

Network Analyst

ArcGIS advanced training

Advanced Geoprocessing Tools

What's the use of Network Analyst tool?

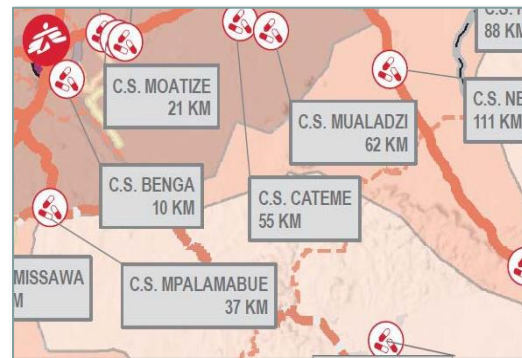
- Calculate fastest road from point A (MSF office) multiple points
- Create service areas (Accessibility buffers around a point)
- Calculate the best itinerary to visit multiple destinations
- Create table of distances from point A to multiple points

In this tutorial the Network Analyst Tool will be used to calculate the fastest road from the MSF Office to each Health facilities. As a result, a road shapefile with the attributes of road length, name of origin and destination will be obtained.

Main Steps

1. Getting software & data ready
2. Build the road network
3. Create the analysis
4. Symbology

Example of products



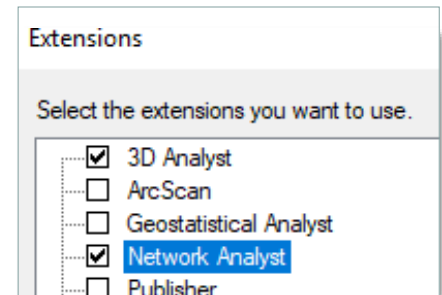
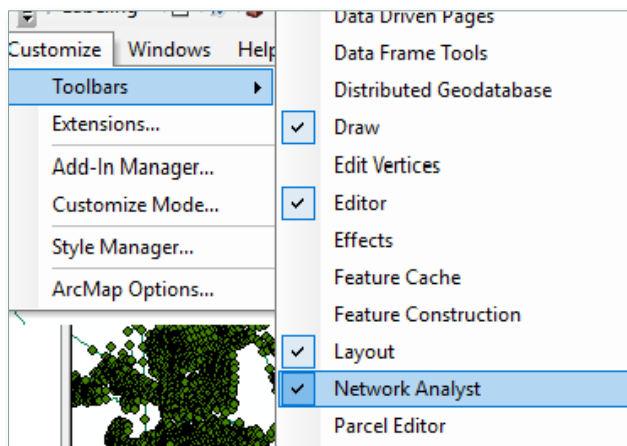
1. Getting software & data ready

Activate extension

>In Customize / Extensions check « Network Analyst »

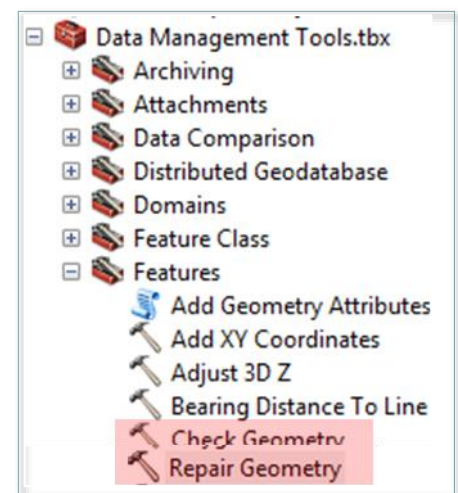
Add the toolbar

>In Customize / Toolbars check « Network Analyst »



Road layer

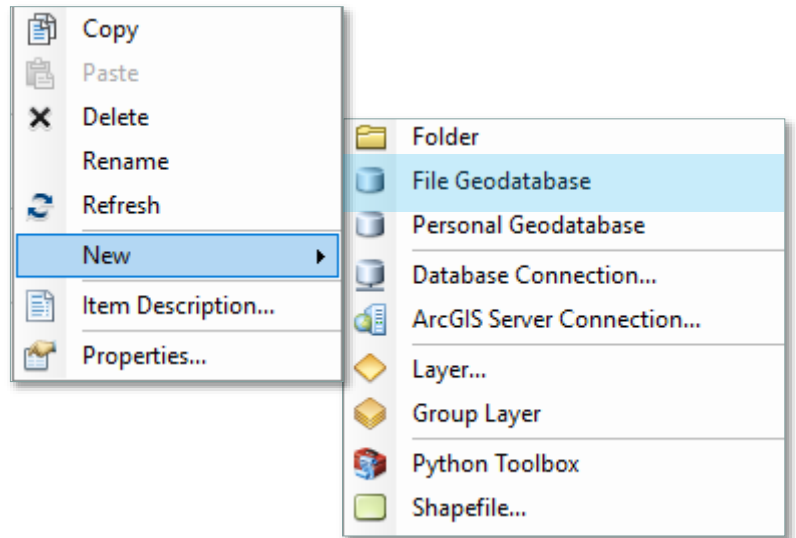
- > Export AOI roads only (faster processing)
- > Check/Repair geometry
- > Add a new field in the attribute table
 - o « hierarchy » as an integer
 - o classify roads by categories:
 - 1 main roads (osm: trunk+ primary),
 - 2 secondary roads (osm: secondary + tertiary),
 - 3 tertiary roads (osm: other roads)



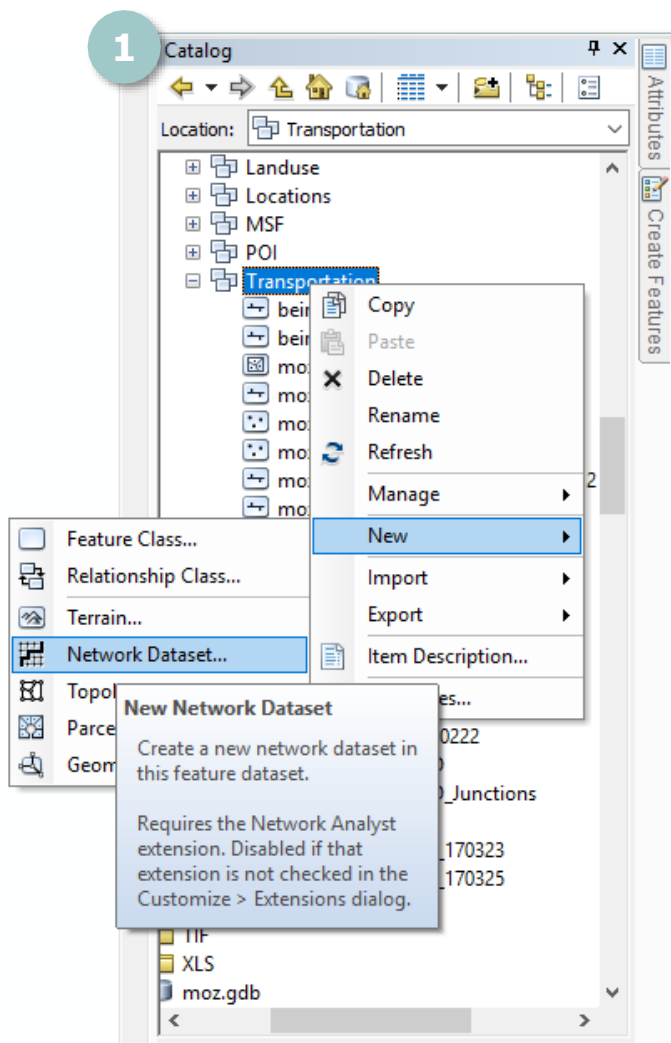
name	type	hierarchy
	trunk	1
Avenida Ho Chi Min	residential	3
Rua John Issa	residential	3
Avenida Patrice Lumumb	residential	3
Rua José Sidumo	residential	3
Avenida Amílcar Cabral	secondary	1

Database

- > Ensure you have a gdb
- > Else create one



2. Build the road network



Network dataset

This step is the longest and the number of parameters will depend on your data and its quality.

You can create a complex model based on many inputs (speed, hierarchy, bridges, one way, elevation...) or, as in this example, a very simple one (based only on hierarchy and length) as it is a network build remotely – no accurate knowledge of the field and with open source data.

1. In the gdb add a « new network dataset »
2. Select transportation feature class
3. Model turns

2

New Network Dataset

Select the feature classes that will participate in the network dataset:

- ☐ beira_rds_l_msf
- ☐ beira_rds_l_msf_wgs84_clip
- ☐ moz_aairdm_l_osm_110315
- ☐ moz_GAACsAccess_l_osm_msf_231215
- ☐ moz_rds_l_cenacarta_161027
- ☐ moz_rds_l_dcw
- ☐ moz_rds_l_msf
- ☒ moz_rds_l_osm_160912_selection
- ☐ moz_rdsGAACs_l_osm_msf_231215
- ☐ moz_rlw_l_cenacarta

3

New Network Dataset

Do you want to model turns in this network?

☐ No

☒ Yes

Turn Sources:

☒ <Global Turns>

Here it is a simple analysis so I select only one layer but you can mix railway with several road layers, footways...

Next,

4. Connectivity (any vertex)
5. Use elevation as a cost

Connectivity: We advise you choose "any vertex" so that two crossing lines can connect even if they don't have an "end point" at this location.

4

New Network Dataset

The default connectivity settings for network datasets establish connectivity only at coincident endpoints of line features during the build process.

If you want to use different connectivity settings, click the Connectivity button below. You can change the connectivity settings now, or you can change them after the network dataset has been created.

Connectivity...

Connectivity

Connectivity Groups:

Source	Connectivity Policy	1
moz_rds_l_osm_160912_selection	End Point	<input checked="" type="checkbox"/>
	Any Vertex	
	End Point	

5

New Network Dataset

How would you like to model the elevation of your network features?

☐ None

☐ Using Z Coordinate Values from Geometry

☒ Using Elevation Fields

You can add elevation as a cost if you have a corresponding field in your attribute table.

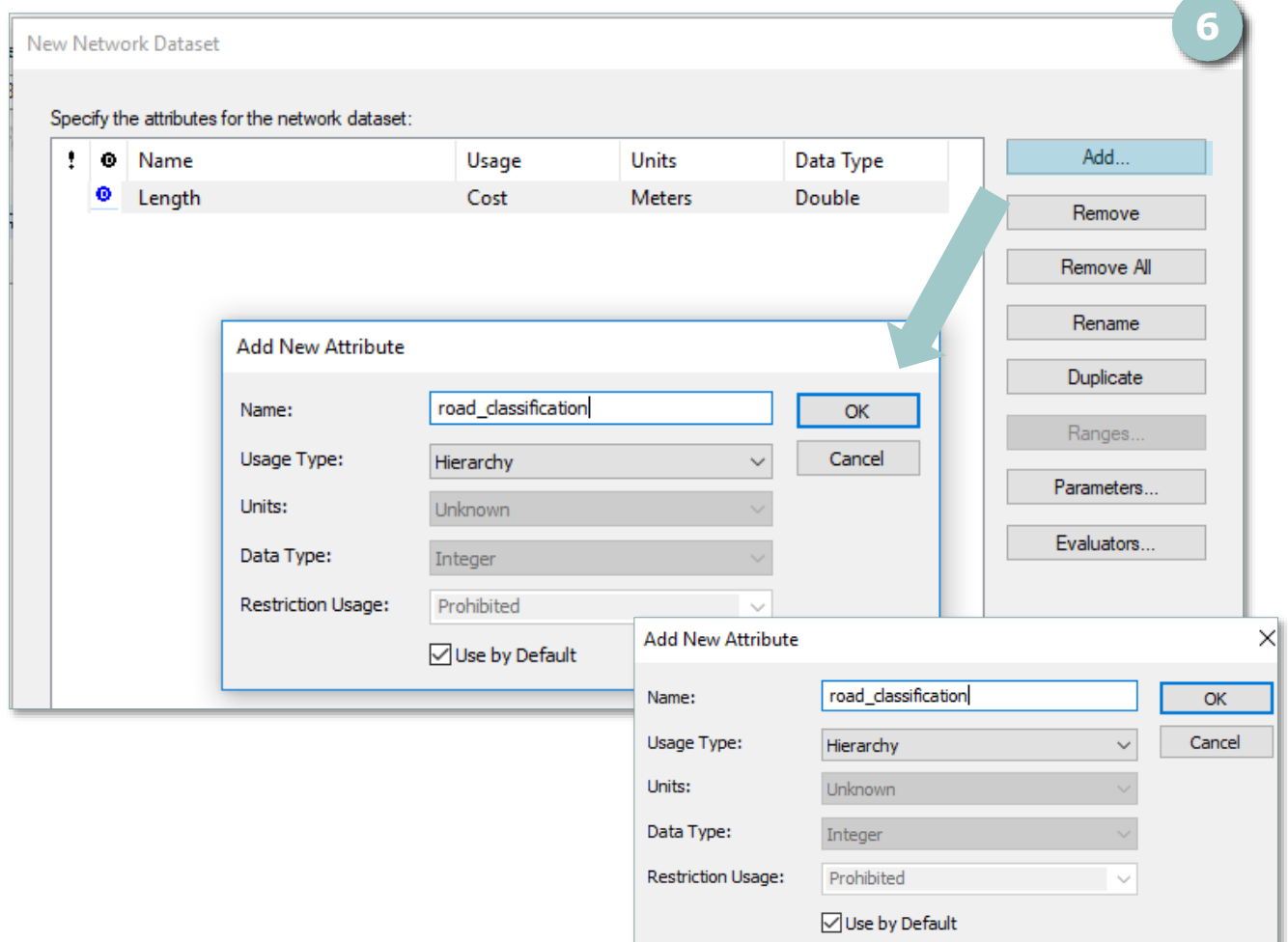
Additional parameters

Depending on your data quality and your knowledge of the field of study you can also:

- > Add "Length" as a cost
- > Add "road classification" as a hierarchy
- > Add "speed limit" as a cost
- > Add "one way" as a restriction

Here length from origin to arrival is a "cost" (analysis will choose the shortest path) and the road classification is a "hierarchy" so the analysis will favor a primary road over a pathway. You can also choose some parameters as "restriction", for example if you have a field about bridge presence on the road, you can add "no bridge" as a restriction. That way the model will not choose road with bridges.

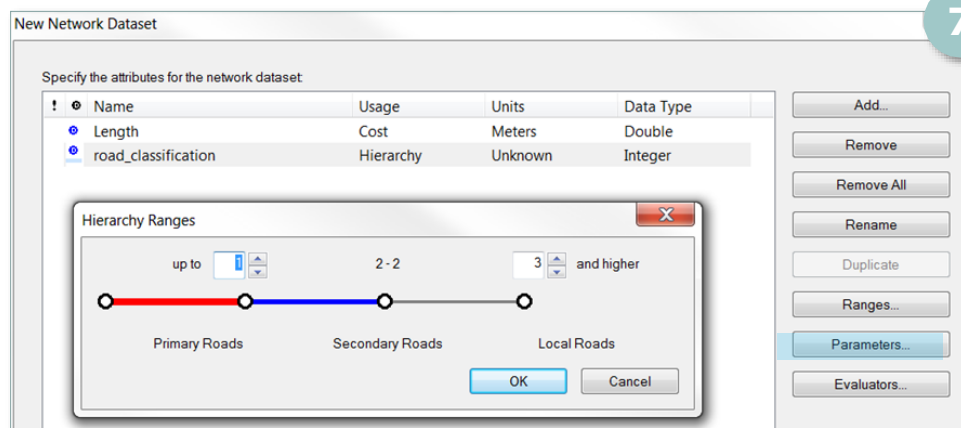
6. Add « Hierarchy » parameter



7. Check "hierarchy" ranges

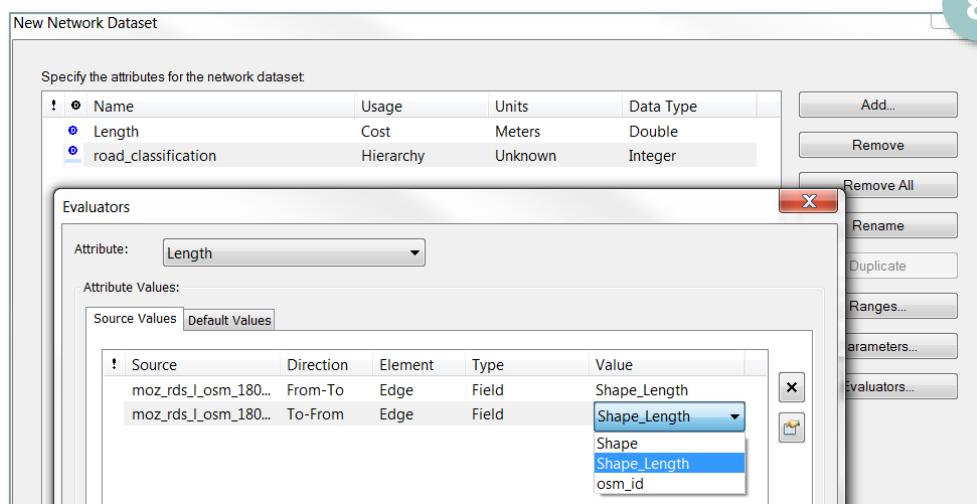
Based on the field you added as the hierarchy at the beginning, choose which numbers will be considered as "primary roads", "secondary" or "tertiary". Notice only three categories are accepted by the software, you could have in your original data source 10 categories and choose:

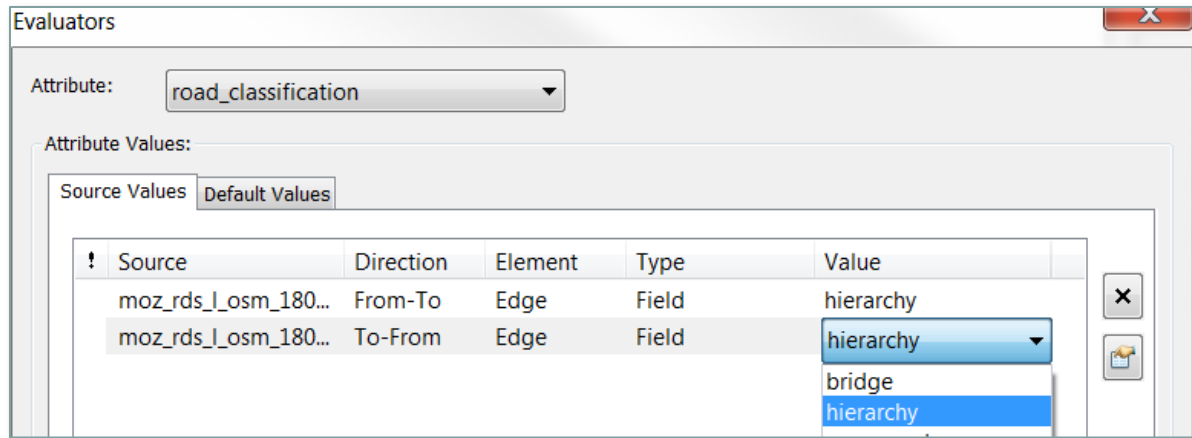
- 1-4 are to be considered as "Primary roads" for the model, 5-7 "secondary roads" and 8-10 "local roads".
- 1-2 "Primary roads", 3-4 "secondary" and 5-7 "local road" and 8-10 not need for the model.



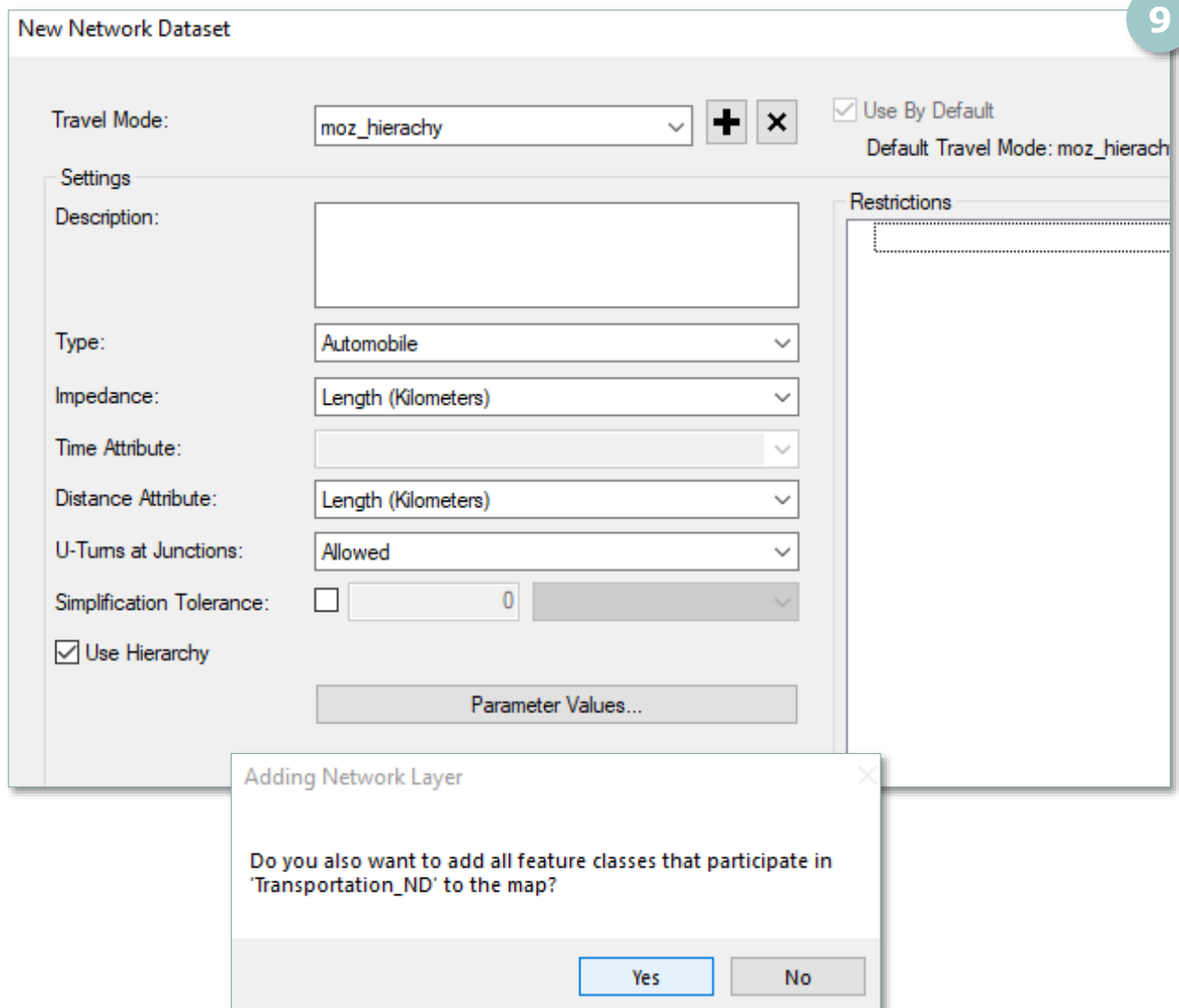
8. Check evaluators

- > For Length make sure the evaluator is length (by default it can be shape)
- > For road_classification make sure the evaluator is hierarchy



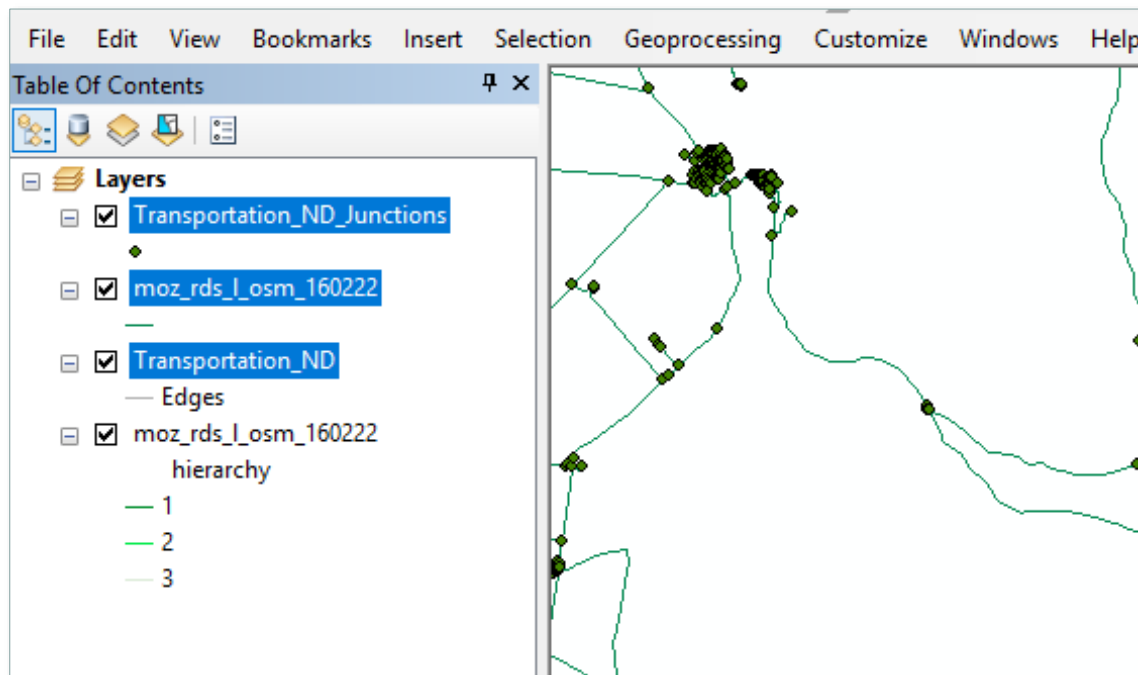


9. Final steps Name the model and check the summary



Result

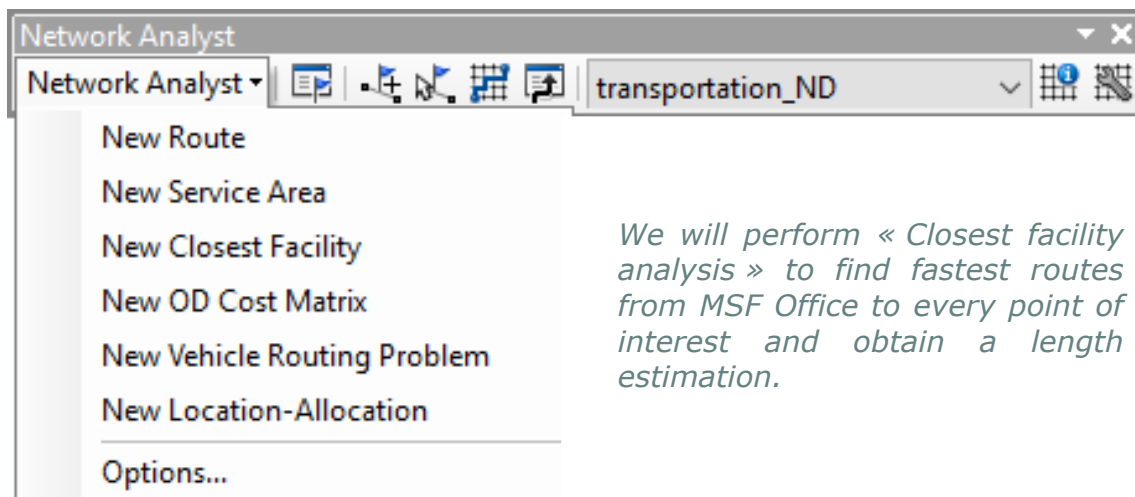
You can see three new layers on your map: junctions, roads, edges. You won't use them so you don't have to answer "yes" when ArcGIS asks if you want them to be added on the map.



3. Create the analysis

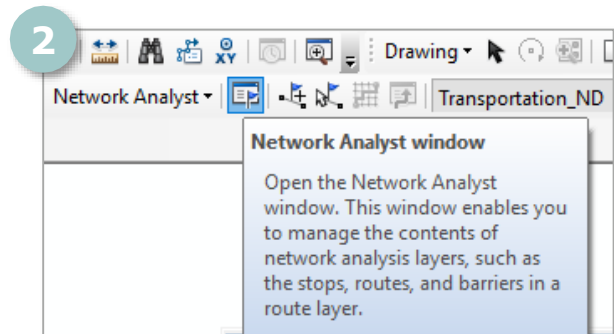
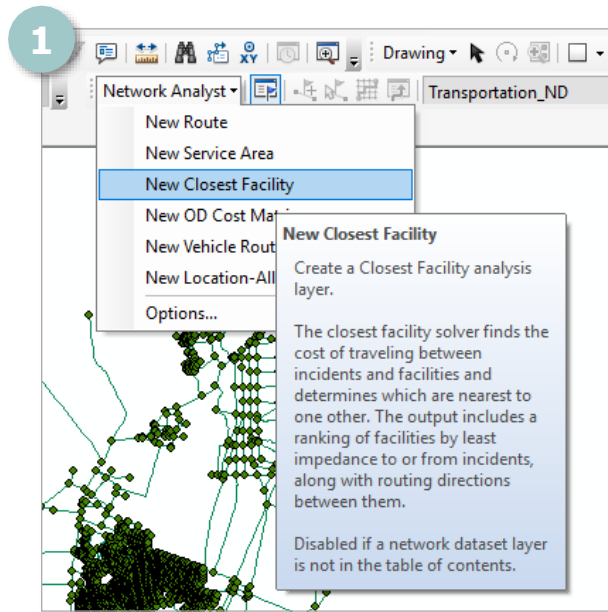
Analysis possible:

- > Open your Network analyst toolbar



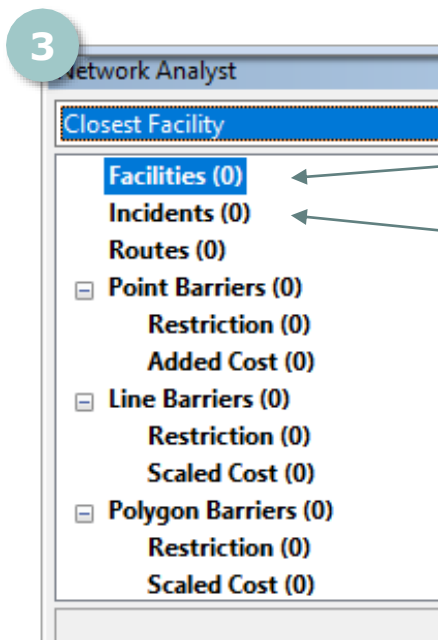
We will perform « Closest facility analysis » to find fastest routes from MSF Office to every point of interest and obtain a length estimation.

1. Select "New Closest Facility", and we will define the starting point as the MSF Office, and the many destination points as the "health facilities" MSF team is interested in.



2. In the "Network Analyst Toolbar", open the "Network Analyst Window" to access the menu where you can input starting and ending points.

3. The Network Analyst Window is composed as follows:



"Facilities": Starting point of the analysis. All distance and routes will start from this point(s).

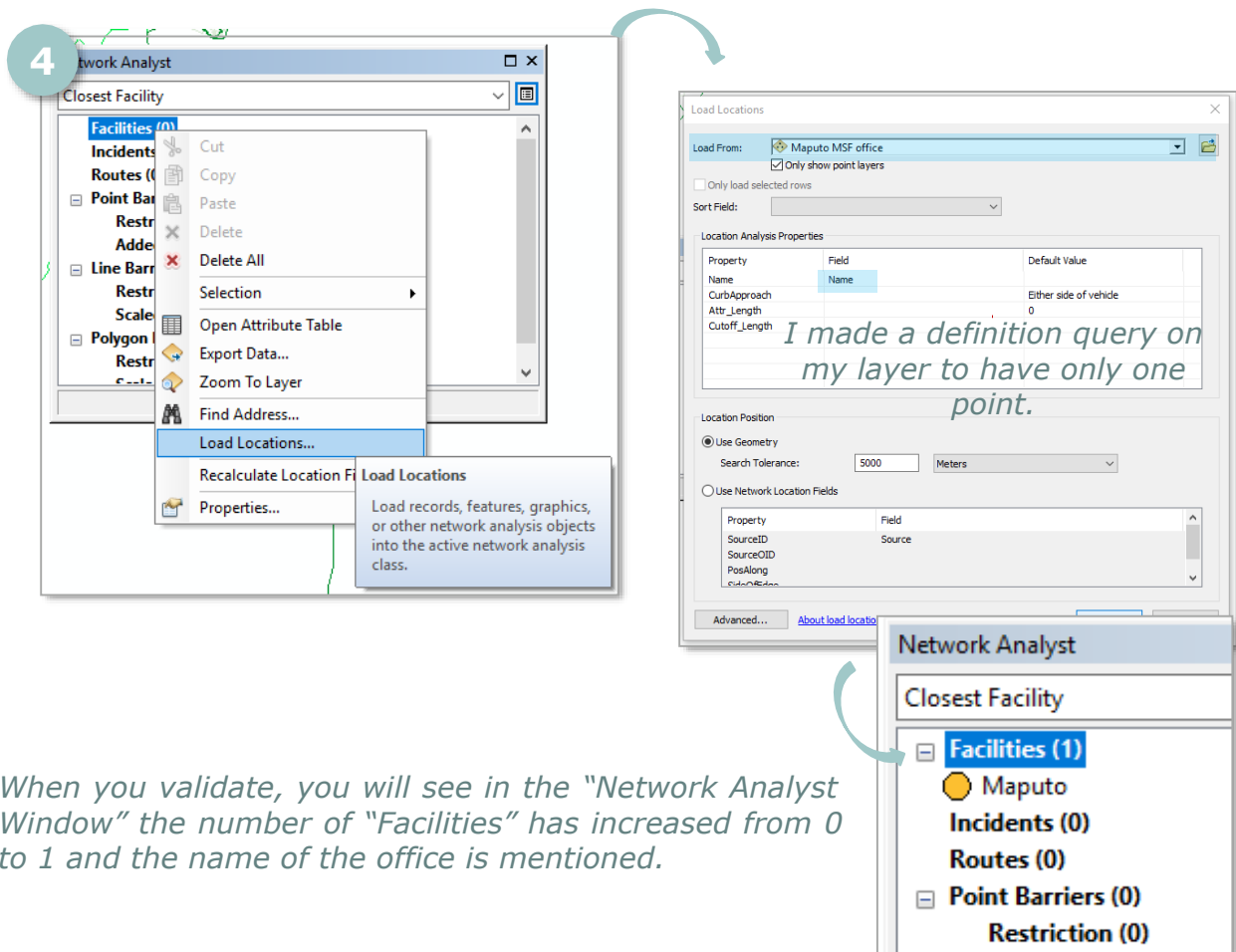
"Incidents": Ending points of the analysis. All distance and routes will be calculated individually from starting point to each ending point.

Notice you can also input "Point barriers" like bridges, checkpoints, "Line barriers" such as international borders, rivers or "Polygon barriers" for military zones, deep forests...

Those default names can be changed to better suits your needs.

4. Load "Facilities": MSF Office (starting point)

- > Right-click on "Facilities" in the "Network Analyst Window"
- > Select "Load locations" in the menu
- > Select the layer containing your MSF Office in "Load From"
- > Check the field containing the name of the office is the one mention below

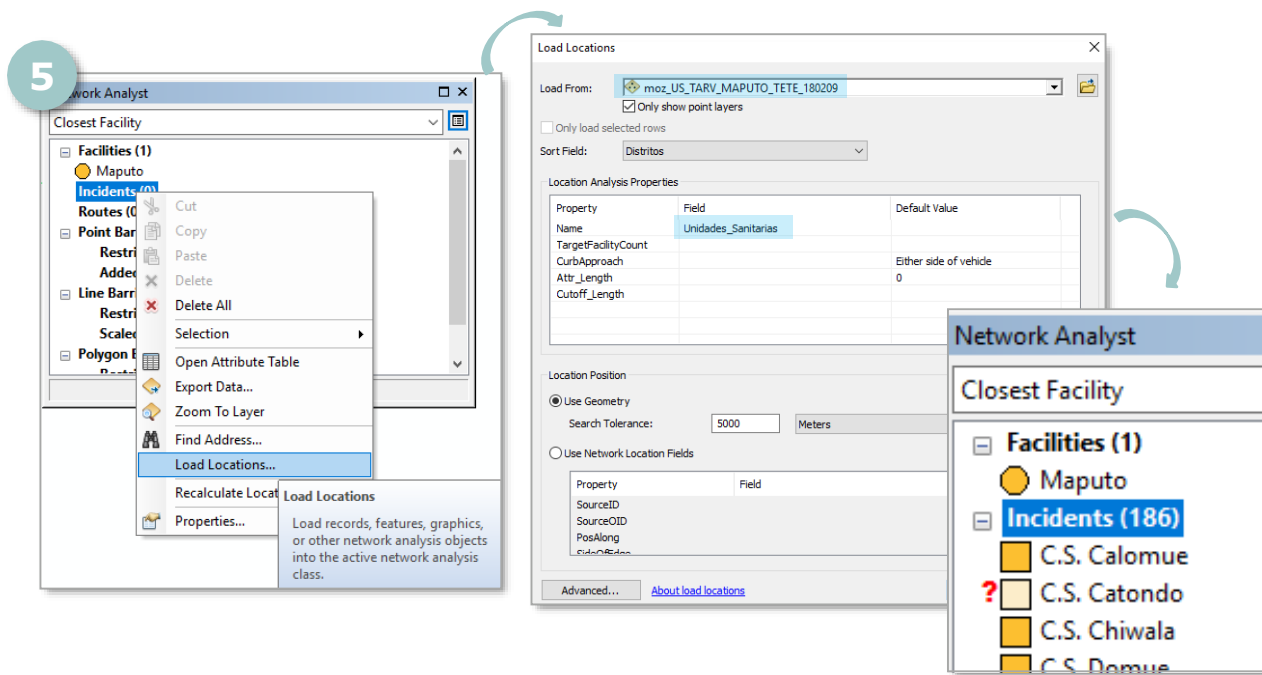


The screenshot shows the 'Network Analyst' window with the 'Closest Facility' task. The 'Facilities' layer is selected, and the 'Load Locations...' option is chosen from the context menu. The 'Load Locations' dialog is open, showing the 'Load From' dropdown set to 'Maputo MSF office'. The 'Sort Field' is set to 'Name'. The 'Location Analysis Properties' table is visible, showing the 'Name' field with a default value of 'Either side of vehicle'. A handwritten note says: "I made a definition query on my layer to have only one point." The 'Network Analyst' window shows the 'Closest Facility' task with the 'Facilities (1)' layer loaded, showing a yellow dot for 'Maputo'.

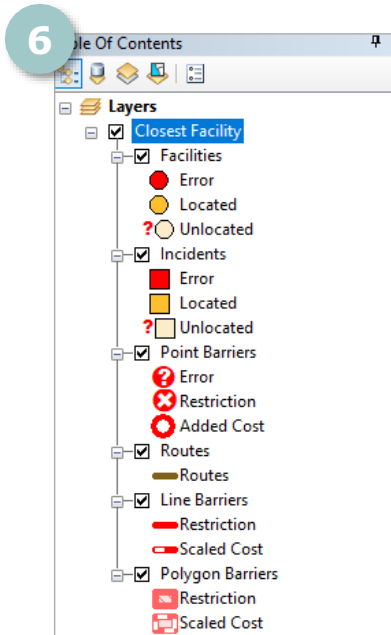
When you validate, you will see in the "Network Analyst Window" the number of "Facilities" has increased from 0 to 1 and the name of the office is mentioned.

5. Load "Incidents": Health facilities (ending points)

- > Right-click on "Incidents" in the "Network Analyst Window"
- > Select "Load locations" in the menu
- > Select the layer containing your Health facilities of interest (make a definition query on your layer if needed) in "Load From"
- > Check the field containing the name of the Health facilities is the one mention below



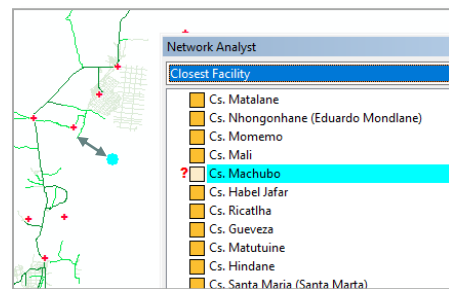
6. Check in the Table of Content



In the "Table of Content" you can see a symbology for "Error", "Located" and "Unlocated" features you just input.

Check how many "Unlocated" features you have in both "Facilities" and "Incidents". One way to diminish this number is to use the "Use Geometry" functionality while loading "Facilities" and/or "Incidents".

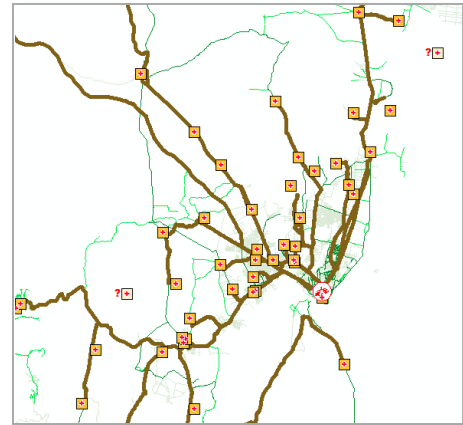
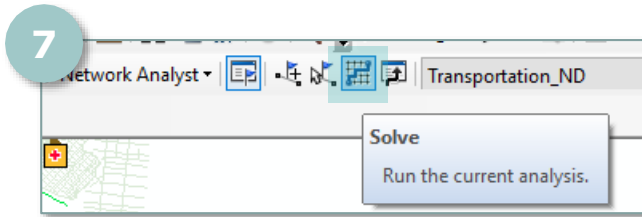
It will use the "search tolerance distance" you mention to consider the feature is connected to the road if the distance between the unlocated feature and the road is inferior to this distance.



Of course the distance you will obtain from the MSF Office to this point will be a very rough estimation as it will only take into account the distance from the MSF Office to the end of the road, then it will be missing from the end of the road to the Health facility. The choice is yours to use or not this option.

7. Solve the analysis

Back on the "Network Analyst Toolbar" click on "Solve".

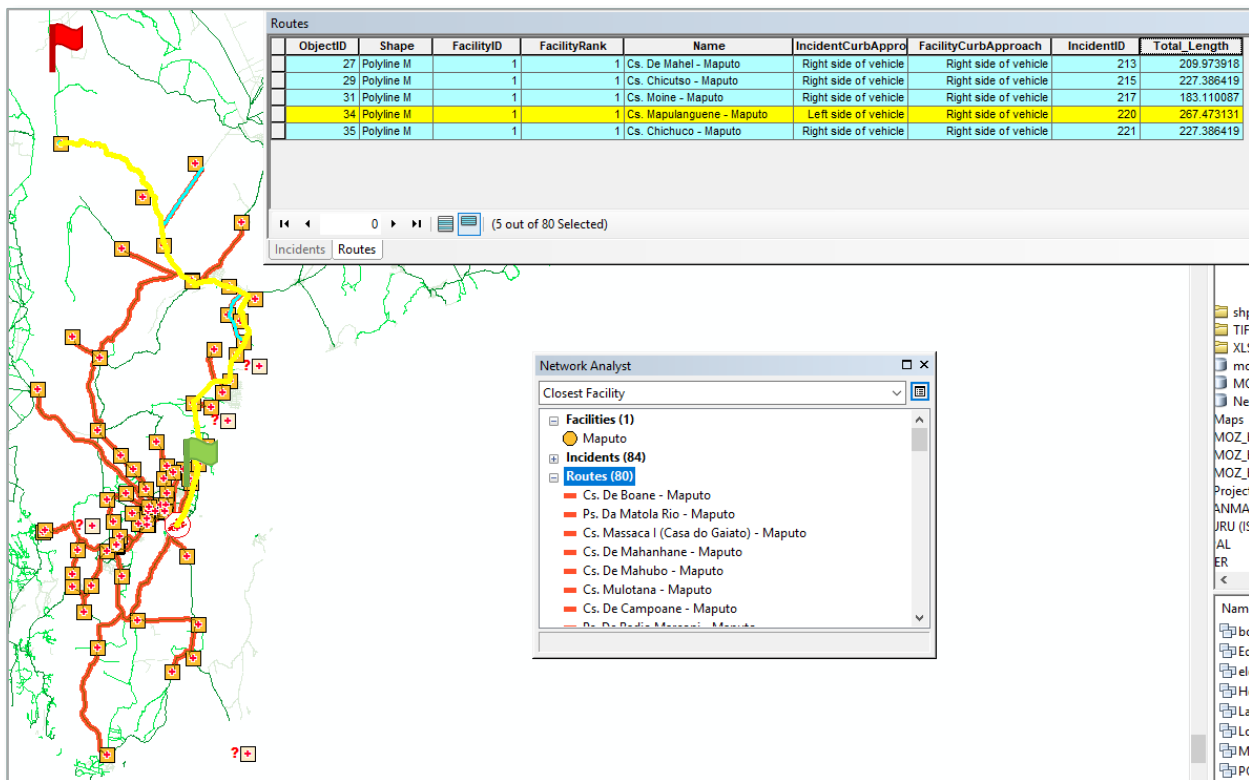


Result

You will obtain the "Routes" connecting the starting point to every ending point (in brown here). You can see them on your table of Content under "Routes" and we strongly advise to register this data in a layer so you can edit it.

Opening the « Route » attribute table have information on:

- The length of the total path,
 - The name of the road,
- And you visualize it on the map.



ObjectID	Shape	FacilityID	FacilityRank	Name	IncidentCurbAppro	FacilityCurbApproach	IncidentID	Total_Length
27	Polyline M	1	1	Cs. De Mahel - Maputo	Right side of vehicle	Right side of vehicle	213	209.973918
29	Polyline M	1	1	Cs. Chicuto - Maputo	Right side of vehicle	Right side of vehicle	215	227.386419
31	Polyline M	1	1	Cs. Moine - Maputo	Right side of vehicle	Right side of vehicle	217	183.110087
34	Polyline M	1	1	Cs. Mapulanguene - Maputo	Left side of vehicle	Right side of vehicle	220	267.473131
35	Polyline M	1	1	Cs. Chichuco - Maputo	Right side of vehicle	Right side of vehicle	221	227.386419

Network Analyst

Closest Facility

Facilities (1)

- Maputo

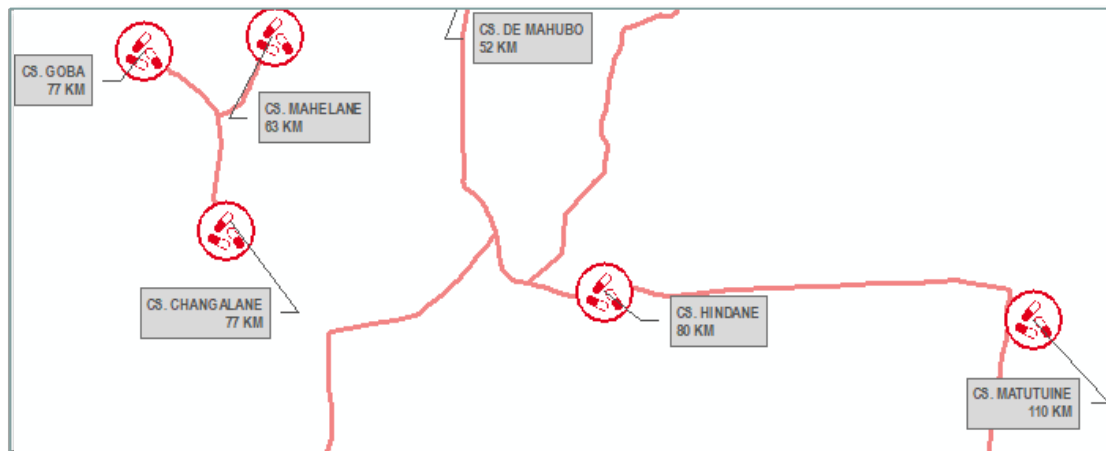
Incidents (84)

Routes (80)

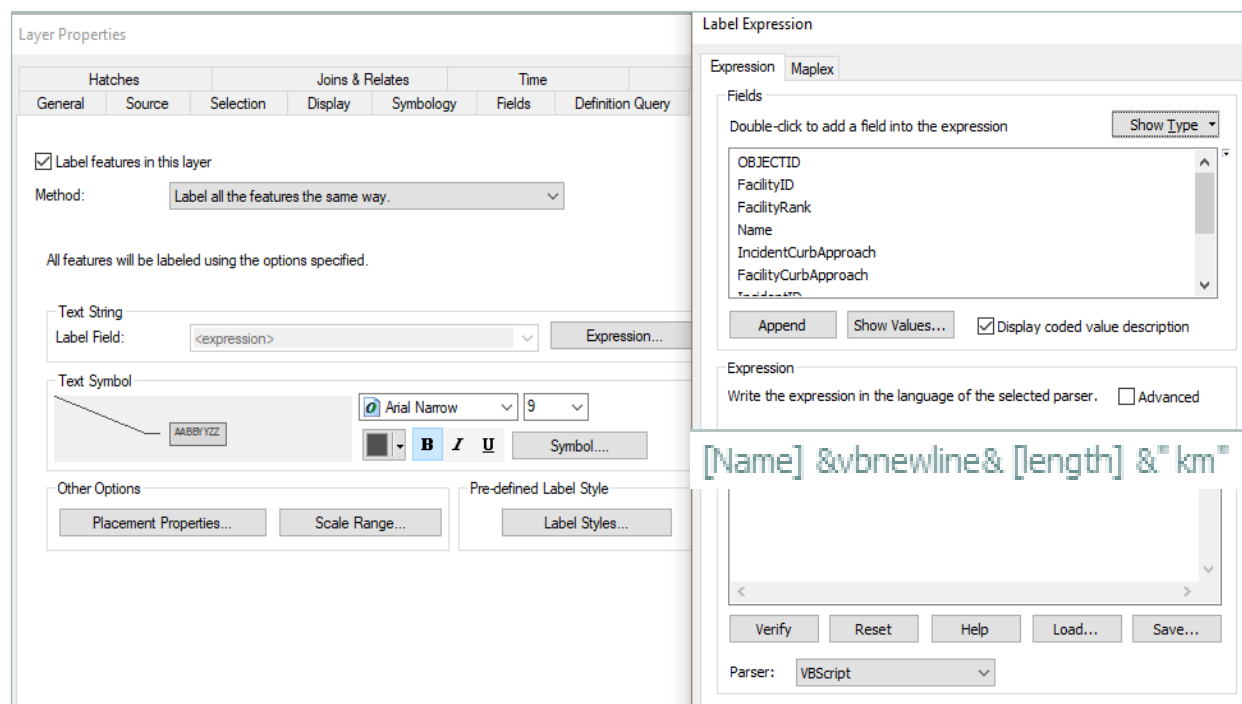
- Cs. De Boane - Maputo
- Ps. Da Matola Rio - Maputo
- Cs. Massaca I (Casa do Gaiato) - Maputo
- Cs. De Mahanhane - Maputo
- Cs. De Mahubo - Maputo
- Cs. Mulotana - Maputo
- Cs. De Campoane - Maputo
- Ps. De Boane - Maputo

4. Symbolology

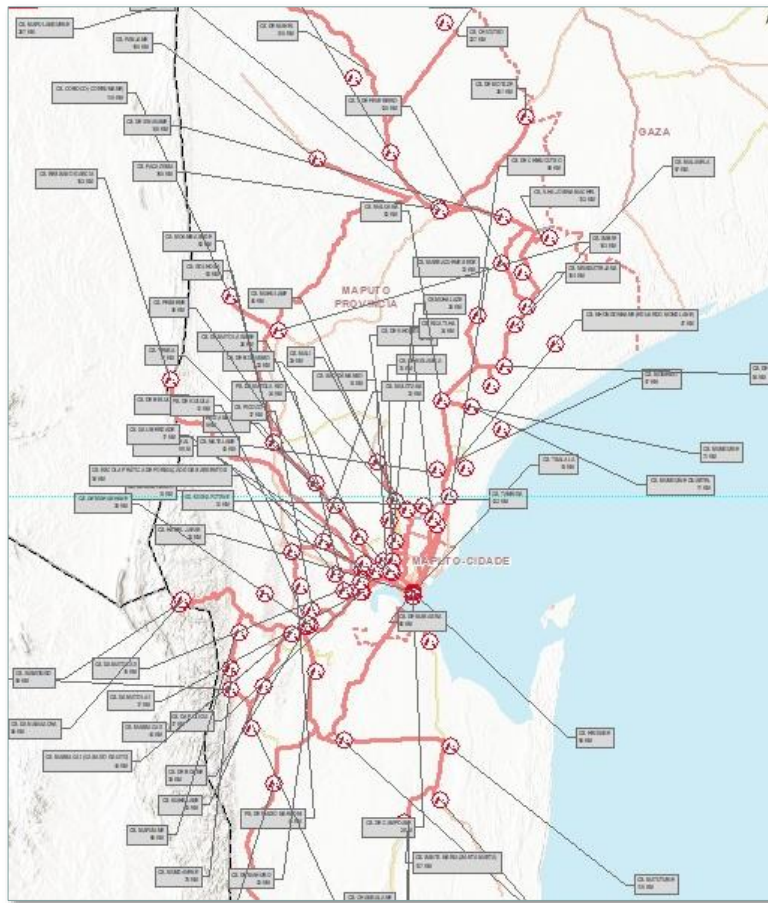
The symbology can be tricky after a network analysis. This last part is to give you tips and tricks about one way of making the symbology.



In this example we want to label each "Health facility" with information contained in two fields: the name of the health facility and its distance to the MSF Office, each on a different line (vbnewline function in maplex).



But the result is very messy!



What is proposed is to convert label to annotations.

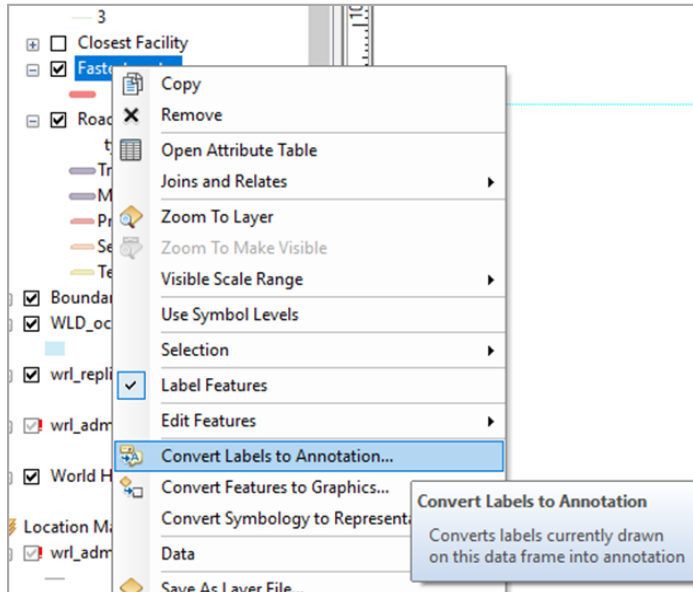
Be careful when using this functionality. We advise to use it only if in a database, never on the replica.

You can either store annotations in the gdb or in the map itself. The second option is not to be advised as if you need to change your symbology, the label expression or modify a label you have to start again as it is not dynamic. Saving the annotations in the gdb is dynamic, so if you modify you label in the annotations it will also change in the attribute table, and if you decide to change colours or to align text differently it is working.

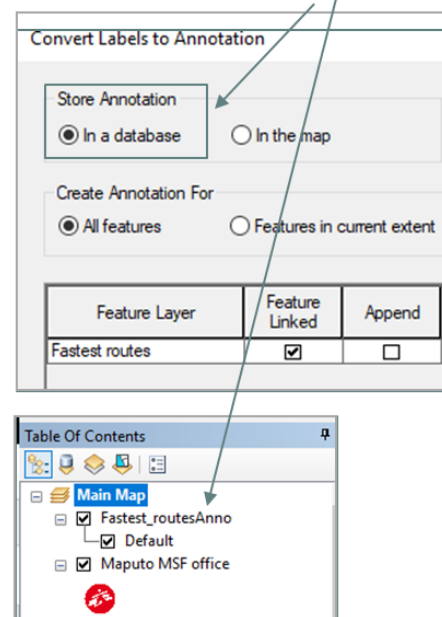
You should not use this functionality on a replica layer, as it will be considered as a change in its data model and won't be able to perform synchronization anymore.

1. The first step is to save the "route" layer from the analysis result into a database layer so you will be able to make modifications on it.

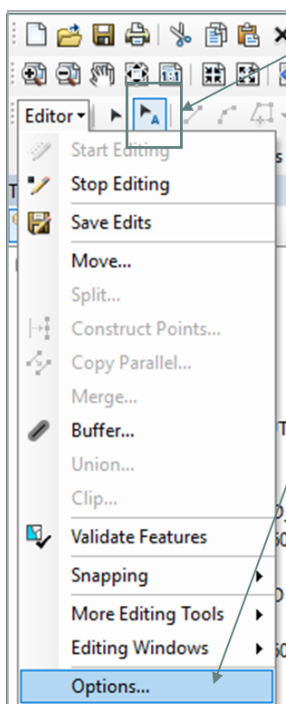
- Then, right-click on the layer and select "Convert Labels to Annotations..." and select "Store Annotations in a database". You will see them appearing as a new layer into the table of content.



So you can check/uncheck the layer of annotation easily.



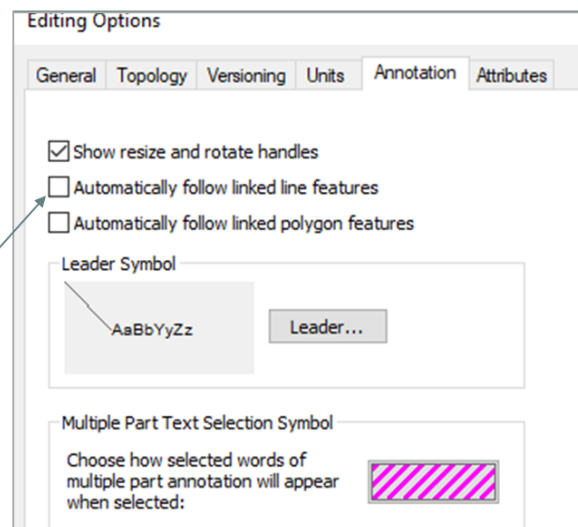
- Move annotations by editing the layer, and use the arrow with "blue A" so the line linked to the feature will move along.



To move annotations, open an editing session Then use the special annotation arrow

Open the « options » windows

If your annotations rotate and try to fix along a line, you can check/uncheck this box



Results

