohibited

[Learn more about travel mode settings](#)

OK Cancel

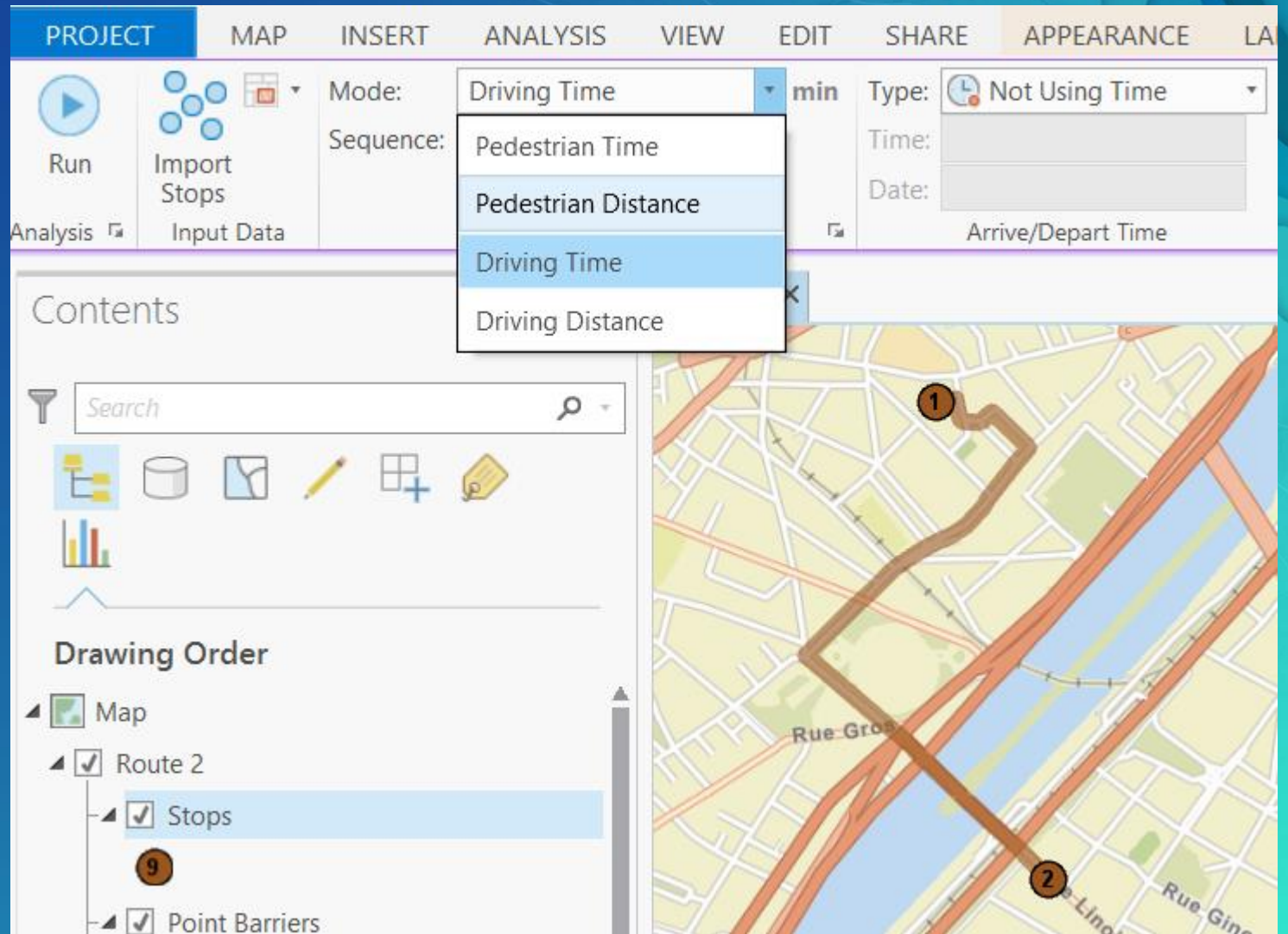
Using Travel Modes – ArcGIS Pro

- In ArcGIS Pro, you can choose the travel mode to use from the UI
 - The Travel Modes shown here are queried from the ArcGIS Online Routing service



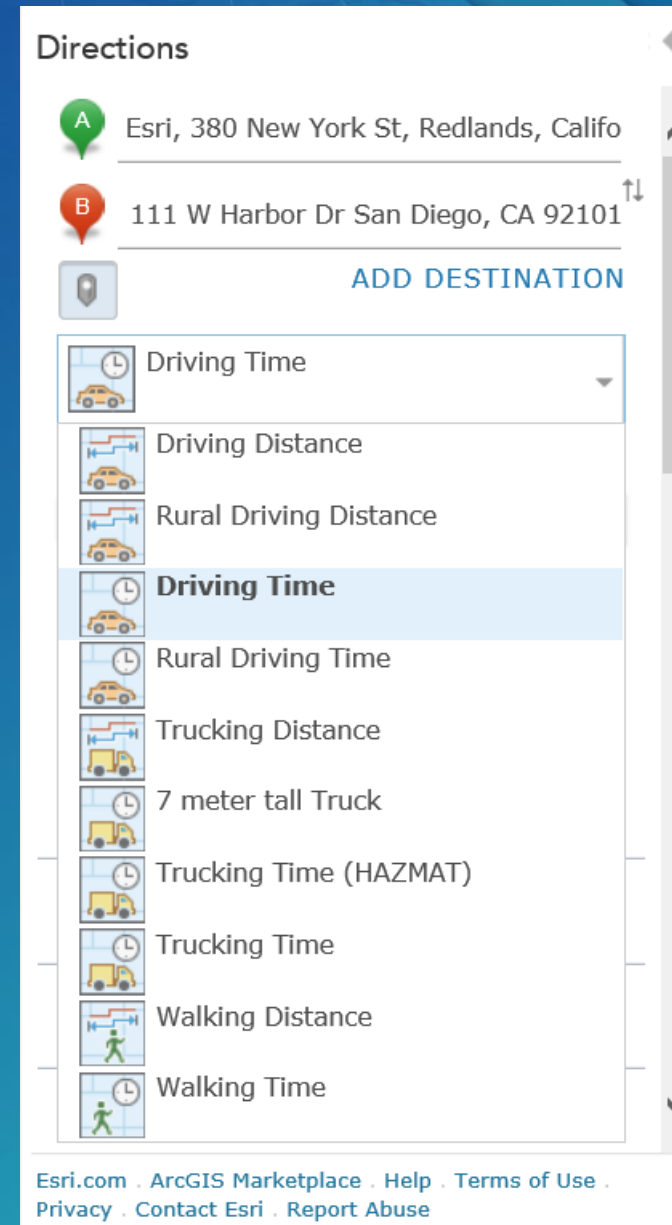
Using Travel Modes – ArcGIS Pro

- In ArcGIS Pro, you can choose the travel mode to use from the UI
 - The Travel Modes shown here are queried from a local network dataset used to create the route analysis layer



Using Travel Mode – Map Viewer

- On the Directions widget in the ArcGIS Online Map Viewer, you can choose the travel mode to use



The screenshot shows the 'Directions' widget in the ArcGIS Online Map Viewer. It displays a route from point A to point B. Point A is 'Esri, 380 New York St, Redlands, Califo' and Point B is '111 W Harbor Dr San Diego, CA 92101'. Below the route, there is a list of travel modes. The 'Driving Time' mode is currently selected and highlighted. Other modes include 'Driving Distance', 'Rural Driving Distance', 'Rural Driving Time', 'Trucking Distance', '7 meter tall Truck', 'Trucking Time (HAZMAT)', 'Trucking Time', 'Walking Distance', and 'Walking Time'. Each mode is accompanied by a small icon representing the vehicle or mode of transport.

Directions

A Esri, 380 New York St, Redlands, Califo

B 111 W Harbor Dr San Diego, CA 92101

ADD DESTINATION

Driving Time

Driving Distance

Rural Driving Distance

Driving Time

Rural Driving Time

Trucking Distance

7 meter tall Truck

Trucking Time (HAZMAT)

Trucking Time

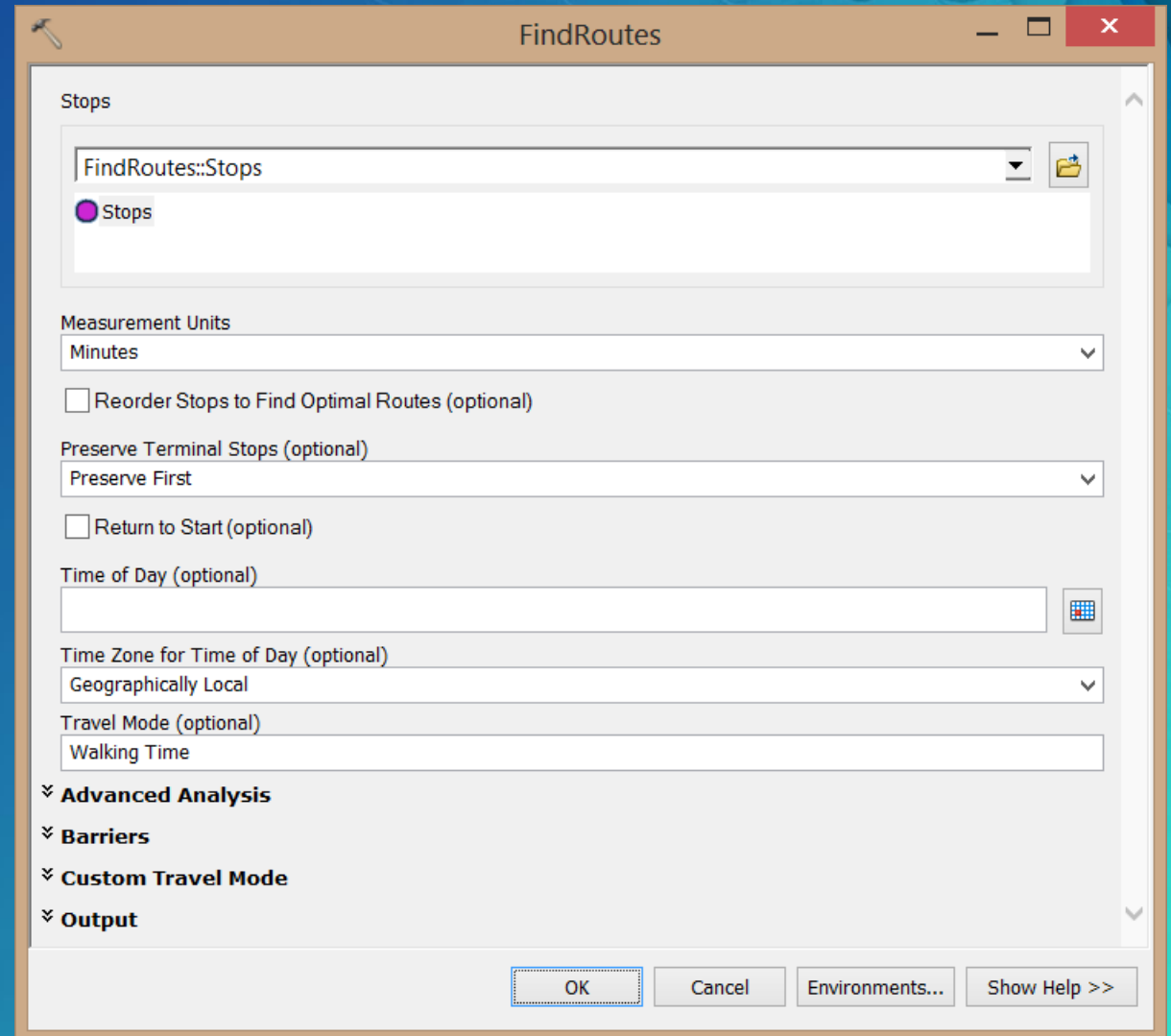
Walking Distance

Walking Time

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Using Travel Mode – ArcGIS Online

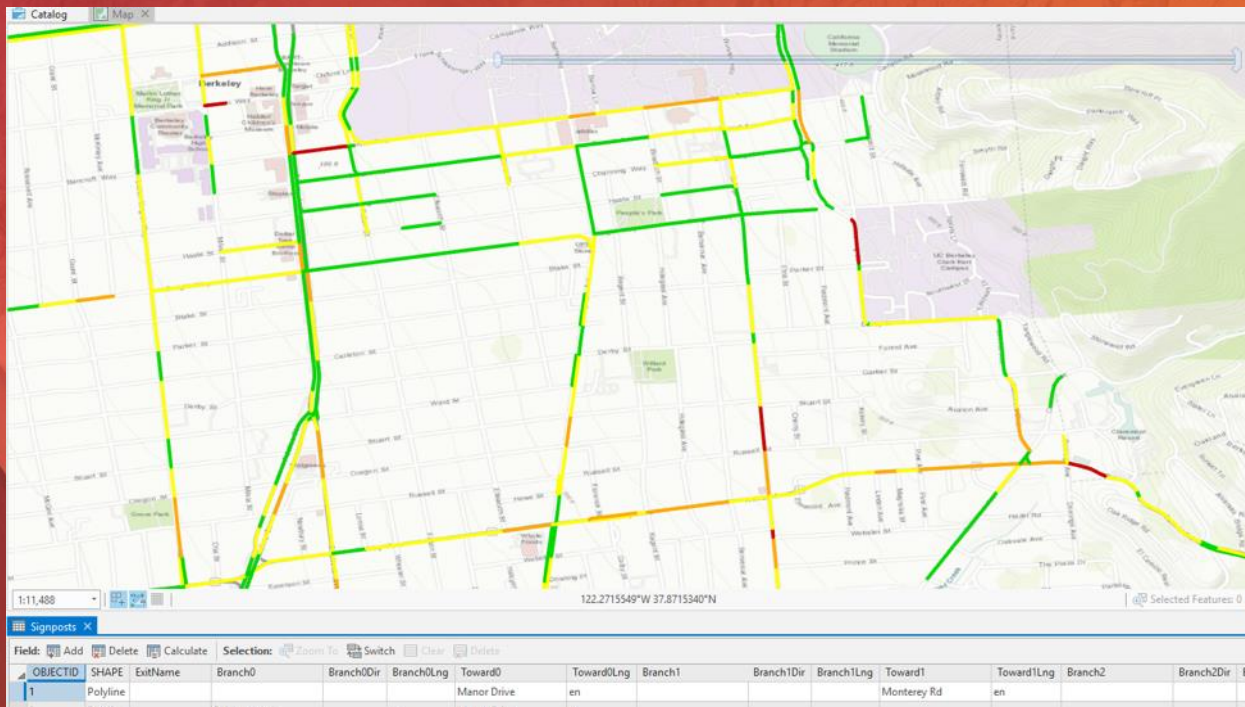
- You can choose which travel mode to use for the Ready-To-Use services in ArcGIS Online



The screenshot shows the 'FindRoutes' dialog box with the following settings:

- Stops:** FindRoutes::Stops (with a folder icon)
- Measurement Units:** Minutes
- ☐ Reorder Stops to Find Optimal Routes (optional)
- Preserve Terminal Stops (optional):** Preserve First
- ☐ Return to Start (optional)
- Time of Day (optional):** (empty field with a calendar icon)
- Time Zone for Time of Day (optional):** Geographically Local
- Travel Mode (optional):** Walking Time
- Advanced Analysis:** (expanded section)
- Barriers:** (expanded section)
- Custom Travel Mode:** (expanded section)
- Output:** (expanded section)

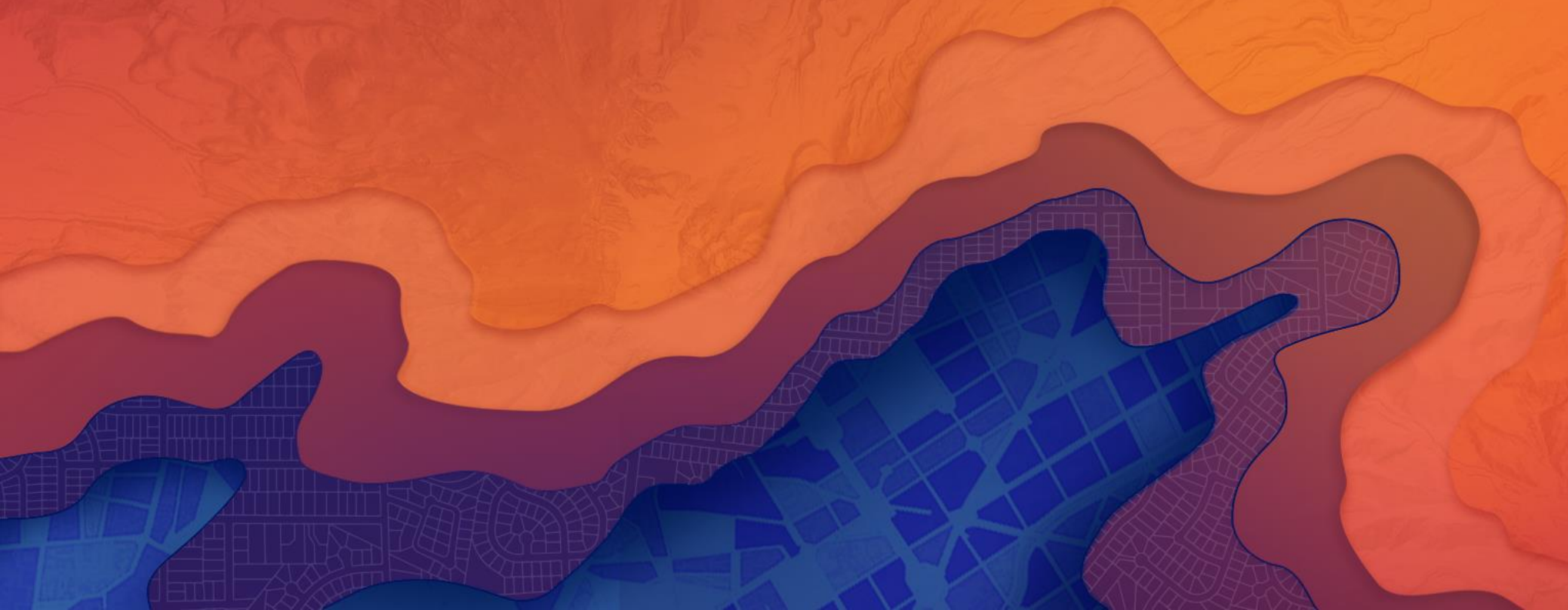
Buttons at the bottom: OK, Cancel, Environments..., Show Help >>



Demo

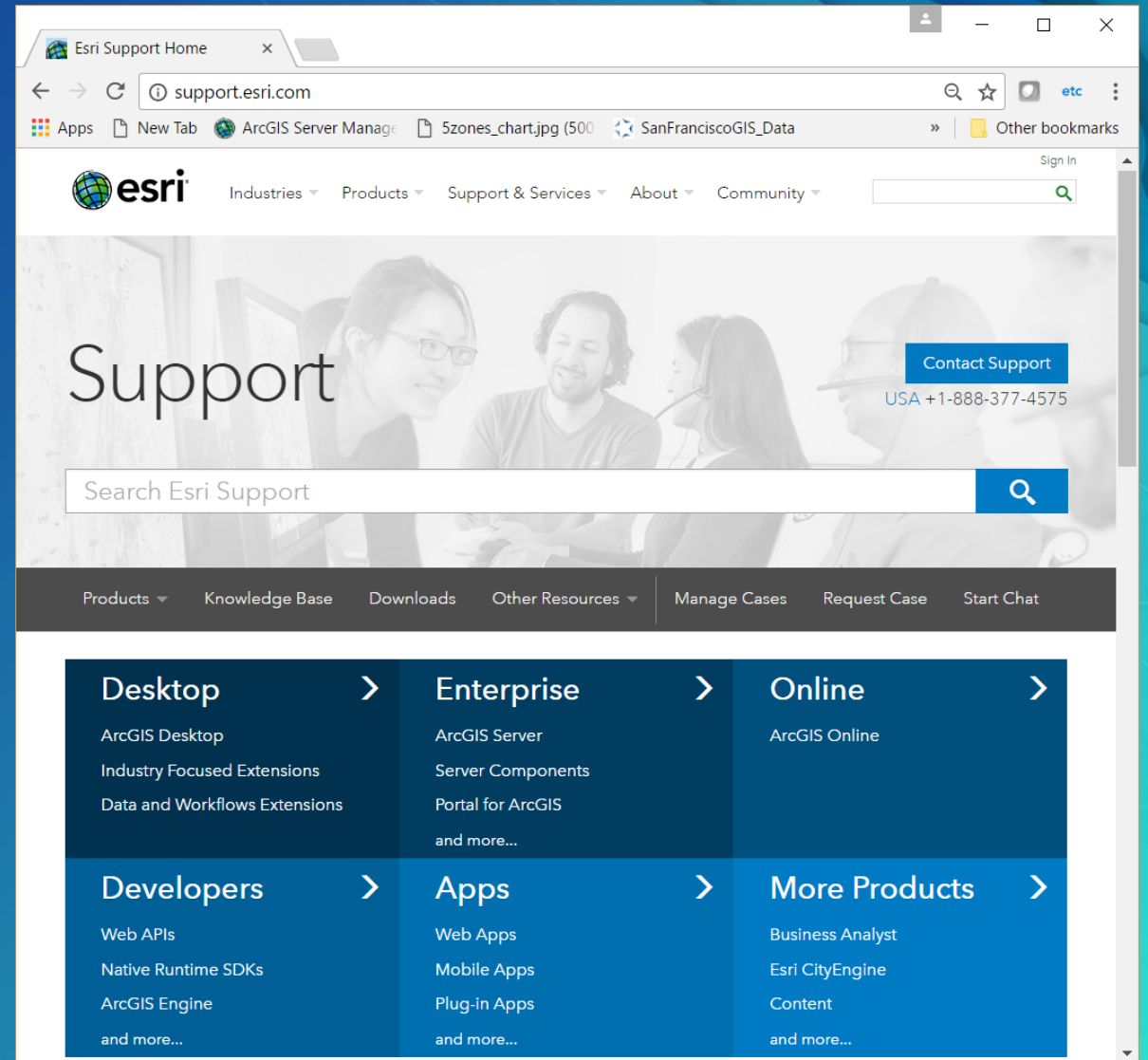
Travel modes and Editing in
ArcGIS Pro

Support & Resources



Esri Support Center

- Online portal to technical information
- Knowledge Base
 - Technical articles
 - White papers
- Downloads
 - Patches
 - Service packs
 - Samples
- Other Resources
 - GeoNet
 - Blogs



<http://support.esri.com/>

For more information

- Network Analyst product page
 - Links to Demos and Other Resources
 - <http://pro.arcgis.com/en/pro-app/help/analysis/networks/what-is-network-analyst-.htm>
 - <http://www.esri.com/software/arcgis/extensions/networkanalyst/>
- Tutorials and Data
 - <http://www.arcgis.com/home/item.html?id=d6bd91b2fddc483b8ccbc66942db84cb>
- Free recorded training seminar
 - Using Network Analyst in ArcGIS Desktop 10
 - <http://training.esri.com/gateway/index.cfm?fa=catalog.webCourseDetail&CourseID=1955>

Network Analyst Technical Workshops

- Network Analyst: An Introduction
 - Tuesday 8:30 AM and Thursday 10:15 AM
- Network Analyst: Creating Network Datasets
 - Tuesday 10:15 AM and Thursday 8:30 AM
- Network Analyst: Automating Workflows with Geoprocessing
 - Wed 10:15 AM and Thursday 3:15 PM
- Navigator for ArcGIS: An Introduction
 - Wednesday 10:15 and Thursday 10:15 AM
- Navigator for ArcGIS: Creating Custom Navigation Maps
 - Thursday 1:30 PM

Network Analyst Technical Workshops – 30 Minutes

- Sharing Routes for Field Use
 - Tuesday 12:00 and Wednesday 4:00 PM
- Building Routing Applications with ArcGIS Online
 - Wednesday 5:00 PM and Thursday 10AM

Network Analyst Demo Theater Presentations

- Fleet routing with the VRP Solver – Tuesday 9:30 AM
- Using Streetmap Premium – Tuesday 9:30 AM
- Using GTFS Public Transit Data in ArcGIS – Tuesday 1:30 PM
- Network Analysis Services in ArcGIS Enterprise – Tuesday 4:30 PM
- Routing with Travel Modes – Create Routes specific to your Vehicle Types – Wednesday 2:30 PM
- Network Analysis using Python – Wednesday 3:30 PM



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