

METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS  
RFP 25-014  
UPDATING THE COGTOOLS NETWORK EDITING AND MANAGEMENT SOFTWARE

**August 28, 2025**

**ADDENDUM #2  
QUESTIONS/ANSWERS**

1. Does the current UGDB Esri Personal Geodatabase use any of these Esri specific features? Topology, Network datasets, Terrains / TINs, Annotation feature classes, Dimension feature classes, advanced Relationship Classes, advanced Subtypes and Domains features such as default values, Attachments, Geometric networks, Replication.

**The current Unified Geodatabase (UGDB) contains only two simple ArcGIS features: Polyline and Point.**

- **Polyline** features represent road links, centroid connectors, and rail links.
- **Point** features represent road intersections, zone centroids, parking lots, and transit stops (e.g., rail stations, bus stops, LRT stops).

**The UGDB does not include topology, network datasets, terrains/TINs, annotation feature classes, or dimension feature classes. However, it does support advanced Relationship Classes as well as advanced Subtypes and Domains. Note that transit lines are not stored as a feature class in the database; instead, they are maintained across three standard tables (see, for example, Attachment #3). When the transit network is in an edit session, COGTools temporarily generates a transit network feature layer in memory.**

2. Could you please clarify if there are any “optional tasks” associated with this RFP? We are not clear how to respond to the following requirement: “Offerors must provide an example scope of work, technical approach, work plan, and proposed staffing for one of the optional tasks that may be issued under this contract. Please refer to the Summary Page and Statement of Work sections of this document to ensure that proposals include all the requested information.” (Section 2 – Proposed Method to Accomplish Work).

**There are no optional tasks for this proposal. Vendors/consultants will propose cost estimates and timelines for both alternatives/options, i.e., for the stepwise migration and the direct migration (explained later in this document), explain their preferred approach with justification, and propose detailed steps to complete each of the four tasks that are detailed in the RFP.**

**Once the contract is awarded, the consultant will perform the two-part software migration (i.e., platform migration and programming language migration) using the approach selected by the COG/TPB staff.**

3. Does MWCOG currently utilize ArcGIS Enterprise? **No**  
If so, what version? Does the deployment include an Enterprise Geodatabase? **N/A**

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4. Does MWCOG currently own and maintain the source code used to develop the tools? Will it be provided for review by the selected contractor?

**MWCOG owns and maintains the source code for COGTools, which will be provided to the selected contractor. The objective of this contract is to migrate the existing version of COGTools, developed in VB.NET for ArcGIS 10.x, to ArcGIS Pro using C# (or an alternate programming language recommended and justified by the vendor) – not to develop a new tool from scratch.**

**Two alternative approaches are proposed for completing this task (shown below), and the vendors/consultant will propose cost estimates and timelines for both alternatives/options, explain their preferred approach with justification, and propose detailed steps to complete each of the four tasks that are detailed in the RFP:**

- 1. Stepwise Migration – Step 1: Migrate COGTools from ArcGIS 10.x to ArcGIS Pro in VB.NET. Step 2: Convert the VB.NET code to C# (or an alternate programming language proposed and justified by the vendor). Stepwise migration can reduce complexity and minimize risk by ensuring that all existing functionality is preserved and validated in ArcGIS Pro before conducting the migration of the implementation language.**
  - 2. Direct Migration – Migrate COGTools directly from the current VB.NET implementation to C# (or an alternate programming language) in ArcGIS Pro. While potentially faster, this approach introduces higher risk, as it combines two major changes — platform migration and language conversion — at the same time. This could increase the likelihood of errors, complicates troubleshooting, and may require significantly more effort in testing and debugging to ensure feature parity with the current tools.**
5. Is there an opportunity for MWCOG to conduct a pre-bid conference allowing bidders to see demonstrations of the tools and their use cases?

**No pre-bid meeting was held or is scheduled.**

6. Does MWCOG possess any architecture/workflow diagrams, or technical documentation, related to the tools that bidders could review prior to submission of proposals?

**For additional details on the functionality and features of the current tools, refer to the COGTools User Guide (Attachment #1).**

7. What volume of transit network features must be converted to any-time transit networks?

**The current MWCOG UGDB includes an any-year highway network (highway link and highway node features in ArcGIS) as well as individual transit networks (for each individual year in a study). In other words, COGTools can be used to edit and export the highway network for any year in the UGDB. By contrast, transit networks (bus and rail routes) are currently stored separately by year within the UGDB. For example, the database may**

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contain a base-year 2025 transit network along with additional analysis-year networks for 2030, 2040, 2050, and beyond. Each transit network is distinguished by the attribute "TransitYear" in the transit network dataset. See Attachments #2 and #3.

Presuming that a viable solution has been identified for Task 3, the selected contractor will be required to conduct Task 3 : **Convert Year-Specific Transit Networks into an Any-Year Transit Network. MWCOG Staff proposed following solution :**

**CONTRACTOR** will convert the individual year-specific transit networks into a unified, continuous transit network by introducing two key attributes: "start year" and "end year." These attributes will define the operational period of each transit route, stop, or network segment, allowing a single dataset to represent the transit system across multiple years.

If vendors believe that there is a critical flaw preventing the execution of Task 3, they should make this clear in their RFP proposal.

8. Who developed the alternate migration approaches outlined in the RFP?

**COG/TPB staff developed the alternative migration approaches outlined in the RFP. It is COG/TPB staff that is primarily responsible for maintaining and updating COGTools. Nonetheless, COG/TPB staff is open to alternative approaches from the vendors in their proposals.**

9. Can you share a data model for the unified geodatabase? If not, can you provide the estimated number of tables and rows in each table?

Attachment #2 provides the data model for the highway networks. Attachment #3 provides the data model for the transit networks. Statistics about the COGTools UGDB are provided in Attachment #4.

10. a. Is the User Guide referenced on page 4 available for the proposers to review? If the User Guide is not available, can you share the main function that the COGTools provides?

b. Is there an existing user guide or documentation for the COGTools?

**Yes. See Attachment #1 (COGTools User Guide, dated 2022).**

11. On page 14 Item B.5 you ask for an example scope of work, technical approach, work plan, and proposed staffing for one of the optional tasks. What optional tasks are you referring to?

As noted on p. 3 (Summary Table) of the RFP:

COGTools is an ArcGIS add-in, written in VB.NET, used for developing and maintaining transportation networks used in the COG/TPB Regional Travel Demand Forecasting Model. COGTools needs to be migrated from ArcGIS 10.8 to ArcGIS Pro. COGTools also needs to be migrated from VB.NET to a new programming language, such as C#. There are two alternatives for the migration:

- Alternative 1 – Direct Migration (ArcGIS 10.8 + VB.NET would be migrated directly to

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ArcGIS Pro + C#)

- Alternative 2 – Phased Migration (i.e., first, ArcGIS 10.8 + VB.NET would be migrated to ArcGIS Pro + VB.NET, and, then the vendor would conduct a subsequent migration to ArcGIS Pro + C#)

In their proposals, the contractor will propose cost estimates and timelines on both alternatives, explain their preferred approach with justification, and propose detailed steps to complete each of the four tasks that are detailed in this RFP.

Based on the contractor proposals, COG/TPB staff will decide which approach to take (Alternative 1 or Alternative 2).

Once the contract is awarded, the contractor will perform the two-part software migration (i.e., platform migration and programming language migration) using the selected alternative approach.

12. Please provide additional clarification on the Lockbox and how to access that or is that the equivalent of the Submission button at the bottom of the Bonfire opportunity page?

See the Submission tab on the project page. If you need additional support, please email [support.bonfire@eunasolutions.com](mailto:support.bonfire@eunasolutions.com)

13. In Section 3, the RFP states that “the proposed CONTRACTOR and any Subcontractor(s) shall provide at least three (3) references.” Could you please clarify whether: • Both the prime contractor and each proposed subcontractor are expected to provide three (3) references each, or • A combined set of at least three (3) references across the project team would be acceptable?

Both the prime contractor and the subcontractor should each provide at least three references.

14. For the required “Debarment Form” listed under Required COG Forms, is there a specific template that should be used, or should proposers prepare and submit their own statement?

Refer to Public Notices Addendum #1

15. Is there a cost range or do not exceed budget for this project?

COG anticipates fixed priced funding not to exceed \$150,000.

16. How many total users use COGTools? How many simultaneous users are there?

COGTools is for internal use only, with about four users in total. There is no need for simultaneous access. We would like the database to be simple and portable.

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**Attachments:**

1. **COGTools User Guide, 5/2/22 (MWCOG-COGTool-USER-Guide05022022.pdf)**
2. **Data model/entity relationship diagram for COG's Unified Network Geodatabase (UGDB): Highway Network (Highway.pdf)**
3. **Data model/entity relationship diagram for COG's Unified Network Geodatabase (UGDB): Transit Network (Transit.pdf)**
4. **Statistics about the COGTools UGDB (cogTOOLS\_Statistics.xlsx): Set of software statistics that provide developers better insight into the COGTools software, such as the source code file name, member functions/methods of modules and classes of COGTools, as well as number of lines of COGTools' source code.**

# COGTOOLS USER GUIDE

<b>Revision</b>	<b>Description</b>	<b>Revised by</b>	<b>Date</b>
Revision 1.0	Initial Release	Qiang Li	06/18/2008
Revision 2.0	Add Transit Network Editing Tools	Qiang Li	01/15/2009
Revision 3.0	Add Several Functions	Jim Yin	10/17/2013
Revision 4.0	ArcGIS 10.3 Migration, Unified Database Application and Other Major Updates since 2013	Jim Yin	05/02/2022

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## 1. INTRODUCTION

A database is an organized collection of data, typically stored and accessed electronically. A database management system (DBMS) is software for managing the data in the database, in a way that ensures and maintains data integrity. A geodatabase, also known as a spatial database, is a database containing geographic features, such as roads and intersections, which are generally represented as abstract geometries, such as points, lines, and polygons. A Geographic Information System (GIS) is a DBMS designed to work with spatial databases. One of the most popular GIS software packages is ArcGIS, developed by Esri, and whose flagship software is ArcMap. COGTools is a customized add-in ArcGIS tool designed to work with Esri geodatabases, which represent transportation networks (highway and transit) that are used as inputs to the National Capital Region Transportation Planning Board's (TPB's) regional travel demand forecasting model.<sup>1</sup> The TPB's travel model is developed and maintained by staff of the Metropolitan Washington Council of Governments (MWCOG or COG), with some consultant assistance. The original COGTools application was developed in 2008 by the Daniel Consultants, Inc. Since about 2010, COGTools has been maintained and updated by COG staff.

Finally, it is useful to note the distinction between “geometric networks” and “logical networks,” which are terms used with ArcGIS and ArcMap. Geometric networks offer a way to model common networks and infrastructures found in the real world, such as water distribution, electrical lines, gas pipelines, telephone services, and water flow in a stream.<sup>2</sup> When a geometric network is created, the geodatabase also creates a corresponding logical network, which is used to represent and model connectivity relationships between features. As noted in the ArcGIS online documentation:

*The logical network is the connectivity graph used for tracing and flow operations. All connectivity between edges and junctions is maintained in the logical network.*

*The logical network is managed as a collection of tables that are created and maintained by the geodatabase. These tables record how the features involved in a geometric network are connected to one another. The logical network allows the geometric network to quickly discover and model the connectivity relationships between connected edges and junctions in a geometric network*

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<sup>1</sup> See, for example, Meseret Seifu, Ronald Milone, and Mark Moran, “Highway and Transit Networks Used in the Air Quality Conformity Analysis of the 2020 Amendment to Visualize 2045 and the FY 2021-2024 TIP (Ver. 2.3.78 Travel Model)” (Washington, D.C.: Metropolitan Washington Council of Governments, National Capital Region Transportation Planning Board, April 10, 2020), <https://www.mwcog.org/transportation/data-and-tools/modeling/model-documentation/>.

<sup>2</sup> Esri, “What Are Geometric Networks?,” ArcMap Documentation, 2021, <https://desktop.arcgis.com/en/arcmap/latest/manage-data/geometric-networks/what-are-geometric-networks-.htm>.

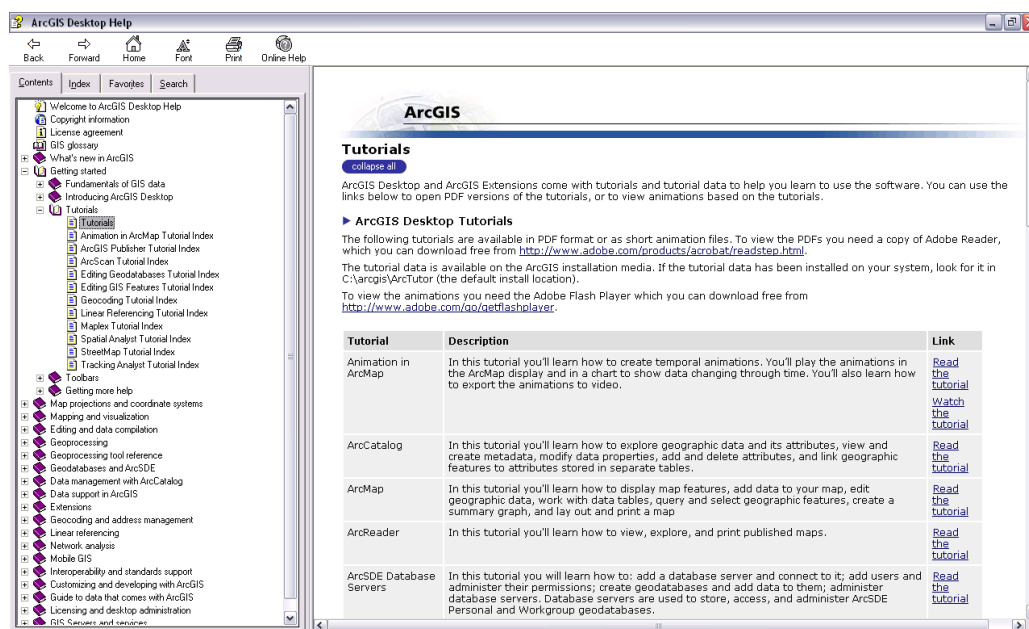
during editing and analysis. This allows fast network tracing and facilitates the generation of on-the-fly connectivity while editing.<sup>3</sup>

Note that the current online ArcGIS documentation states, “Transportation networks, such as roads, are best modeled in ArcGIS by network datasets.”<sup>4</sup> However, COGTools was not designed using network datasets and working with network datasets and performing analyses on them requires the ArcGIS Network Analyst extension, which some agencies may not have.

## 2. BEFORE YOU BEGIN

### 2.1 Familiarity with ArcGIS

As the COGTools application is implemented as an ArcGIS extension, the user should be familiar with some basic operations with ArcGIS, such as select features, sketch features and split features, before using this application. Users who are not familiar with ArcGIS are recommended to read the ArcGIS Tutorials. As shown in Figure 1, ArcGIS Tutorials are available from the ArcGIS Desktop Help. Go to the *Contents* tab and select *Getting started* → *Tutorials* → *Tutorials*. Find a link of interest and click it, which will bring up the corresponding tutorial. You might need to install the tutorial data from the ArcGIS setup.



<sup>3</sup> Esri, “Essential Geometric Networks Vocabulary,” ArcMap Documentation, 2021, <https://desktop.arcgis.com/en/arcmap/latest/manage-data/geometric-networks/essential-geometric-networks-vocabulary.htm>.

<sup>4</sup> Esri, “What Are Geometric Networks?”

## Figure 1 ArcGIS Tutorial

### 2.2 GIS Database Application System

As noted earlier, COG staff develops and maintains a network geodatabase to manage transportation planning networks that are used to support various regional transportation planning processes, especially the TPB's travel demand forecasting model, which is implemented using Cube software (Bentley Systems Inc.). The GIS database application system is designed to maintain and operate the COG transportation network geodatabase. The system comprises two major components: A network geodatabase and software for managing the geodatabase (COGTools). Currently, the geodatabase contains both the geometric network with spatial features (described earlier) and the corresponding logical network representing the network connectivity. One complicating factor is that the geodatabase is a multi-year database, so it can represent highway and transit networks for multiple years (e.g., 2020, 2025, 2030). The COGTools application is developed to help with network data processing and operations, including the operations of creating, editing, deleting (permanently removed from database), retiring (retained in database but removed from some or all network years), and splitting links. Other functions provided by the COGTools include: Exporting highway network files in Cube Voyager DBF or Public Transport (PT) format; exporting transit network files in Cube TRNBUILD or PT format; and generating dynamic layers such as base network layer, travel direction layer and transit layer.

The database system currently supports Personal Geodatabases and will potentially support Enterprise Geodatabases such as Microsoft SQL Server and Oracle. In either case, the database administrator (DBA) should be responsible for system configuration and management.

### 2.3 MPO Survey of Network Management Practices

To have a better understanding of the state of the practice for network management, COG conducted a national survey of peer MPOs in 2019. Twenty-three MPOs, consisting of the twenty largest MPOs (based on 2010 population) and three smaller MPOs, known for innovations in travel demand modeling, were requested to complete the survey questionnaire. Twelve of them completed the survey.

The survey responses indicate that different MPOs have different needs for network management tools/processes. Given that network management is, by nature, a very complex process, especially when it involves a multi-year, multi-model (Cube TRNBUILD vs. Cube PT), integrated-scenario network database, it came as no surprise that COG staff did not find from the survey a universal tool that can solve every MPO's problems. On the contrary, the analysis of survey responses suggests that a reliable, customized tool is needed for any MPO to be able to perform multi-year, multi-modal, integrated scenario network management tasks. A comparison of the network management practices between COG and peer MPOs indicates that the COG

database application performs reasonably well in serving the network management needs of this agency. More details of the survey can be found in a technical memo.<sup>5</sup>

The remainder of this User's Guide addresses the structure and configurations of the COG database application. Chapter 2 addresses COGTools installation in greater detail. Chapter 3 presents system configurations of the network geodatabase. Chapter 4 describes the current and planned network geodatabase structure including major enhancements to COGTools. Chapter 5 presents in detail the Graphical User Interface (GUI) of the COGTools toolbar and editor windows. Chapter 6 describes the main operations of COGTools in greater detail which is the focus of this user manual.

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<sup>5</sup> Jim Yin to Mark Moran, "MPO Survey of Network Management Practices", COG/TPB Memorandum, 1/6/2020, <https://www.mwcog.org/file.aspx?&A=7gMA90V0I5fBTfUZPgGs2GS5VWwYE1R8x6wDlvNisoE%3D> (Internal ref link: I:\ateam\docum\FY20\memos\NetworkSurvey2019\_v11.pdf)

### 3. COGTOOLS INSTALLATION

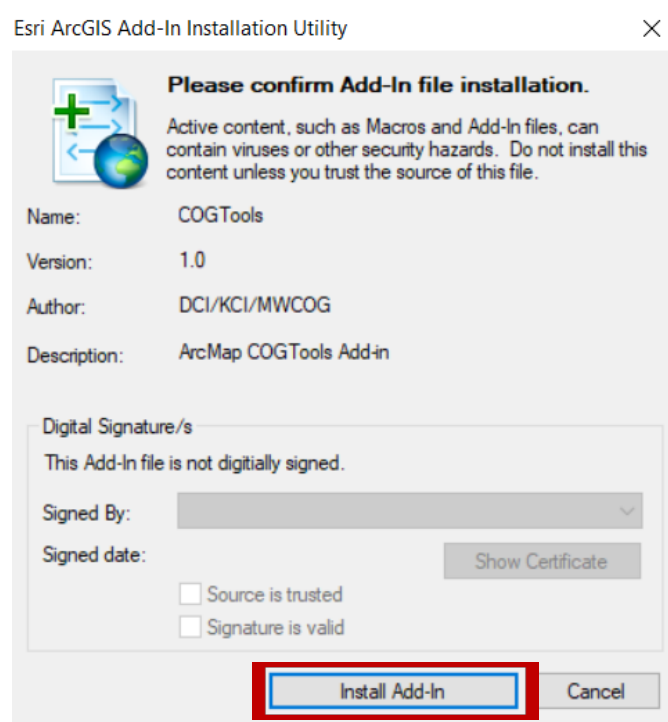
Since COGTools is an add-in to Esri's ArcGIS ArcMap, to install COGTools, your computer must have ArcMap installed. COGTools is known to work with ArcMap version 10.3 The current version of COGTools is COGTool04262002

There are four COGTools-associated installation files, as shown in the following list:

1. COGTools.dll
2. COGTools.esriAddIn
3. COGTools.pdb
4. COGTools.xml

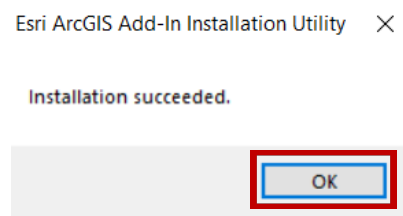
The user should copy these files to the designed subdirectory of their personal computer (PC). If a previous version of COGTools is installed, the user should delete and install the updated files.

To install the tool to the ArcGIS software, double click on the "COGTools.esriAddIn" file and a pop-up window as shown in figure 2 will appear:



**Figure 2 COGTools Installation, part 1**

Click the "Install Add-In" button on the screen. If everything goes as expected, the "Installation Succeeded" pop-up window (shown in Figure 3) will appear. Click the "OK" button to finish the installation.



**Figure 3 COGTools Installation, part 2**

## 4. SYSTEM CONFIGURATIONS

There are four configuration tables in the geodatabase – two of them are for user access control, one for data field operations, and one for definition of network node ranges. Only authorized users (e.g., the database administrator, or DBA) can make changes to these configurations.

### 4.1 User Privilege Configuration

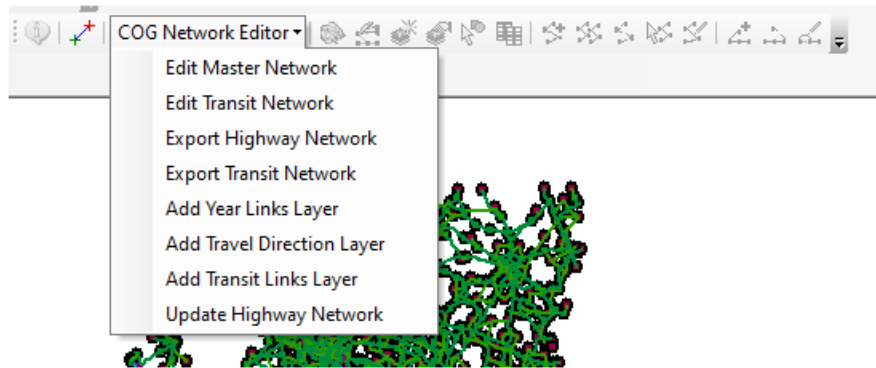
Two tables are involved in the user privilege configuration: *RoleProfile* and *UserProfile*. Only the DBA can modify these two tables. However, they should be readable to other users because the COGTools software will have to retrieve the user privilege information from these two tables in the application mode. It should be noted that the two tables are included in the geodatabase, but they cannot be accessed through the COGTools. Instead, they can be viewed by opening the geodatabase file (e.g., .mdb files) in Microsoft Access. Currently, the *UserProfile* table in the COG network database is made visible solely to the DBA.

The *RoleProfile* table includes three fields (besides the OBJECTID): RoleName, Task, and Tool as shown in Figure 4.

OBJECTID	RoleName	Task	Tool
1	Admin	1	1
2	Admin	2	2
3	Admin	3	3
4	Admin	4	4
5	Admin	5	5
6	Admin	6	6
7	PowerUser	1	1
8	PowerUser	2	2
9	PowerUser	3	3
10	PowerUser	4	4
11	PowerUser	5	5
12	PowerUser	6	6
13	CommonUser	0	0
14	CommonUser	0	0
15	CommonUser	3	0
16	CommonUser	4	0
17	CommonUser	5	5
18	CommonUser	6	6
*	(AutoNumber)		

**Figure 4 User Privilege Configuration**

“RoleName” defines a role, while “Task” and “Tool” define the privileges associated with the role. For example, role name “Admin” has all privileges provided by COGTools. “Task” defines which menus can be used by a specific role, and “Tool” defines which editing buttons can be used by the role. Codes corresponding to different tasks (menus) and tools (buttons) are defined in Table 1 and Figure 5 shows the corresponding tasks (menus) and tools (buttons) in the COGTools graphical user interface (GUI). A zero (0) value in the Task/Tool field means no privilege and is used as a placeholder. The DBA can add new role records or modify records that define the existing roles.



**Figure 5 COGTools Task/Tool Items**

**Table 1 Definition of Values in Task/Tool fields**

	Menu	Tool	
		Highway Button	Transit Button
1	Edit Master Network	Create New Link	Add Route
2	Edit Transit Network	Edit Link	Copy Route
3	Export Highway	Delete Link	Delete Route
4	Export Transit	Split Link	Select route
5	Add Year Links Layer	Add Selected Link(s)	Edit Route
6	Add Travel Direction Layer	Copy Feature	Extend Route
7	Add Transit Layer		Shrink Route
8	Update Highway Network		Modify Route

The *UserProfile* table has two fields (besides the OBJECTID): UserName and RoleName, as shown in Figure 6. Each entry (row) in this table defines a user with the corresponding role. The DBA can either add new users or make modifications to existing users such as changing usernames and modifying user roles.

OBJECTID	UserName	RoleName
1	DBAdmin	Admin
2	APowerUser	PowerUser
3	ACommonUser	CommonUser

Record: 3 of 3  
Datasheet View

**Figure 6 User Profile Table**

**Note:** The UserName should be the username used to connect to the geodatabase, which is the Windows login name when using a personal geodatabase/SQL Server with Windows NT authorization, or the database username when using a SQL Server with Database Authorization.

## 4.2 Fields Editable Configuration

The *LayersConfiguration* table is designed to manage the fields editable configuration as shown in Figure 7. The fields editable configuration specifies which fields in the network table will be shown in the COGTools (*FieldVisible*), which ones are editable (*FieldUpdatable*), which ones are eligible for batch updating (*MassUpdatable*), and which ones accept no null value (*NotNull*). Other fields in this table should be kept as they are because they are either retrieved from other table fields or deprecated for use. Currently, the table contains four layers, BaseLinksLayer, TransitLinksLayer, TransitStopsLayer, and TransitRouteLayer, that can be configured for field editing.

LayerID	LayerName	SourceTable	FieldName	FieldVisible	MassUpdatable	Selectable	ObjectQuery	DomainName	FieldType	FieldUpdatable	FieldAutoUpdate	NotNull
1	BaselinksLayer	Baselinks	OBJECTID						6			
1	BaselinksLayer	Baselinks	LinkID						1			
1	BaselinksLayer	Baselinks	EdgeID						1			
1	BaselinksLayer	Baselinks	FromNode						1			
1	BaselinksLayer	Baselinks	ToNode						1			
1	BaselinksLayer	Baselinks	BaseYear						1			
1	BaselinksLayer	Baselinks	SourceID						4			
1	BaselinksLayer	Baselinks	SourceYear						1			
1	BaselinksLayer	Baselinks	NetworkYear						1			
1	BaselinksLayer	Baselinks	NetworkYearStar						1			
1	BaselinksLayer	Baselinks	NetworkYearEnd						1			
1	BaselinksLayer	Baselinks	ANode						1			
1	BaselinksLayer	Baselinks	BNode						1			
1	BaselinksLayer	Baselinks	WPK2						4			
1	BaselinksLayer	Baselinks	TravelDirection						4			
1	BaselinksLayer	Baselinks	TravelRestricti						1			
1	BaselinksLayer	Baselinks	NumberLanes						1			
1	BaselinksLayer	Baselinks	Distance						3			
1	BaselinksLayer	Baselinks	SpeedLimit						3			
1	BaselinksLayer	Baselinks	HOVFLag						0			
1	BaselinksLayer	Baselinks	SFPFlag						0			
1	BaselinksLayer	Baselinks	TOLL						0			
1	BaselinksLayer	Baselinks	TollGroup						1			
1	BaselinksLayer	Baselinks	FType						1			
1	BaselinksLayer	Baselinks	LType						4			
1	BaselinksLayer	Baselinks	AType						1			
1	BaselinksLayer	Baselinks	AMLane						1			
1	BaselinksLayer	Baselinks	PMLane						1			
1	BaselinksLayer	Baselinks	OPLane						1			
1	BaselinksLayer	Baselinks	Limit						1			
1	BaselinksLayer	Baselinks	AMLimit						1			
1	BaselinksLayer	Baselinks	PMLimit						1			
1	BaselinksLayer	Baselinks	OPLimit						1			
1	BaselinksLayer	Baselinks	ScreenLine						1			
1	BaselinksLayer	Baselinks	TravelCost						3			
1	BaselinksLayer	Baselinks	CostUnit					CostUnit	1			
1	BaselinksLayer	Baselinks	ProjectID						4			
1	BaselinksLayer	Baselinks	ZoneID						1			

Figure 7 Layers Configuration Table

### 4.3 Node Ranges Configuration

The *NodeRange* Table defines the node ranges used for specific jurisdictions, facilities, and transit network elements as shown in Figure 8. There are seven fields (besides the OBJECTID) in this table: *NodeType*, *NodeTypeDescription*, *NodeSubType*, *Jur*, *Name*, *Low*, and *High*. The *NodeTypeDescription* field provides a description of *NodeType*, the *Name* field provides the name of the corresponding jurisdiction/facility/network element, and the other five fields can be edited to specify the node range of a specific *NodeType/NodeSubType*.

NodeType	NodeTypeDesc	NodeSubType	JUR	NAME	LOW	HIGH
1	Highway Node		0	A. District of Columbia	8400	9999
1			1	B. Montgomery County	3000	3999
1			1		15000	15299
1			2	C. Prince George's County	4000	4999
1			3	D. Arlington County	5000	5499
1			4	E. Alexandria	5500	5999
1			5	F. Fairfax County	6000	6385
1			5		6500	6899
1			5		10501	10900
1			7	G. Prince William County	6386	6499
1			7		7000	7100
1			7		10151	10200
1			7		10401	10450
1			7		16000	16199
1			6	H. Loudoun County	6900	6999
1			6		7101	7299
1			6		15600	15799
1			9	I. Frederick County	13200	13499
1			14	J. Carroll County	13500	13599
1			10	K. Howard County	13600	13799
1			11	L. Anne Arundel County	13000	13199
1			11		13800	13999
1			15	M. Calvert County	14000	14099
1			16	N. Saint Mary's County	14100	14199
1			12	O. Charles County	14200	14399
1			17	P. King George County	14400	14499
1			19	Q. Stafford / City of Fredericksburg	14500	14699
1			20	R. Spotsylvania County	14700	14799
1			21	S. Fauquier County	14800	14899
1			22	T. Clarke County	14900	14949
1			23	U. Jefferson County	14950	14999
4	Metrorail Station			A. Station	7301	7417
4				B. Future Station	7418	7449

**Figure 8 Node Range Configuration Table**

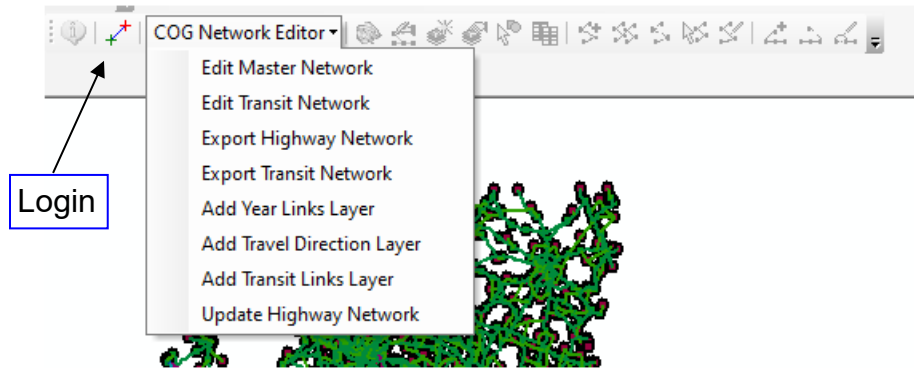
Different entries (rows) with the same *Jur* value will be combined to define the overall node range for the corresponding jurisdiction. As shown in Figure 8, a jurisdiction could correspond to multiple discrete node ranges. It is recommended to extend the node range of a jurisdiction by adding new node ranges for the jurisdiction, instead of changing the node ranges of existing records. The node ranges coded in the current COG geodatabase are shown in Table 2 below. The database originally was designed to handle highway nodes between 20000 and 54999. However, when the network was expanded, some jurisdictions ran out of node numbers. Therefore, the 120000 to 154999 node number range was introduced to the database for potential future use.

**Table 2** COG Network Node Ranges and Jurisdiction

JUR	NAME	LOW	HIGH
	Existing centroid nodes	1	3724
	Additional centroid nodes	3725	5000
	Future use- not available at this time	5001	7999
	Metrorail Station & Future Station	8000	8999
	Commuter Rail Station	9000	9999
	Light Rail Station	10000	10499
	BRT Street Node	10500	10999
	Metrorail Parking Lot	11000	11999
	Commuter Rail Parking Lot	12000	12999
	Bus/Light PNR Lot nodes	13000	13999
	Light Rail PNR Nodes	14000	14499
	Future use transit PNR node- future subtype	14500	14999
0	District of Columbia	20000	21999
1	Montgomery County	22000	25999
2	Prince George's County	26000	29999
3	Arlington County	30000	31999
4	Alexandria	32000	33999
5	Fairfax County	34000	37999
6	Loudoun County	38000	39999
7	Prince William County	40000	41999
9	Frederick County	42000	43999
10	Howard County	44000	45499
11	Anne Arundel County	45500	46999
12	Charles County	47000	47999
14	Carroll County	48000	48999
15	Calvert County	49000	49499
16	Saint Mary's County	49500	49999
17	King George County	50000	50499
18	City of Fredericksburg	50500	50999
19	Stafford County	51000	51999
20	Spotsylvania County	52000	52999
21	Fauquier County	53000	53999
22	Clarke County	54000	54499
23	Jefferson County	54500	54999
0	District of Columbia	120000	121999
1	Montgomery County	122000	125999
2	Prince George's County	126000	129999
3	Arlington County	130000	131999

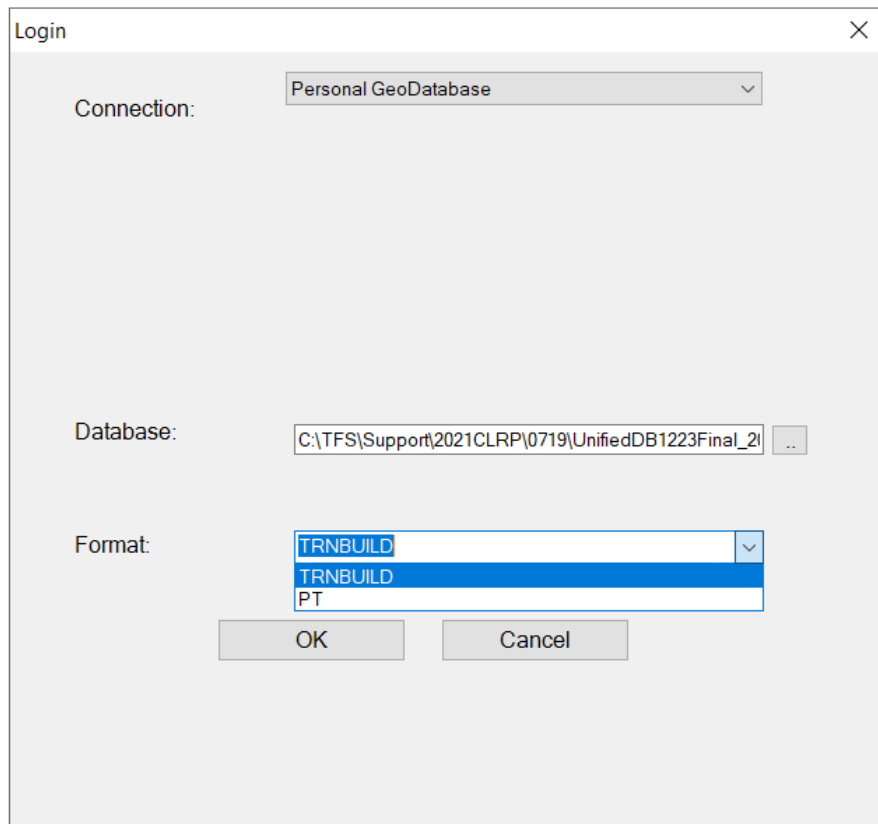
4	Alexandria	132000	133999
5	Fairfax County	134000	137999
6	Loudoun County	138000	139999
7	Prince William County	140000	141999
9	Frederick County	142000	143999
10	Howard County	144000	145499
11	Anne Arundel County	145500	146999
12	Charles County	147000	147999
14	Carroll County	148000	148999
15	Calvert County	149000	149499
16	Saint Mary's County	149500	149999
17	King George County	150000	150499
18	City of Fredericksburg	150500	150999
19	Stafford County	151000	151999
20	Spotsylvania County	152000	152999
21	Fauquier County	153000	153999
22	Clarke County	154000	154499
23	Jefferson County	154500	154999

## 5. NETWORK GEODATABASE



**Figure 9 Login Button**

As shown in Figure 9, click the “Login” button on the COGTools GUI to bring up the geodatabase login window (which is shown below in Figure 10).

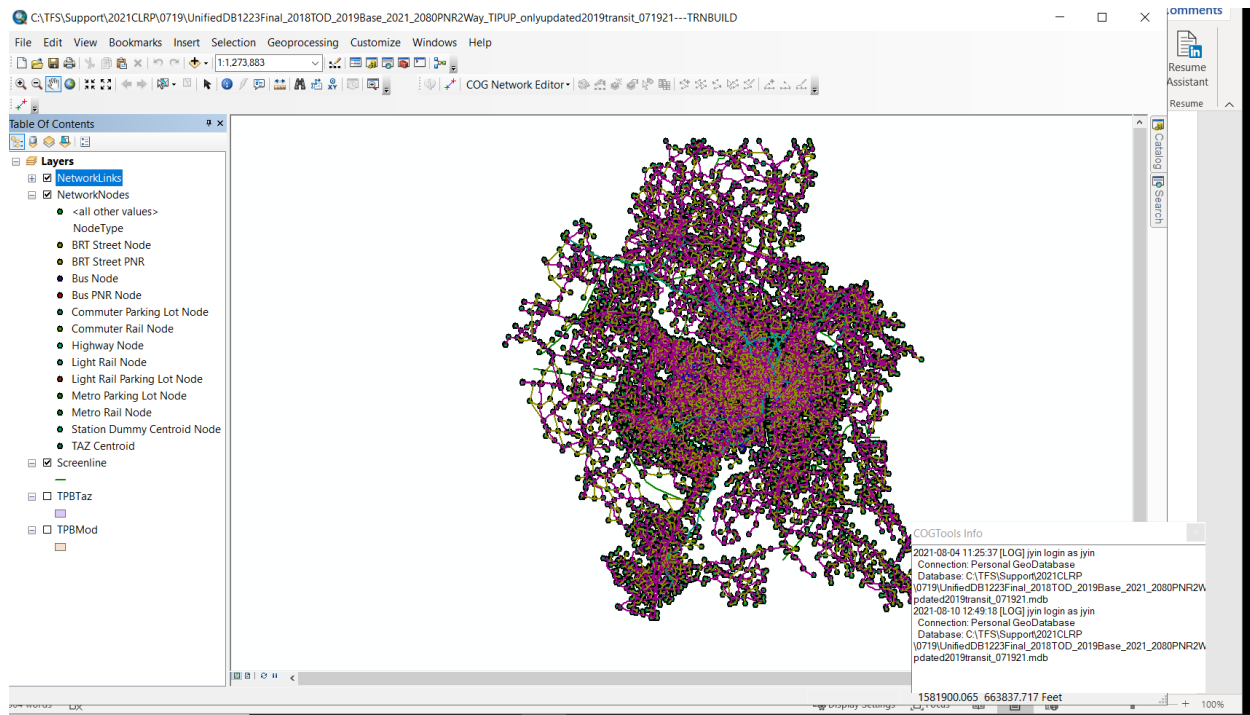


**Figure 10 Geodatabase Login Interface**

On the login screen (Figure 10), the user may choose to open the database either in Cube TRNBUILD or Cube Public Transport (PT) format. Since 2021, COG staff have been using the Unified network geodatabase, which combines TRNBUILD and PT networks in one database.

## 5.1 Geodatabase Structure

The network geodatabase contains five feature layers (*NetworkNodes*, *NetworkLinks*, *Screenline*, *TAZ\_TPBMod*, *TPBMod*) and four standalone tables (*BaseLinks*, *TransitLinks*, *TransitRouteStops*, and *TransitLineDefinition*). These layers will be added automatically to an ArcMap window as shown in Figure 11 after the user successfully logs in through the COGTools bar.



**Figure 11 An ArcMap Window for COG Networks**

**NetworkNodes:** contains the information about all network nodes. Some important fields in the attribute table of this layer include its shape, X/Y coordinates, node ID, node type, and jurisdiction ID.

**NetworkLinks:** contains the geometric information about network links. Some important fields in the attribute table of this layer include its shape, length, link type, one way/two way flag<sup>6</sup> and jurisdiction ID.

<sup>6</sup> In the current settings, counterintuitively, a value of “1” indicates a “two way” link while a value of “2” indicates “one way”.

The network links Feature Class with "Link Type" codes (1-24) and the network nodes Feature Class with "Node Type" codes (1-13) are Listed in Table 3.

**Table 3 COG Network Link Type and Node Type**

Link Type				Node Type	
1	Highway Link	13	Light Rail PNR to Station	1	Highway Node
2	Bus Link	14	BRT/Street Link	2	Bus Node
3	TAZ Connector	15	BRT/Street PNR to Station	3	TAZ Centroid
4	Metro Rail Link	16	BRT/Street to Bus	4	Metro Rail Node
5	Commuter Rail Link	17	Hwy to Metro PNR	5	Commuter Rail Node
6	Light Rail Link	18	Hwy to COMM PNR	6	Light Rail Node
7	Light Rail to Bus Stop	19	Hwy to LRT PNR	7	Light Rail Parking Lot Node
8	Metro Station to Bus Stop	20	Hwy to Metro KNR	8	Metro Parking Lot Node
9	Commuter Station to Bus Stop	21	Hwy to COMM KNR	9	Commuter Parking Lot Node
10	Metro PNR to Station	22	Hwy to LRT KNR	10	Bus PNR Node
11	Commuter PNR to Station	23	BusPNR-ro-BusSta	11	BRT Street PNR
12	Bus PNR to Station	24	wk-xfer	12	BRT Street Node
13	Light Rail PNR to Station			13	Station Dummy Centroid Node

**Screenline:** contains the geometric information about regional screenlines used for the validation of the TPB’s travel demand models. Some important fields in the attribute table of this layer include its shape and Screenline ID.

**TPBMod:** contains the geometric information of jurisdictions in the TPB Modeled Area.

**BaseLinks:** contains the logical information of highway and transit network link attributes. For each network link record, it may contain more than one record to represent different analysis years/scenarios. Some important fields in this table include ANode, BNode, NetworkYear, ProjectID, TravelDirection, and Distance.<sup>7</sup>

**TransitLinks:** contains the logical information of network links that constitute transit lines. Some important fields in this table include ANode, BNode, NetworkYear and LinkSequence.

**TransitRouteStops:** contains the logical information of transit stops that constitute transit lines. Some important fields in this table include NodeID, TransitRouteID, NodeSequence, and Status.

<sup>7</sup> Highway and Transit Networks Used in the AQC Analysis of 2020 Amendment to Visualize 2045 and the FY 2021-2024 TIP (Ver 2.3.78 Travel Model), Pages 99-100.

**TransitLineDefinition:** contains the logical information of transit lines or routes. Some important fields in this table include NodeID, TransitRouteID, NodeSequence, and Status (which indicates if a link is active or retired).

Attributes maintained in the Transit Links, Transit Route Stops, and Transit Lines Definition tables are listed in detail in the Version 2.3.78 Highway and Transit Network report.<sup>8</sup>

COGTools software is designed to facilitate network editing and network database management. The functions of COGTools could be classified into three categories:

1. Editing Networks
  - a. Highway Link Editing
    - Create New Link
    - Edit Link Attributes (such as number of lanes, facility type, or completion date)
    - Delete Link (remove from database)
    - Retire Link (retain in database, but remove from some or all network years)
    - Split Link
  - b. Transit Route Editing
    - Add/Copy/Delete Transit Route
    - Extend Transit Route
    - Shrink Transit Route
    - Edit Transit Route
    - Edit Transit Route Attributes (such as run time and headway)
2. Exporting Networks (Highway and Transit)
  - Cube Voyager highway and transit Network Files in TRNBUILD Format
  - Cube Voyager highway and transit Network Files in Public Transport (PT) Format
  - Personal GDB
3. Generating Dynamic Layers of
  - Base Network
  - Travel Direction Network
  - Transit Network

## 5.2 Migrating Personal Geodatabase to ArcSDE Enterprise Geodatabase

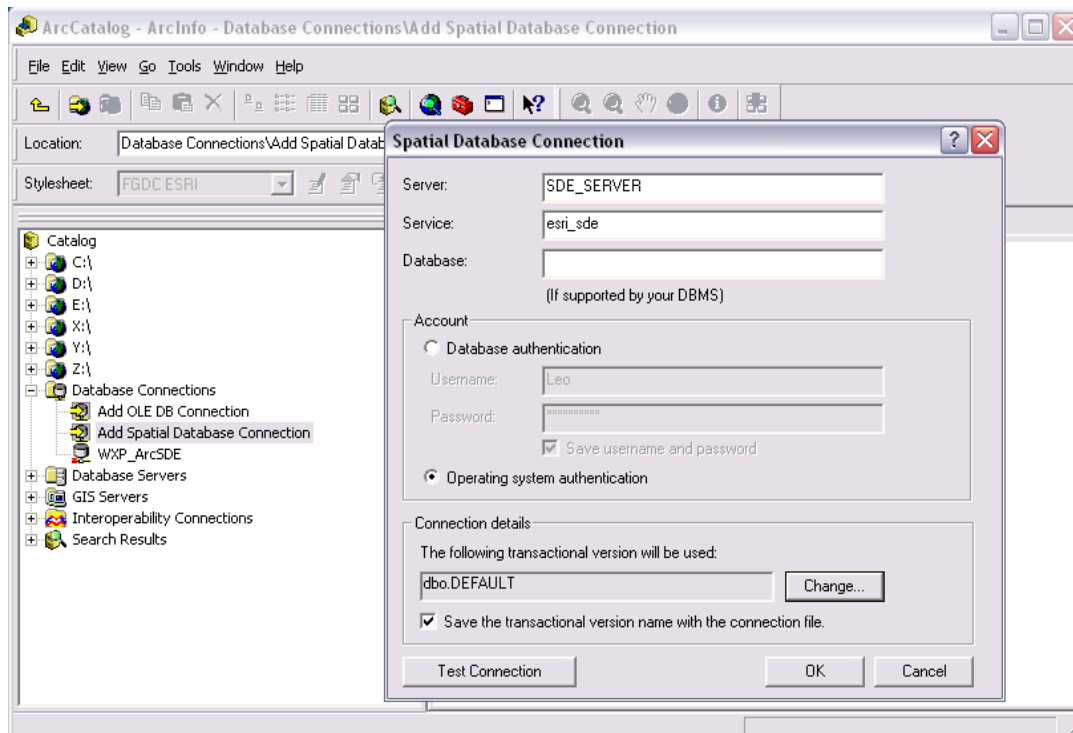
Currently, COG staff uses personal geodatabases for all transportation network development. The personal geodatabase is flexible and user friendly. It provides the user the most flexibility to view, query and edit the data directly from the database, which, however, may compromise database integrity. The biggest concern for using personal geodatabase is size (it can handle only files less than 2 GB in size) and has a limited multi-user access capability. ArcSDE Enterprise Geodatabase provides a solution to those issues. The enterprise geodatabase is the foundation for

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<sup>8</sup> Highway and Transit Networks Used in the AQC Analysis of 2020 Amendment to Visualize 2045 and the FY 2021-2024 TIP (Ver 2.3.78 Travel Model) Pages 101-102.

building a large-scale GIS. It uses a combination of ArcObjects, ArcSDE technology, and relational DBMS (RDBMS) software to define how data is stored, accessed, and managed by ArcGIS. Conceptually, it stores GIS data in a centralized location.

The procedure to migrate a personal geodatabase to an enterprise geodatabase on an SQL Server begins with establishing an enterprise spatial database connection using ArcCatalog. This process entails using a Spatial Database Connection window to specify the server, service, and user account (as shown in Figure 12). Once established, the folder schema of that data server will appear in the application screen.

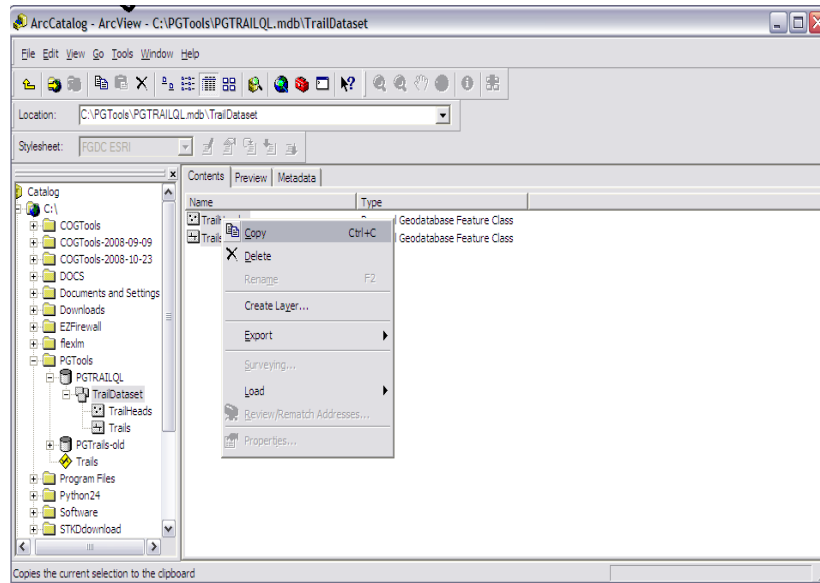


**Figure 12 Database Server Login**

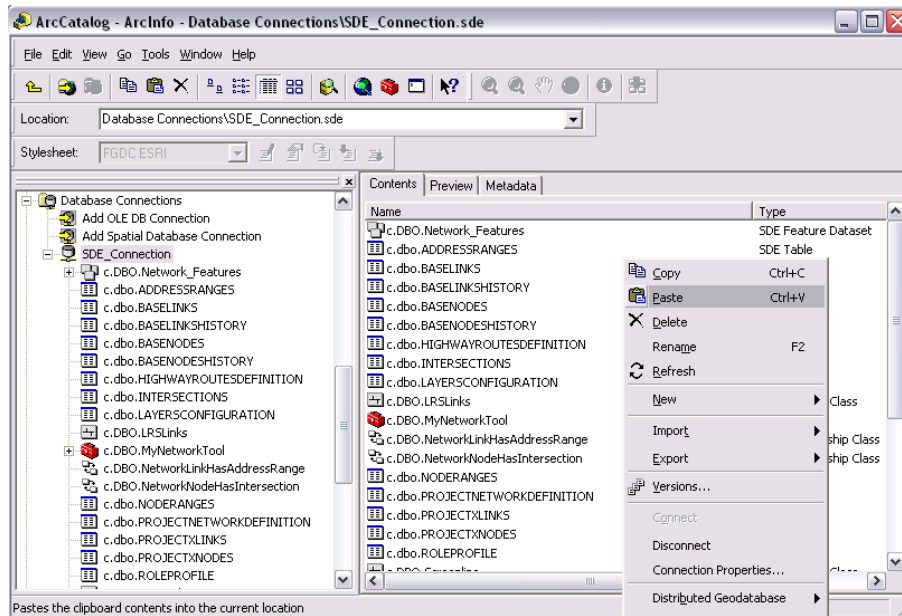
The contents of the folders can be viewed in ArcCatalog where spatial datasets are listed and displayed with special icons that indicate the different data formats. The DBA can navigate to the local folder containing the personal geodatabase to open a context menu and select the copy option as shown in Figure 13. Next, the DBA can navigate to an enterprise database folder on the remote server, open a context menu and select the paste option as shown in Figure 14. This simple “copy and paste” operation can move all the geodatabase table schemas, subtype and attribute domains, spatial features, and geometric rules from a personal geodatabase to an enterprise database. Below are the step-to-step operations to migrate from a personal geodatabase:

1. In the Catalog tree, click the personal geodatabase from which you want to migrate.
2. On the Contents tab, while holding down the Shift key, click the first data item and the last data item to select all objects in the list.

3. Right-click and select Copy.
4. Connect to the ArcSDE Enterprise geodatabase to which you want to migrate by creating a spatial database connection.
5. Right-click the ArcSDE Enterprise geodatabase to which you want to migrate and click Paste.
6. On the data Transfer dialog box, confirm that all the data items you want to migrate are listed.
7. Click OK



**Figure 13 Copy File Window**



**Figure 14 Paste File Window**

Once the migration operations are completed, the geodatabase, by default, becomes a read-only dataset. In order to make the geodatabase editable, the dataset must be registered as “versioned.” This procedure is completed by right-clicking and opening the context window associated with the geodatabase feature class and selecting the “Register as Versioned...” option, as shown in Figure 15. The versioned geodatabase is subsequently managed through a “Version Manager”.

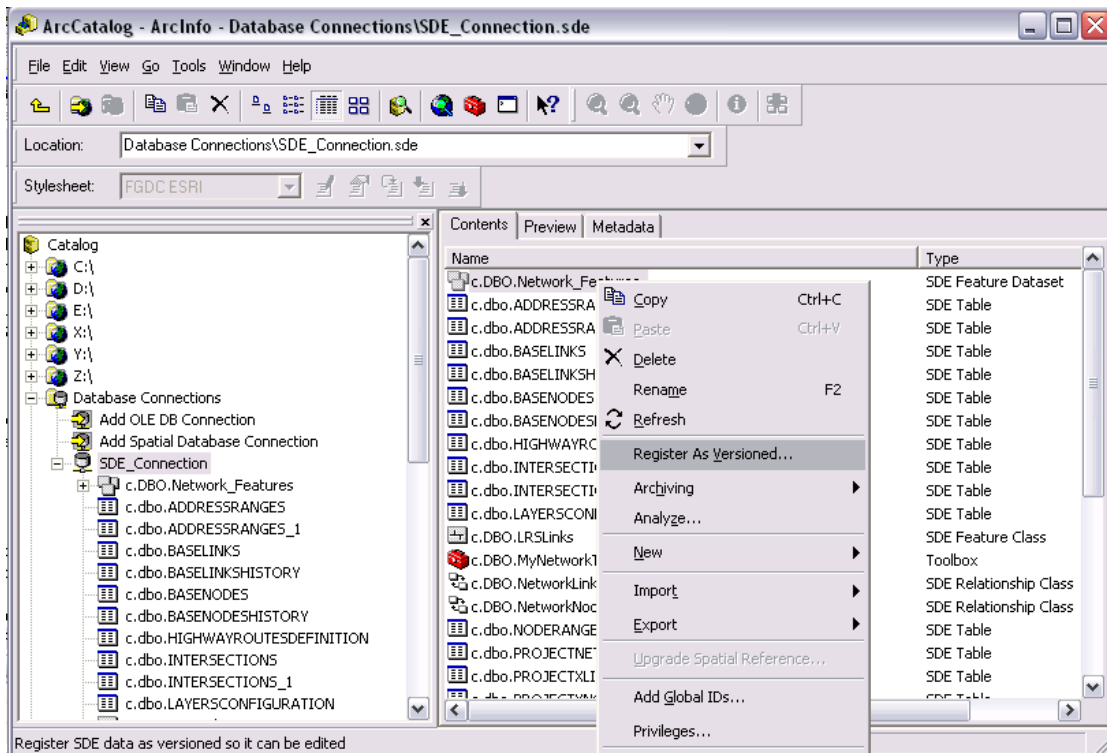


Figure 15 Version Registration of GIS Layers

### 5.3 Major Enhancements to MWCOG Network Geodatabase since 2013

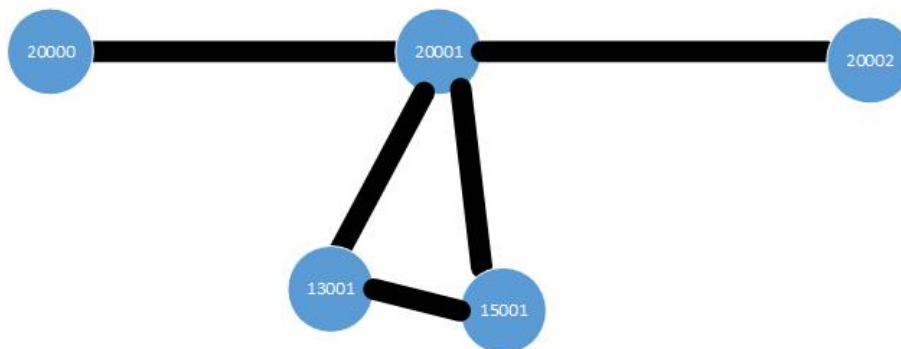
In the last decade, COG staff has been using Cube TRNBUILD networks for the TPB's Generation 2, or Gen2, travel demand models. Currently, COG has retained consulting firms to develop the TPB's next-generation travel demand model, known as Generation 3, or Gen3, Travel Model. The Gen3 Model adopts Cube's Public Transport (PT) for transit modeling. As COG continues to support the Gen2 Model while developing the Gen3 Model, TRNBUILD and PT networks will coexist in the network database. An existing procedure to convert a TRNBUILD network to PT format is both time-consuming and error prone. To solve this problem, COG staff developed a unified database where TRNBUILD and PT components are included in one place. The user may select which format to work on when logging in to COGTools. Network changes made in either format are updated in both formats, as appropriate. However, it is necessary to both open and export the network files in the appropriate format (TRNBUILD or PT) in order for the files to be accurate for use in the TRNBUILD versus the PT environment. More details regarding the unified database will be provided in the forthcoming Network Development Documents.

Table 4 highlights some differences between TRNBUILD and PT.

**Table 4 TRNBUILD and PT Difference**

Node Range		One Way/Two Way	Common	TRNBUILD	PT	Mode Type		FType	
A	B					TRNBUILD	PT	TRNBUILD	PT
<=3722	>=15000	2	Y			NA	NA	0	0
>=15000	>=15000	2	Y			NA	NA	Various	Various
>=5001 and <=6999	>=20000	2	N	x		4	NA	NA	NA
>=20000	>=11000 and <=13999	N/A	N/A			15 (2-way)	11(1-way)	0	4
>=20000	>=8000 and <=10999	2	Y			12	14	0	4
>=13000 and <=13999	>=15000 and <=15999	1	N		X	NA	15	NA	0
>=15000 and <=15999	>=20000	2	N		X	NA	17	NA	4
>=8000 and <=8999	>=9000 and <=10999	2	Y			12	13	0	0
<=3722	>=8000 and <=9999	2	N		X	NA	12	NA	0

A significant difference between the TRNBUILD and PT networks is the introduction of 15000 range (15000-15999) bus stops in the PT network. 15000 range nodes (Bus Stops) are placed next to the 13000 range nodes (Bus PNR Node). In a network in PT format, any transit bus route that runs through a highway node that has connection with 13000 needs to be rerouted through the new 15000 range node. An example of this is shown in Figure 16.



**Figure 16 Special Bus Node (15000) in PT Network**

Assume a bus route runs through 2000-20001-20002. Since bus node 20001 has a connection with PNR node 13001, for a PT network, this route needs to be rerouted as 20000-20001-15001-20001-20002. And for this unique PT network coding situation, 20001-15001-20001, Non stop—Stop—Stop rule shall apply to entire route except when this occurs at the beginning of a bus route. If the beginning of a route starts as A-15000-A, then the first node, A, will be enforced as stop node and the second node A will be coded as Non Stop. Otherwise the TB export

function will remove first two nodes, then the export of the route that begins with A-15000-A will end up with the first node in the bus route erroneously being a non-stop node.

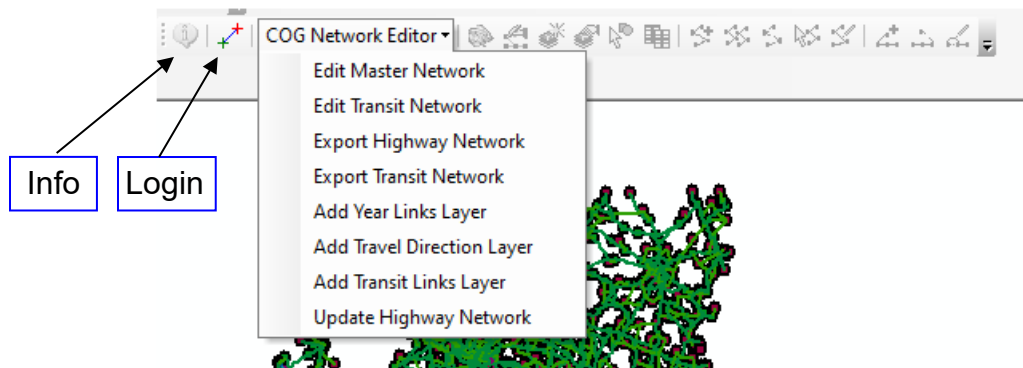
## 6. COGTOOLS TOOLBAR AND EDITOR WINDOWS

This chapter describes the following two main components on the Graphic User Interface (GUI) of COGTools:

- Toolbar
- Editor Windows

### 6.1 COGTools Toolbar

The COGTools Toolbar initiates most of the operations as shown in Figure 16.



**Figure 17 COGTools Toolbar**

The availability of menus and buttons on the toolbar is described as follows:

- When the toolbar is initiated, only *Login* and *Info* buttons are enabled.
- The menus are not enabled until the user successfully logs into the network geodatabase.
- The editing buttons, such as *New Link*, *Edit Link*, *Delete Link*, *Split Link*, and *Add Selected Link(s)*, are not enabled until the *Edit Master Network* menu is clicked. On the other hand, *Add Route*, *Copy Route*, *Delete Route*, *Select Route*, and *Edit Route* are not enabled until the *Edit Transit Network* menu is clicked, and a transit network is generated for a specified year.

### 6.1.1 Menus of COGTools Toolbar

#### Edit Master Network

**Function:** Click this menu to edit the master network.

**Action:** Pop up the *Master Network Editor* window and enable the editing buttons on the toolbar: *Create New Link*, *Edit Link*, *Delete Link*, *Split Link*, and *Add Selected Links* (see Figure 17). While these actions may also be performed outside of the COGTools, users are strongly recommended **NOT** to do so. Performing operations on the network geodatabase (including master network) outside of the COGTools will undermine the logical integrity of the database and may cause fatal errors.

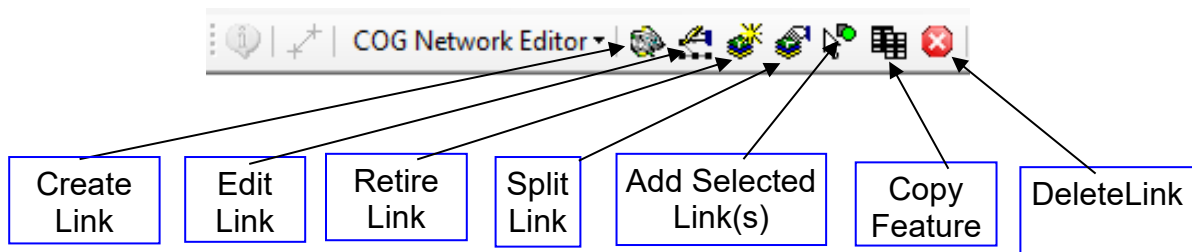


Figure 18 Master Network Editing Toolbar

#### Edit Transit Network

**Function:** Click this menu to edit a transit network.

**Action:** Pop up the *Transit Network Editor* window and enable the editing buttons on the toolbar: *Add Route*, *Copy Route*, *Delete Route*, *Select Route*, and *Edit Route*, after a transit network is generated for a specified year (see Figure 18).

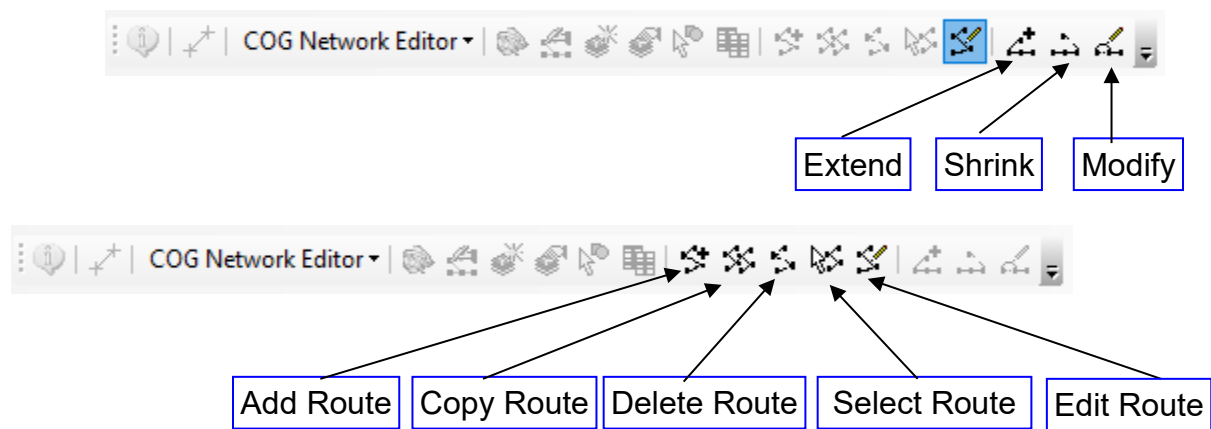


Figure 19 Transit Network Editing Toolbar

#### Export Highway Network

**Function:** Click/select this menu to export a highway network.

**Action:** Pop up the *Export Network* window, accept user input parameters, and export the highway network.

**Export Transit Network**

**Function:** Click this menu to export a transit network.

**Action:** Popup the *Export Transit Network* window, accept user input parameters, and export the transit network.

**Add Year Link Layer**

**Function:** Click this menu to add a year-specific link layer on the map.

**Action:** Create a new layer containing all network links for a specified year and add it into current map.

**Add Travel Direction Layer**

**Function:** Click this menu to add a layer of travel direction network on the map.

**Action:** Create a new layer containing all base-network links offset by travel direction and add it into current map.

**Add Transit Link Layer**

**Function:** Click this menu to add a layer of transit network.

**Action:** Create a new layer containing all transit network links and add it into current map.

**Highway Network Update**

**Function:** Click this menu to perform the TIPUP process that updates the Transportation Improvement Program (TIP) table.

**Action:** Update the highway network based on the TIP update table.

### 6.1.2 Buttons of COGTools Toolbar

**Info**

**Function:** Click this button to toggle the visibility of the *COGTools Info* window.

**Action:** Toggle the visibility of the *COGTools Info* window, which is used to record user operations.

**Login**

**Function:** Click this button to log into a database.

**Action:** Popup the *Personal GeoDatabase/SDE Login* window, accept user input database connection information, and connect to the database.

**Create Link**

**Function:** Click this button to create a new link.

**Action:** Start an edit session, accept user-sketched link addition(s) and user-specified link information, split involved links if necessary, and add the new link record(s) to the database. This action will need user confirmation by clicking the *Confirm* button in the *COG Network Editor* window.

**Edit Link**

**Function:** Click this button to edit a link.

**Action:** Enable the editing buttons in the *COG Network Editor* window.

#### Retire Link

**Function:** Click this button to retire a link.

**Action:** Retire the selected link in the *COG Network Editor* window for the selected year or for all years (if no year is selected)

#### Delete Link

**Function:** Click this button to physical delete a link.

**Action:** Physical remove the selected link in the *COG Network Editor* window for the for all years.

#### Split Link

**Function:** Click this button to split the selected link.

**Action:** Start an editing session, accept the user-located split point and user-specified split information, and split the selected link. This action will need user confirmation by clicking the *Confirm* button in the *COG Network Editor* window.

#### Add Selected Link(s)

**Function:** Click this button to add the selected nodes/links in sequence into the *COG Network Editor* window.

**Action:** Add all selected nodes/links into the *COG Network Editor* window. This action will need user confirmation by clicking the *Save* button in the *COG Network Editor* window.

#### Copy Feature

**Function:** Click this button to copy a line feature from other layer data to the working geodatabase.

**Action:** Select links from other layer data and copy the selected link(s) to the working geodatabase. This action will need user confirmation by clicking the *Save* button in the *COG Network Editor* window.

#### Add Route

**Function:** Click this button to create a new transit route.

**Action:** Add a new transit route by selecting the network links on which the transit route will be operated. Start an editing session, accept user-selected links that constitute a route, and add the route into the Transit Route Editor window and the database.

#### Copy Route

**Function:** Click this button to copy a transit route from an existing transit route.

**Action:** Copy an existing transit route specified by the user and add the new transit route to the database.

**Delete Route**

**Function:** Click this button to delete the selected transit route.

**Action:** Delete a selected route or a user-specified route from the database.

**Select Route**

**Function:** Click this button to select an existing transit route.

**Action:** Add the selected route into the *Transit Network Editor* window.

**Edit Route**

**Function:** Click this button to edit a selected transit route.

**Action:** Start an editing session which displays and enables three buttons, *Extend*, *Shrink*, and *Modify*:

**Extend Route**

**Function:** Click this button to extend a selected transit route.

**Action:** Start an editing session, extend the selected route, and update the route on the Transit Route Editor window and in the database.

**Shrink Route**

**Function:** Click this button to shrink a selected transit route.

**Action:** Start an editing session, shrink the selected route, and update the route on the Transit Route Editor window and in the database.

**Modify Route**


**Function:** Click this button to modify a selected transit route.

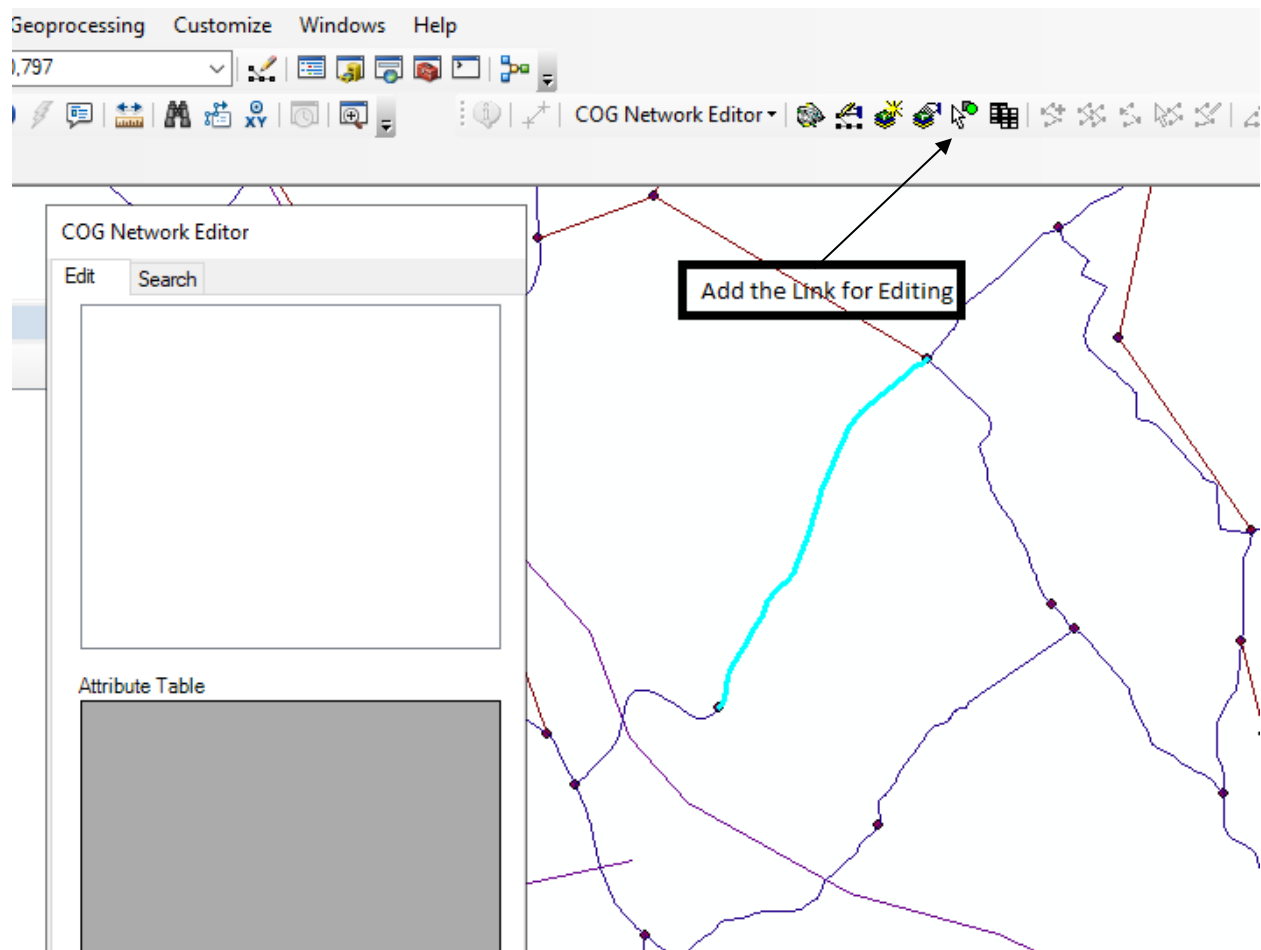
**Action:** Start an editing session, modify the selected route, and update the route on the Transit Route Editor window and in the database.

## 6.2 Editor Windows

There are two main editor windows available in the COGTools: *Master Network Editor* and *Transit Network Editor*. Highway network links, highway centroid connections, transit links (such as rail lines), transit support links (such as walk connections between rail and bus), and highway and transit nodes are all created and edited in the *Master Network Editor*. The Transit Network Editor is only used to add, delete, or edit transit routes and transit line attributes (such as headway and runtime).

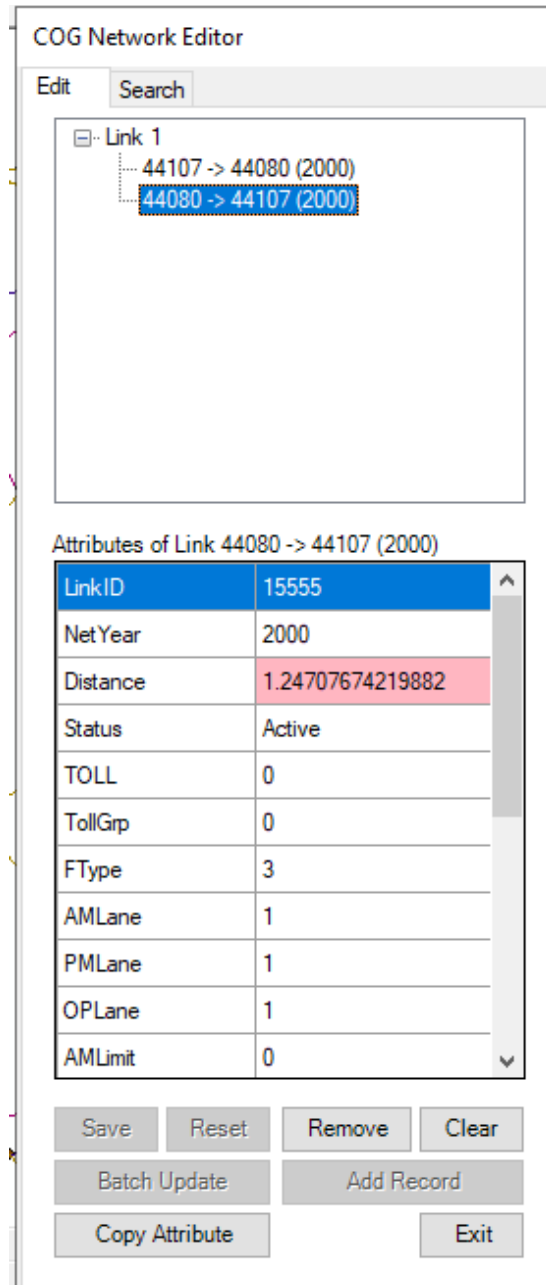
### 6.2.1 Master Network Editor Window

Using the *Select Features* button  the user must first select one or more links for editing, and then click the 'Add Selected Link' button to bring the link/s into the Editor window as shown in Figure 19.



**Figure 20 Add the Selected Link into Editor Window**

The Master Network Editor window is used for editing the attributes of highway network links as shown in Figure 20.



**Figure 21 Master Network Editor Window**

The highlighted pink cell in the link attribute table indicates that the corresponding attribute value cannot be edited (for example, as shown in Figure 21-----). The following eight command buttons are available on the *Master Network Editor* window:

#### **Reset**

**Function:** Click this button to discard the changes to the selected link.

**Action:** Discard the changes to the selected trail link in the Editor window.

### **Remove**

**Function:** Click this button to remove a selected link.

**Action:** Remove the selected trail link from the Editor window.

### **Clear**

**Function:** Click this button to remove all selected links.

**Action:** Remove all selected links from the Editor window.

### **Exit**

**Function:** Click this button to close the Editor window.

**Action:** Closes the highway Editor window.

### **Save**

**Function:** Click this button to save the changes to the selected link.

**Action:** Save current changes to the selected link and exit the editing session.

### **Add Record**

**Function:** Click this button to add a new record for a different year (logical link) for the link.

**Action:** Create a new logical link and add it into the Baselink table.

### **Batch Update**

**Function:** Click this button to batch update the specified field of the links in the Editor window.

**Action:** You can filter those links by specifying a Year/ProjectID value in the Batch Update dialog window. Alternatively, you can batch update all links in the Editor window by clicking OK on the dialog without specifying any Year/ProjectID value.

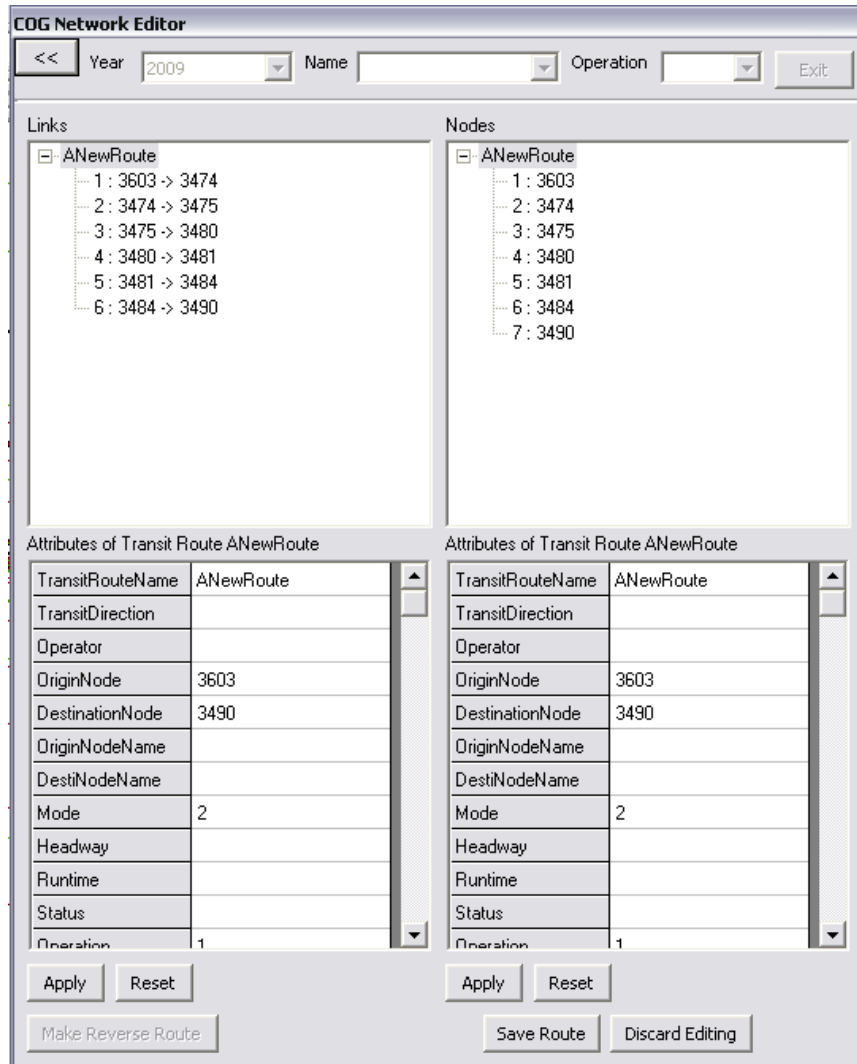
### **Copy Attribute**

**Function:** Click this button to copy the attributes of an existing selected link to the selected link in the Editor window.

**Action:** Copy existing link attributes to the selected link in the Editor window.

## **6.2.2 Transit Network Editor Window**

The transit network editor window is used for editing the attributes of transit routes as shown in Figure 21.



**Figure 22 Transit Network Editor Window**

After selecting the transit route and time period (AM peak, Midday, PM peak, Nighttime) the user may edit the route using the following nine command buttons which are available on the *Transit Network Editor* window:

### **Apply**

**Function:** Click this button to save the changes to the selected stop/link.

**Action:** Save attributes of the selected stop/link in the Transit Network Editor window.

### **Reset**

**Function:** Click this button to discard the changes to the selected stop/link.

**Action:** Discard the changes to the selected stop/link in the Editor window.

### **Make Reverse Route**

**Function:** Click this button to create a new route that reverses the direction of the selected route. (The bus route needs to be changed to two-way route before applying this function)

**Action:** Create a new route by reversing the direction of the selected route in the Editor window.

### **Exit**

**Function:** Click this button to close the Editor window.

**Action:** Remove the selected route in the Editor window and close the Editor window.

### **Save Route**

**Function:** Click this button to save the changes to the attributes of the selected route.

**Action:** Save current changes/edits to the selected route and exit the editing session.

### **Discard Editing**

**Function:** Click this button to discard the changes to the attributes of the selected route.

**Action:** Discard current changes/edits to the attributes of the selected route.

## **6.3 Major Enhancements to COGTools since 2013**

The original COGTools was developed in Microsoft Visual Basic 6.0 SP6. In 2000, Microsoft introduced VB.Net, which was intended to replace VB6. Finally, in 2005, Microsoft stopped providing technical support for VB6, which caused lots of compatibility issues, as the ArcGIS software continued to evolve. In 2013, COG decided to upgrade COGTools from VB6 to VB.Net.<sup>9</sup> In 2014, COG contracted with DCI to conduct the upgrading. The new version of COGTOOLS in VB.Net was delivered in June 2014.

The following are major enhancements that COG staff made to the VB.Net based COGTools since 2013.

- Added a class to export transit mode files and transit support files in PT format
- Added a class to copy GIS features from a third-party data source, such as HERE, as new features or replace existing GIS features in the network database.
- Added a function to copy the attributes of an existing GIS feature to a newly created GIS feature
- Added the capability of logging transit network editing operations
- Added a function to export the Station file
- Enhanced the highway/transit exporting capabilities to export network files in multiple export formats (TRANBUILD, PT, and PGDB)
- Changed the data access method from the ArcGIS-provided data access engine to the Microsoft data access engine (ADO/ADO.NET)
- Rewrote the PrepTIP or TipUP process in VB.NET
- Enhanced the capability of logging transit network editing operations
- Adapted the COGTools to support the Unified database

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<sup>9</sup> See, for example, Charlene Howard, "Migration / Redevelopment of Custom Transportation Editing Tools to Function in the ArcGIS 10.x Environment," October 2013.

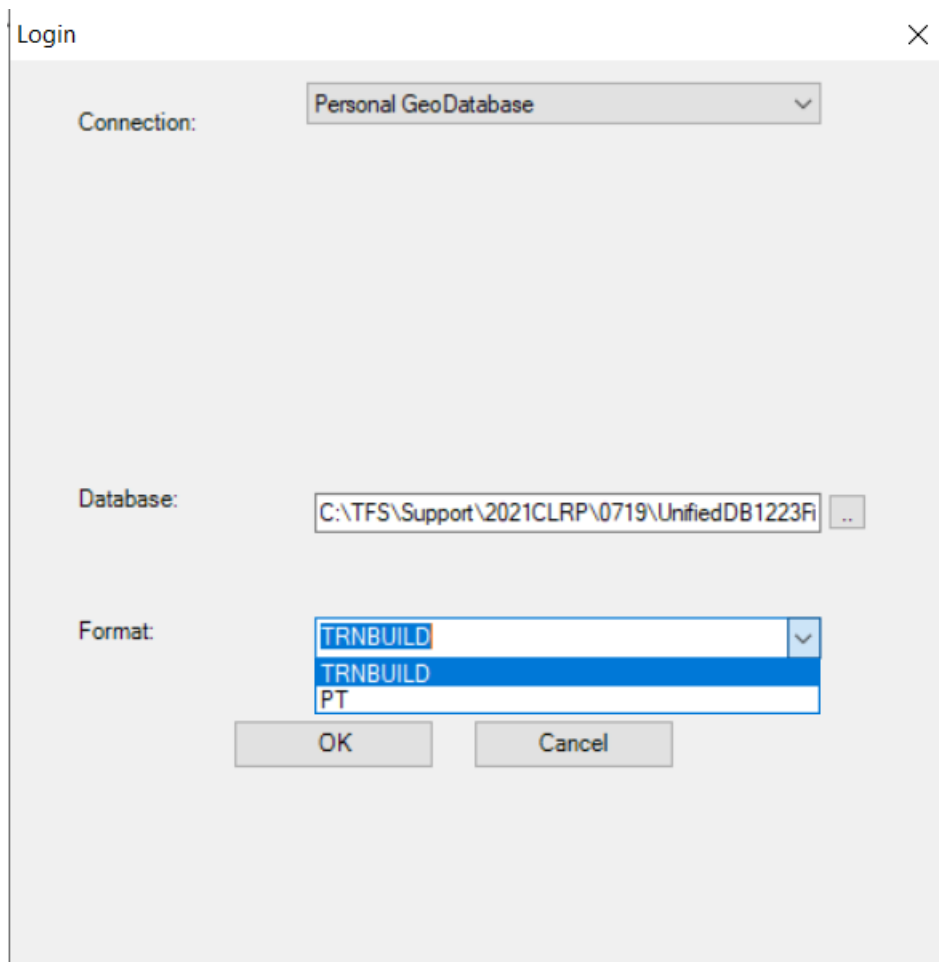
## 7. MAIN OPERATIONS OF COGTOOLS

### 7.1 Login

A *Login* window pops up after you click the Login button on the toolbar. You will have options for three types of connections: *Personal GeoDatabase*, *Personal SDE* and *ArcSDE*.

#### 7.1.1 Personal GeoDatabase

To create a *Personal GeoDatabase* connection, you need to specify two fields: *Database* and *Format* in the login window (see Figure 22).



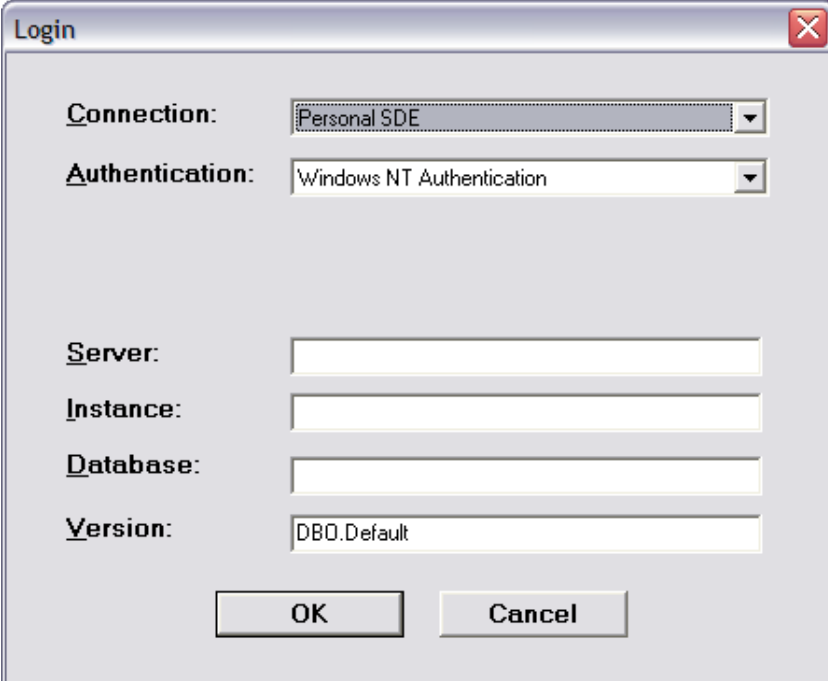
**Figure 23 Login Window for Personal Geodatabase**

#### 7.1.2 Personal SDE and ArcSDE

Personal SDE and ArcSDE connections are available only for the COGTools with ArcGIS Version 9.1. For ArcGIS 10.1 or newer versions, the Personal SDE and ArcSDE connections are still under development.

As shown in Figure 23 and 24, you need to provide more specifications for a *Personal SDE* or *ArcSDE* connection than for a *Personal GeoDatabase* connection. The only difference between the Personal SDE and ArcSDE connections is the default version, which is DBO.DEFAULT for *Personal SDE* and SDE.DEFAULT for *ArcSDE*

If you select the *Windows NT Authentication* for either connection, you do not need specify a username or password to connect to the database. However, you need to specify the username and password if the Authentication type is *Database Authentication* (Figure 25).



The screenshot shows a 'Login' dialog box with the following fields and values:

- Connection:** Personal SDE (dropdown menu)
- Authentication:** Windows NT Authentication (dropdown menu)
- Server:** (empty text box)
- Instance:** (empty text box)
- Database:** (empty text box)
- Version:** DBO.Default (text box)

Buttons: OK, Cancel

**Figure 24 Login Window for Personal SDE**

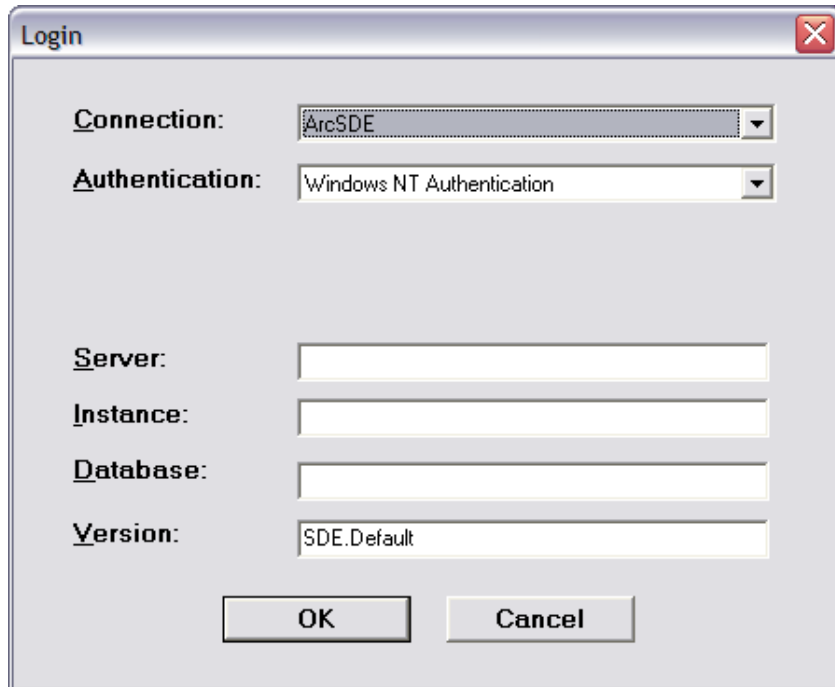


Figure 25 Login Window for ArcSDE

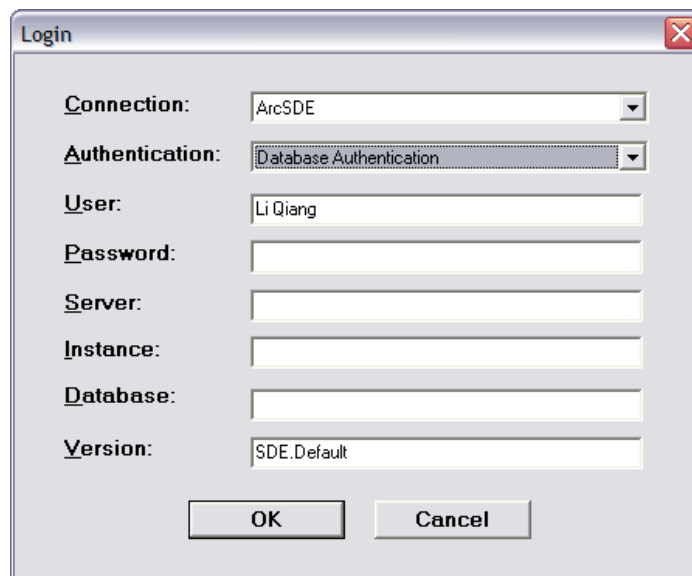
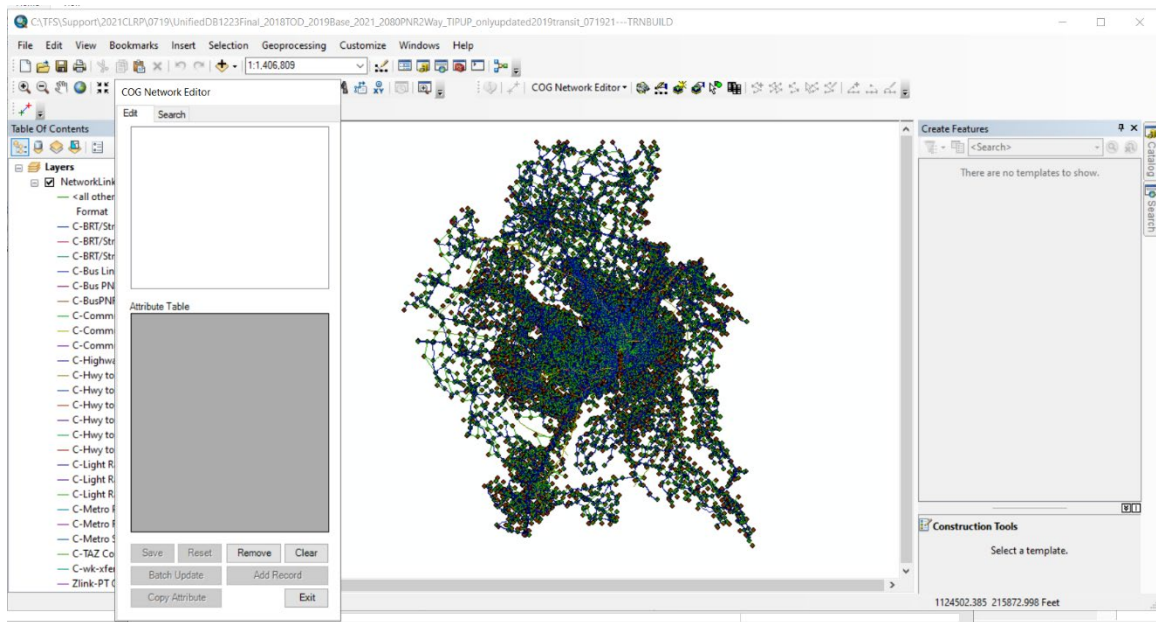


Figure 26 Login Window for an ArcSDE Connection with Database Authentication

## 7.2 Edit Master Network

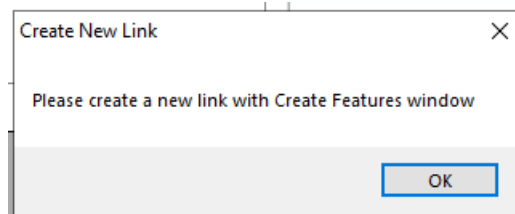
The buttons for master network editing will be displayed and enabled after clicking the *Edit Master Network* menu. In the meantime, *Master Network Editor* window is loaded and displayed. After that, you can start to perform editing operations as shown in Figure 26.



**Figure 27 Master Network Editing Window**

### 7.2.1 Create New Link

1. Click the *Create New Link* button, and a message box will pop up as shown in Figure 27.

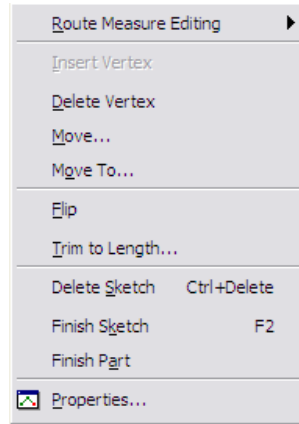


**Figure 28 Sketch Link Message Window**

2. Click the *OK* button to enable the sketch tool, select the linktype that you want to add (highway, BRT, highway to Metro, TAZ connector, etc.), and then hold the left button on the Mouse to sketch a link and release the button to add a vertex; Repeat the two operations to continue to sketch the link until reaching the end of the link. Links may start and/or end at existing nodes may start or end where no node exists such that a new

node is added. When new nodes are added, the node must be from the appropriate node range<sup>10</sup> associated with a particular linktype and/or jurisdiction.

3. There are two ways to finish sketching a link:
  - a. Double click the left button on the Mouse
  - b. Click the right button and select the Finish Sketch menu on the pop-up window as shown in Figure 28.



**Figure 29 Popup Menu Window**

4. A dialog window pops up for the user to specify the basic information of the new link: Year, LinkType, and Oneway as shown in Figure 29.

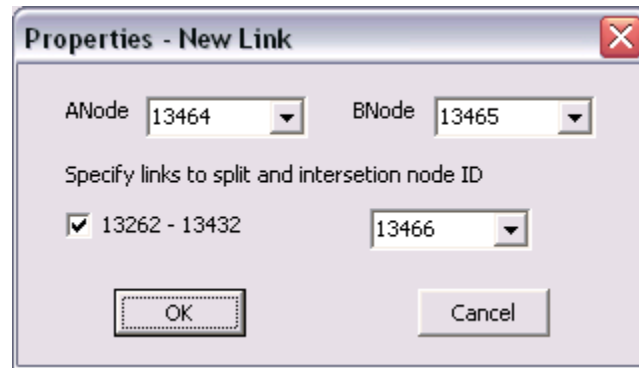


**Figure 30 Sketch Link Property Window**

5. Fill in the needed information and then click OK.

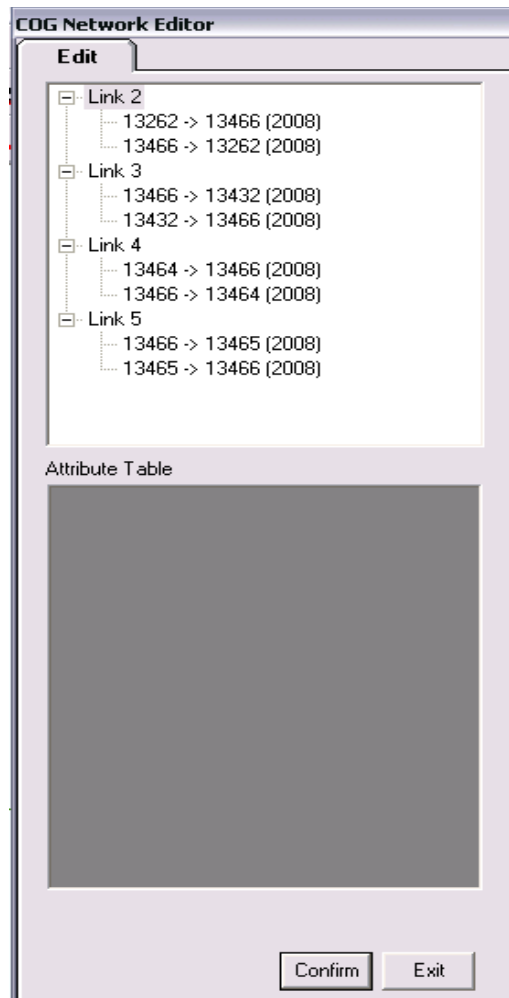
<sup>10</sup> Pages 18-19, “Highway and Transit networks Used in the Air Quality Conformity Analysis of the 2020 Amendment to Visualize 2045 and the FY 2021-2024 TIP (Ver. 2.3.78 Travel Model),” (Washington, D.C.: Metropolitan Washington Council of Governments, National Capital Region Transportation Planning Board, April 10, 2020), <https://www.mwcog.org/transportation/data-and-tools/modeling/model-documentation/>.

- The tool will examine the intersections of the new link with existing links, and then pop out another dialog window (Figure 30) for you to specify other information: ANode, BNode, whether an intersected link will be split, and the intersection Node ID. (**Note:** *Only links with the same link type will be shown in the dialog box for selection. For example, if a highway link is created, only the intersecting highway links can be selected for splitting; transit links will not be split even if they intersect with the new link.*)



**Figure 31 Split Link Property Window**

- Fill in the needed information and then click OK.
- A message box pops up, reminding you to click the *Confirm* button later.
- Click *OK* to close the message box, and the Editor window will show in Figure 31.



**Figure 32 Confirm Editor Window**

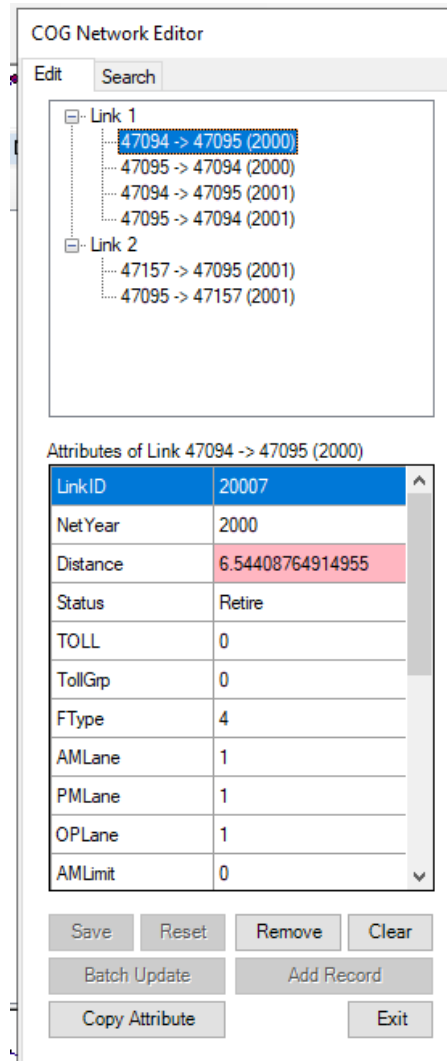
10. Click the *Confirm* button to finish your editing and link addition(s). Before you click the *Confirm* or *Exit* button, all other editing buttons are disabled.

11. Add/Edit the new link(s) attributes on both sides of the link (if it is a two-way link).

### 7.2.2 Edit Link

1. Before you use the *Edit Link* button, make sure that there is at least one link selected in the *COG Network Editor* window.
2. Click the *Edit Link* button on the toolbar, which will lead to the following changes to the state of the Grid box and some buttons in the *COG Network Editor* window, as shown in Figure 32.

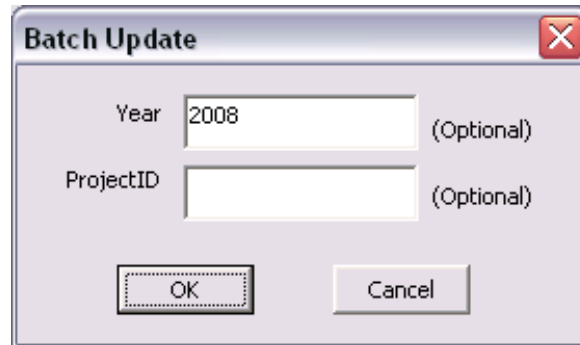
- a. Some fields in the grid box will become editable.
- b. The *Save*, *Reset*, *Batch Update* and *Add Record* buttons will be enabled.
- c. The *Remove* and *Clear* buttons will be disabled.



**Figure 33 Editor Window for Link Editing**

3. Change the value of a field in the grid box, and/or click the *Reset*, *Batch Update* and *Add Record* buttons for the following operations.
  - a. **Reset:** Click this button to reset the attributes of the selected link.
  - b. **Batch Update:** Click into a field and then click this button to batch update the value of this field for the links in the editor window. You can filter those links by

specifying Year and ProjectID in the Batch Update dialog window shown in Figure 33. Alternatively, you can batch update all the links in the editor by clicking OK on the dialog window without specifying any Year/ProjectID value.



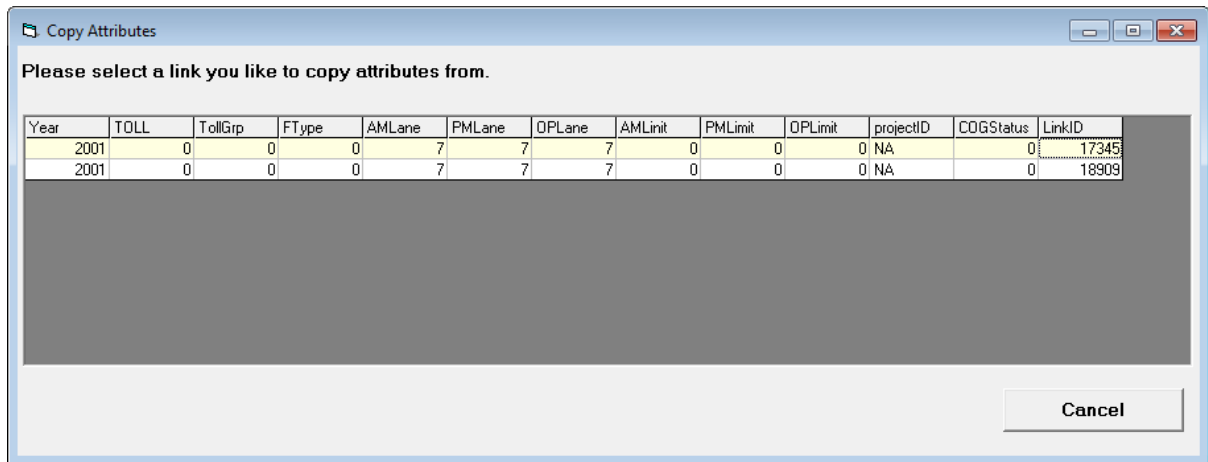
**Figure 34 Batch Update Dialog Window**

- c. **Add Record:** Click this button to add a new logical link record for the selected link. You need to specify the year of the new record and the year to copy information from as shown in Figure 34.



**Figure 35 Add New Logical Link Dialog Window**

- d. **Copy Attribute:** Click this button to copy an attribute of an existing link to a different link that has been selected.

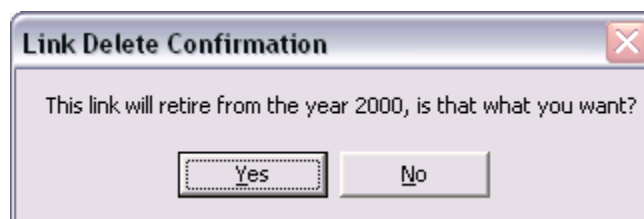
**Figure 36 Copy Attribute Dialog Window**

- Click the Save Button to save the modifications on the selected link and exit the editing session.

**Note:** The Batch Update and Add Record operations are undoable, even if you have not clicked the Save button. The two operations cannot be reversed by clicking the Reset button, either. The Save/Reset buttons only work for the single link selected.

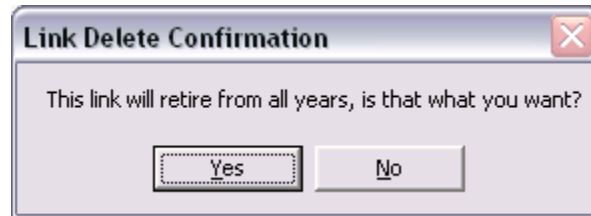
### 7.2.3 Retire Link

- Before you use this button, make sure that a link is selected in the *COG Network Editor* window.
- Click the *Retire Link* button, and a message box will pop up. The message will look differently depending on whether a year is selected for the network that you are working on:
  - If you selected a year, say 2000, then the message box pops up for confirmation as shown in Figure 36:



**Figure 37 Link Delete Confirmation Message Window**

- b. If you did not select a year, then the message box pops up for confirmation as shown in Figure 37:

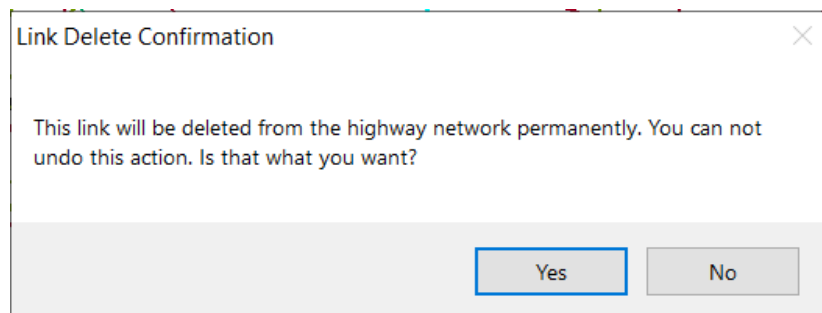
**Figure 38 Link Delete Confirmation Message Window**

3. Click the *Yes* button to confirm your operation.

Please note that when a link retires, it ceases to be part of the network and will not be included in the exported network files. However, the records of this link are kept in the network database and are intentionally made visible during editing sessions (so that the user can reuse some of the retired links).

#### 7.2.4 Delete Link

1. Before you use this button, make sure that a link is selected in the *COG Network Editor* window.
2. Click the *Delete Link* button, and a message box will pop up

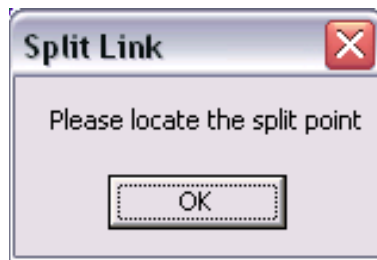
**Figure 39 Link Delete Confirmation Message Window**

4. Click the *Yes* button to confirm your operation.

Please note that when a link is deleted, all records of this link will be removed from the network database permanently and this action can not undo.

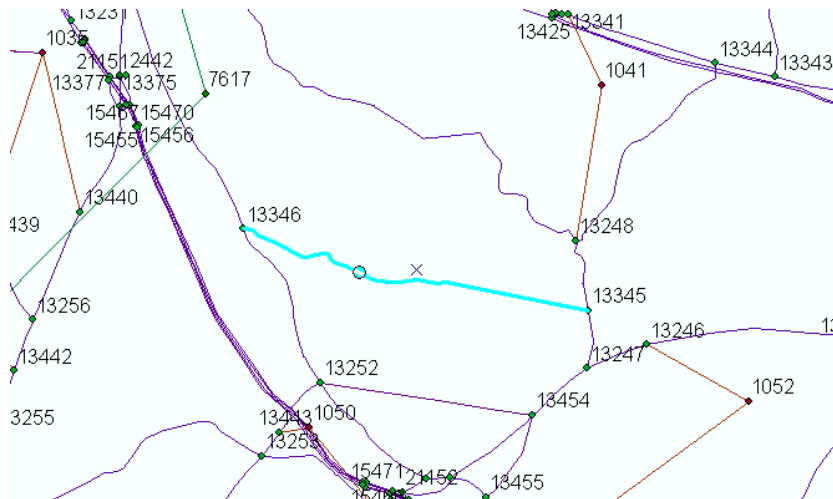
### 7.2.5 *Split Link*

1. Before you use this button, make sure that one and only one link is selected in the *COG Network Editor* window.
2. Click the *Split Link* button, and a message box will pop up as shown in Figure 38.



**Figure 40 Message Window for link splitting**

3. Click *OK* to enter the split state.
4. Use the mouse to locate the split point (see Figure 39-shown in light blue). A dialog will pop up after the location of the split point is specified, as shown in Figure 40. In the dialog window, you need to specify the following two parameters for the link splitting: Year and select the Node ID (from the drop down menu) in the link split parameter window. .



**Figure 41 Link Split Operation Display**

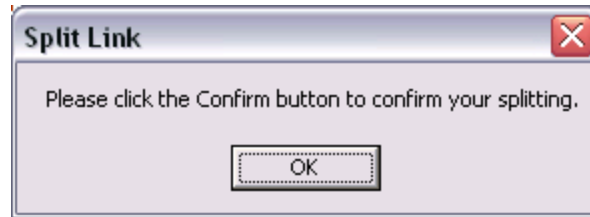


**Figure 42 Link Split Parameter Window**

5. Fill in the needed information and click OK to close the dialog.

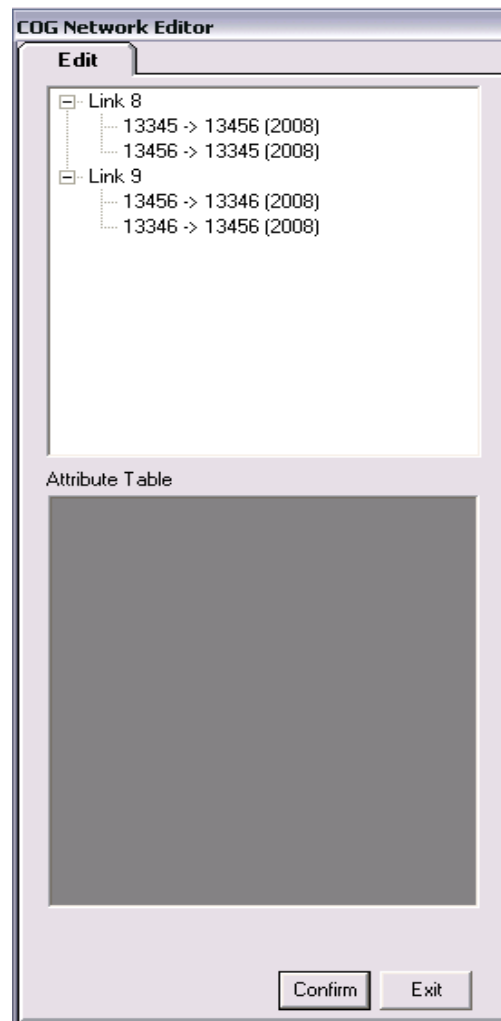
NOTE: The “Year to Split the Link” should always be 2001 (the first edited year of the database) or the network year when the link comes into existence. When a link is split, all transit routes in all the transit years in the database that run over that link will be updated to reflect the split. If a link that exists in 2001 is split in a later year, there will be an inconsistency in the highway networks over various network years that will cause additional unnecessary editing of the transit routes over the same roadway in different network years.

6. A message box pops up, reminding you to click the *Confirm* button to confirm your link splitting operation.



**Figure 43 Link Split Confirmation Message Window**

7. Click OK to close the message box, and the Editor window will show the split links, as can be seen in Figure 42.

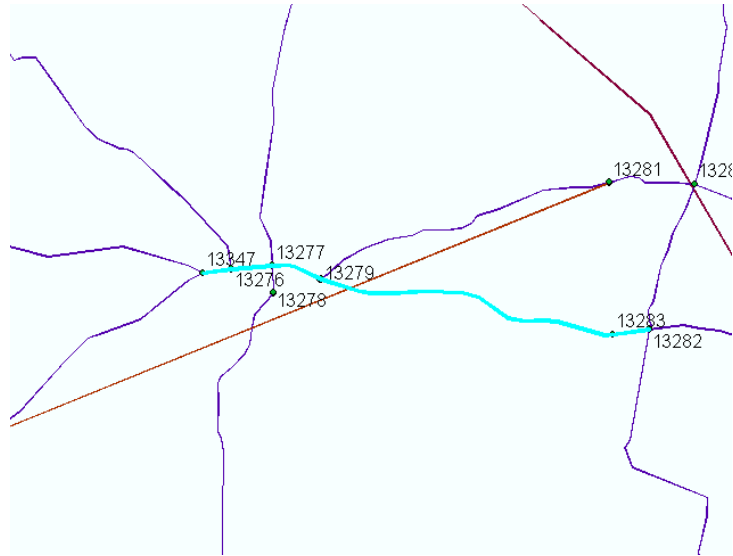


**Figure 44 Editor Window for Confirming the Splitting**

8. Click the *Confirm* button to complete your editing. Before you click the *Confirm* or *Exit* button, all other editing buttons are disabled.

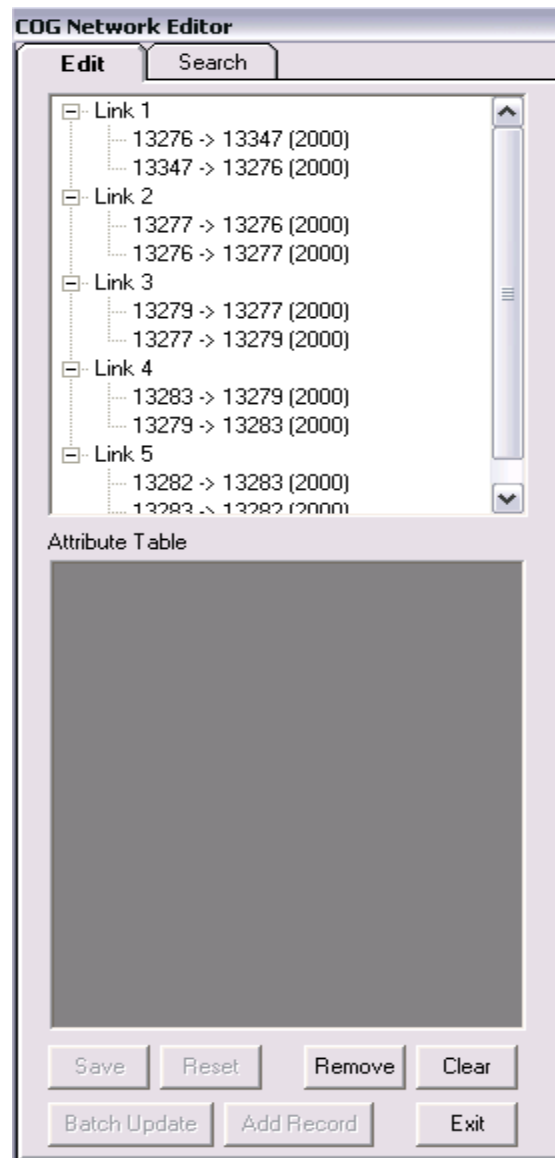
### 7.2.6 Add Selected Links

1. Before you click the *Add Selected Links* button, make sure that at least one link is selected on the network map (Figure 43).



**Figure 45 Link Selection Operation Display**

2. Click the *Add Selected Links* button, and all selected links will be added into the *Master Network Editor* window as shown in Figure 44. It is important to note that it is necessary to assure that each link selected is an active link and that all of the intended links are in the editing window. If a link was split, so that A-B becomes A-C-B and the user selects A-C, both the A-C and the original A-B link will be highlighted, and therefore it is easy to erroneously exclude the C-B link in the editing window because it appears as if C-B is highlighted and thus included in the editing window, but it is not unless the user specifically selects the C-B link.



**Figure 46 Editor Window for Link Selection**

### 7.2.7 Search

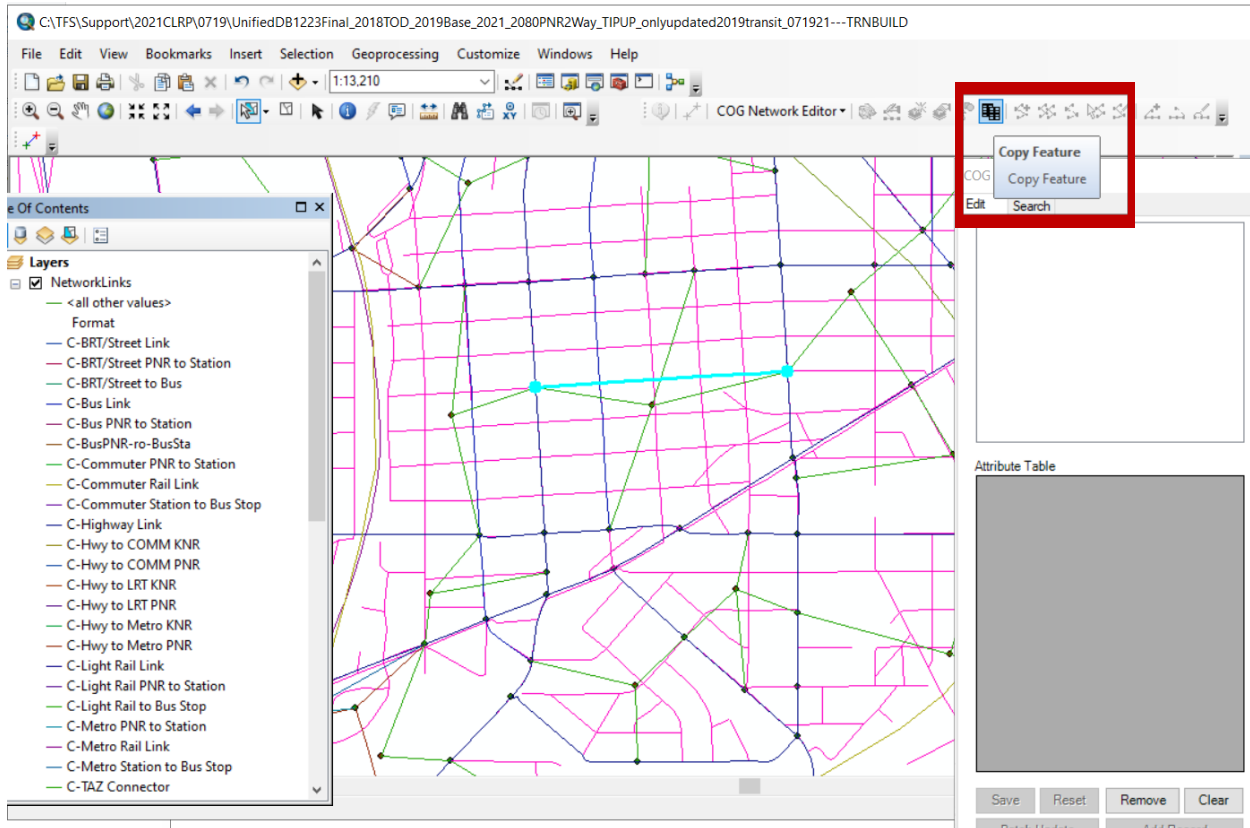
This function is available in the *Search* tab of the *COG Network Editor* window as shown in Figure 45. The user can set the search criteria by specifying the values of *Anode*, *BNode*, *ProjectID* or any combination of them.



**Figure 47 Editor Window for Search Operation**

### 7.2.8 Copy Feature

1. Before using the 'Copy Feature' function, make sure the 'Nav\_Street' layer is loaded into the map. As shown in Figure 46, 'Red Links' are from the Nav\_Street layer and 'Blue Links' are from the 'Networklinks' layer.
2. Select links/nodes to be copied from in the 'Nav\_Street' layer. At least one link and both its end nodes need to be selected. (Figure 46)



**Figure 48 Both Links (From Nav\_Street) and Nodes (From Networknodes) Are Selected**

3. Click on the “Copy Feature” button (marked with red box in Figure 46), and the following window will pop out (Figure 47). You have two options, either to create a new link in the ‘Networklinks’ layer by selecting the Copy Link Only option or to replace an existing link by selecting the other option. Click the OK button to confirm the operation. If you choose to create a new link, you need to follow the same instructions described in Section 5.2.1 “Creating New Link” .

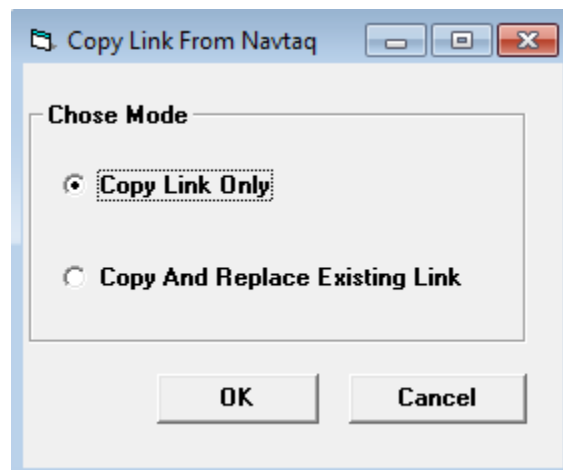


Figure 49 Copy Feature

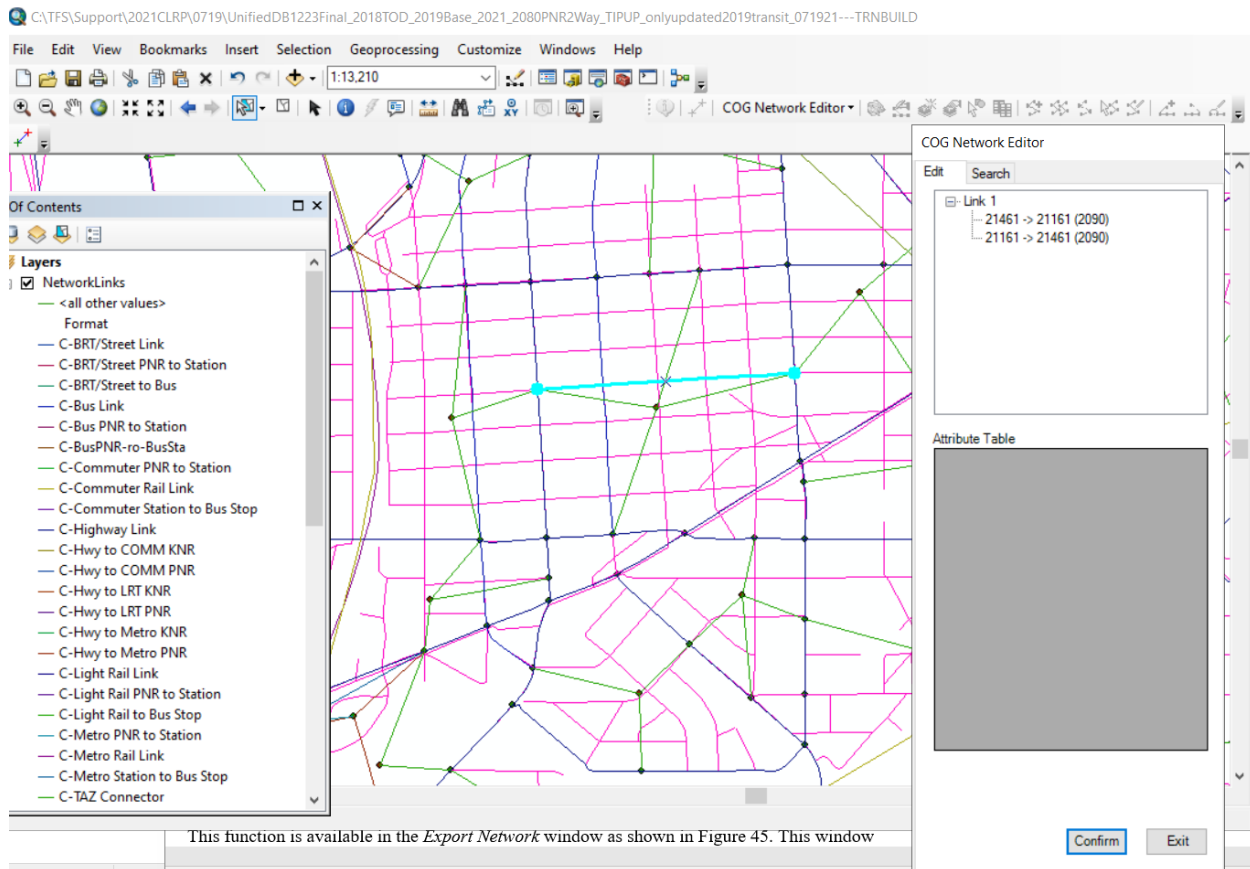
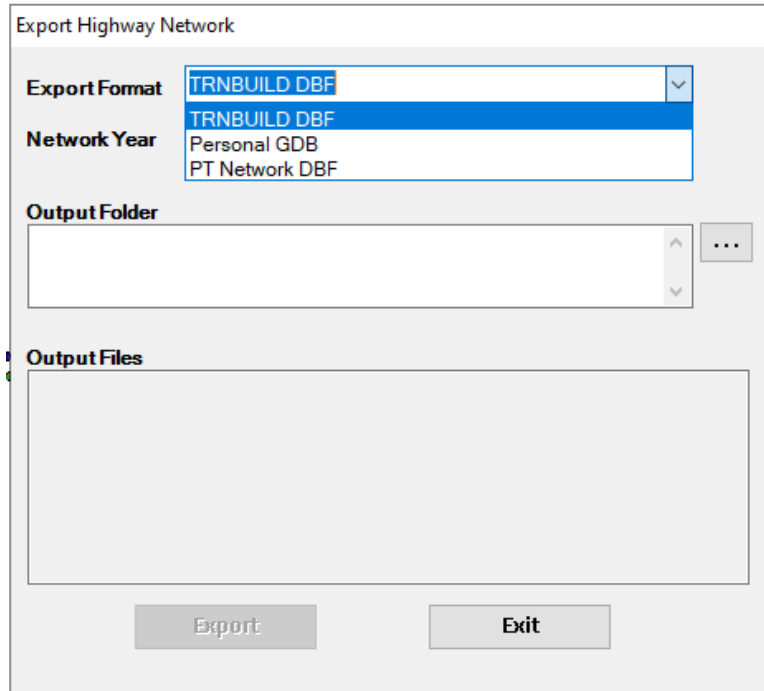


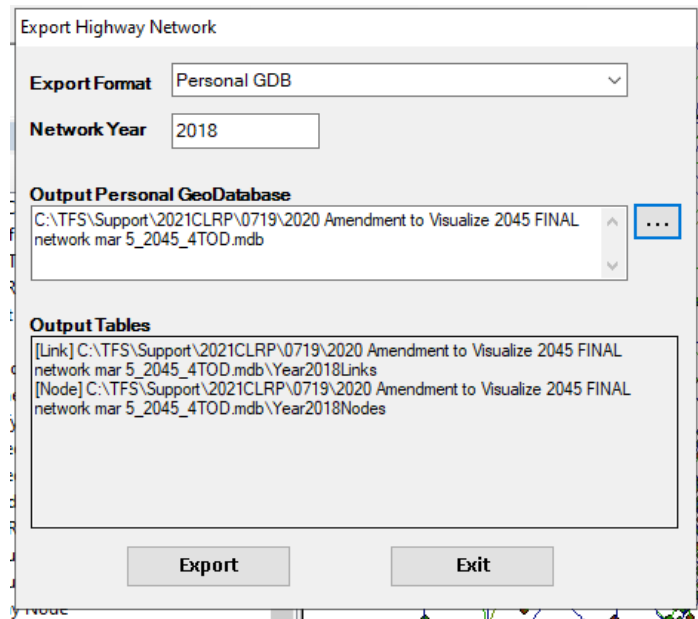
Figure 50 Copy Link Only

### 7.3 Export Highway Network

This function is available in the *Export Network* window as shown in Figure 49. This window will pop up after the user clicks on the *Export Highway Network* menu on the toolbar. The user can specify the following export criteria: *Export Format*, *Network Year* and *Output Folder/Output Personal GeoDatabase*. The Export Format could be *CUBE-Voyage DBF*, *Personal Geodatabase* or *PT Network DBF*. If the export format is DBF, you need to specify an “Output Folder”, and an Output Files textbox will show the location of final exported DBF files after the export operation is completed. On the other hand, if the export format is a personal geodatabase, you need to specify the name and location of an “Output Personal GeoDatabase” and an “Output Tables” textbox will show the location of final exported tables in the personal database after the operation is completed (Figure 50).



**Figure 51 Configuration Window for Exporting Highway Network**



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**Figure 52 Configuration Window for Exporting Personal Geodatabase**

#### 7.4 Edit Transit Network

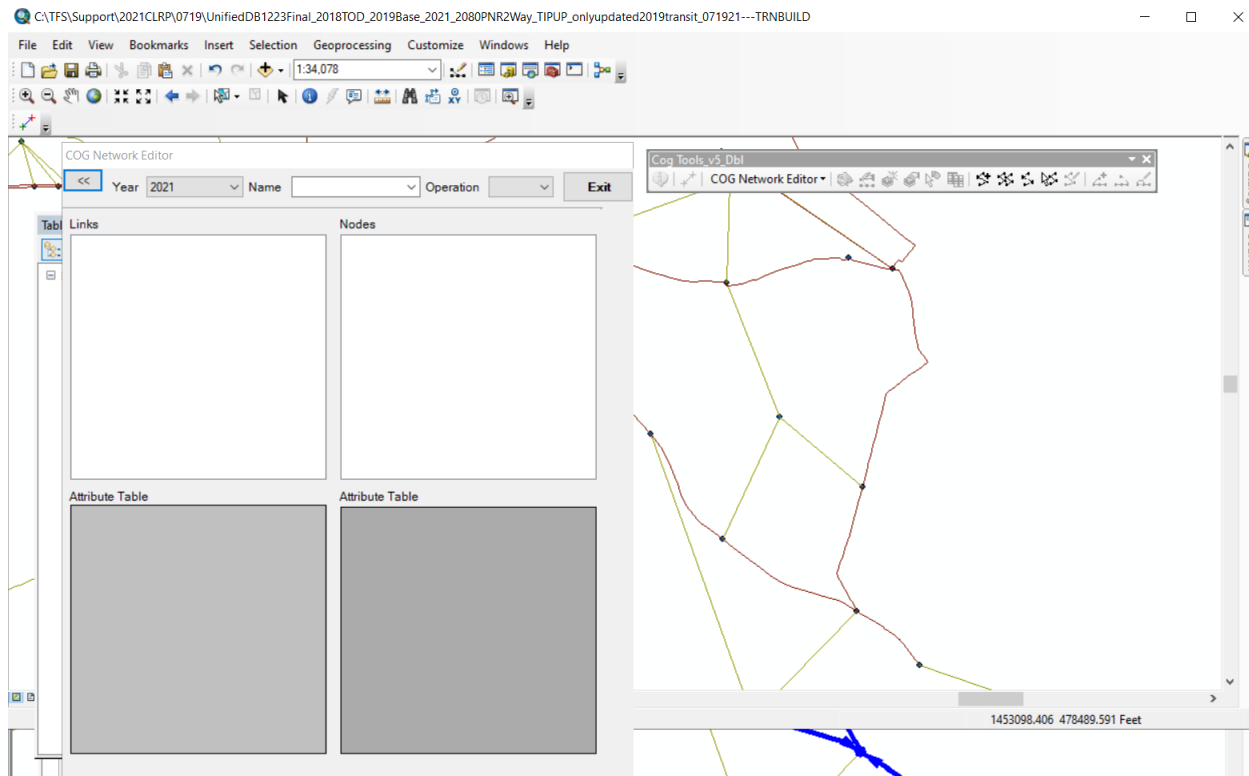
Transit TB File Notes window will show up after clicking on the *Edit Transit Network* menu as shown in Figure 51. The user could type in any notes to include in the Transit Line Files (it is optional).

**Figure 53 Transit Editing Notes**

Click OK after typing in the notes or click Cancel without typing any notes. The Transit Editor Toolbar will show up. Next, specify an Action, a Mode, an Operation period, and a Year<sup>11</sup> for transit editing, and a dialog will pop up informing that the layers for the route editing are being generated as shown in Figure 52. After the transit layers are generated, the user can start the editing operations.

---

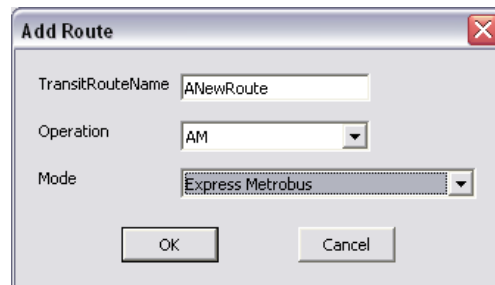
<sup>11</sup> While the network geodatabase allows one to edit an any-year highway network, a user can only choose to work on a transit network from specific years that are included in the database.



**Figure 54 Transit Network Display**

#### 7.4.1 Add Transit Route

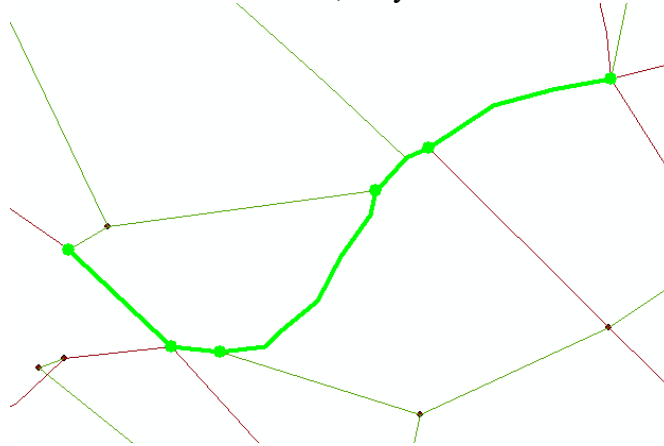
1. Click the *Add Route* button on the Transit Toolbar, a dialog window will pop up as shown in Figure 53.



**Figure 55 Add Route Configuration Window**

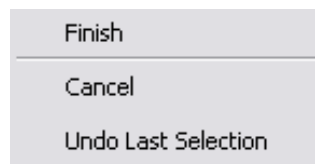
2. Fill in all needed information and then click *OK*

- Left click on the map to select nodes in the stop sequence of the new route. (See Figure 54)<sup>12</sup>. If a node is not a stop node, then after clicking the node, right click the mouse and the option to “made last selection non-stop”. It should be noted that in the travel demand model a bus route may only stop once at any node in the network, so if a bus route passes through the same node more than one time, only one of the occurrences may be a stop.



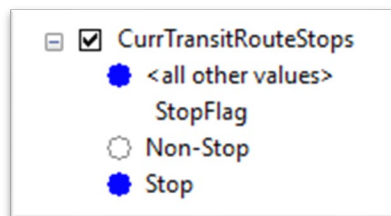
**Figure 56 Adding New Route Display**

- After selecting all stops, click the right button on the mouse to pop up a context menu window (including *Finish*, *Cancel* or *Undo Last Selection* menus) as shown in Figure 55.

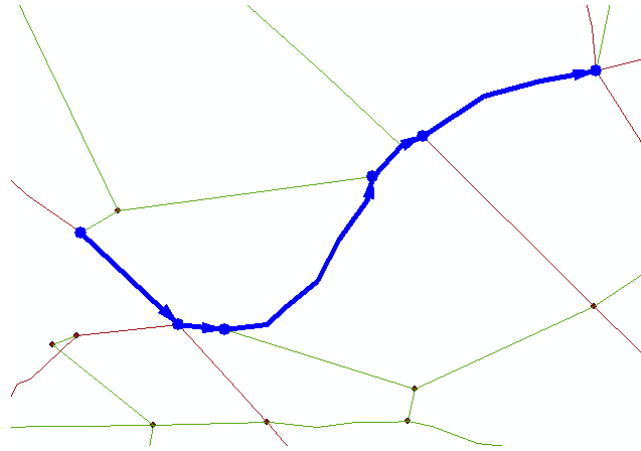


**Figure 57 Popup Context Menu Window**

- Select *Finish on the context menu* to complete the operation, and a new route will be generated as shown in Figure 56 (color will change to dark blue). In COGTools the key is inaccurate, showing non-stop nodes as clear circles and stop nodes as blue circles when in fact the opposite is shown on the route display.

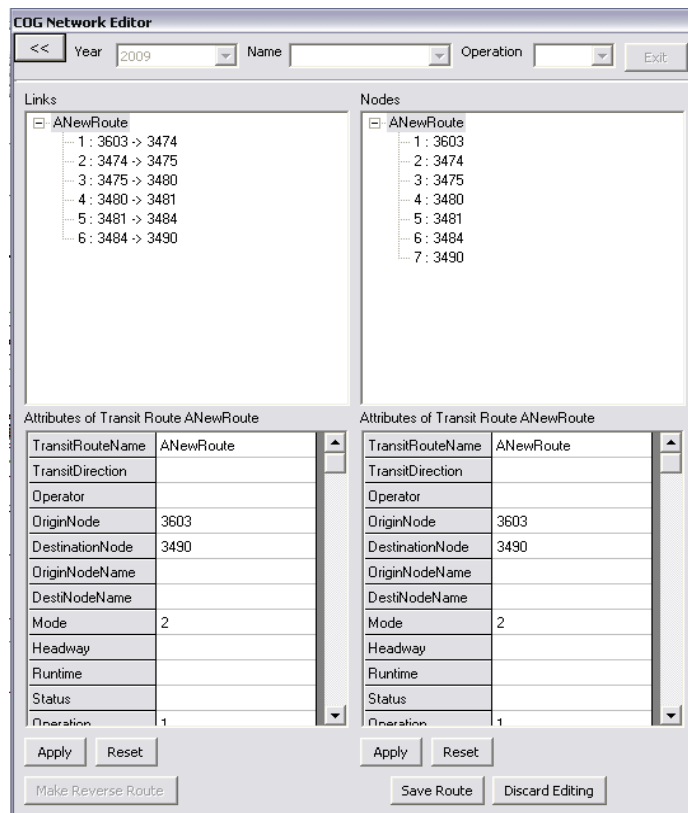


<sup>12</sup> The new route is created using the existing nodes in the highway network. If the transit route needs to go through a new highway node, the user has to quit the ‘Transit Edit’ mode and go back to the ‘Highway Edit’ mode to create the new node first.



**Figure 58 Completed New Route Display**

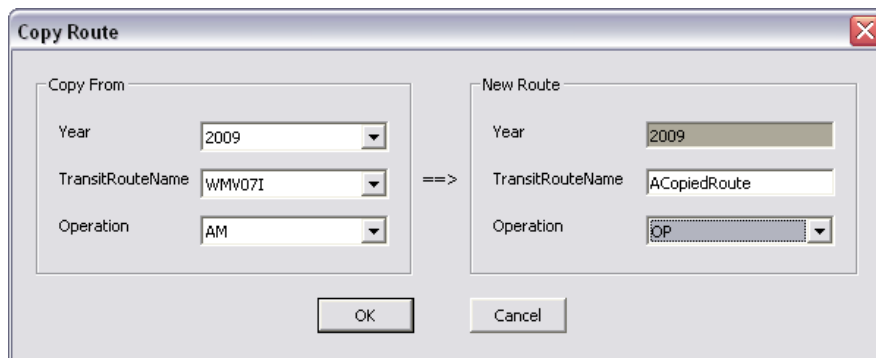
6. Enter the attributes of the new route on the Transit Network Editor, and then click the *Save Route* button to save the entries. In the MWCOC networks it is important to populate the SYEAR (year transit route begins service) and SCENARIO (which LRTP or study the transit route is associated with) so that information is clear when exported in the transit mode files to help with quality assurance of forecast year transit network files.



**Figure 59 Transit Network Editor Window**

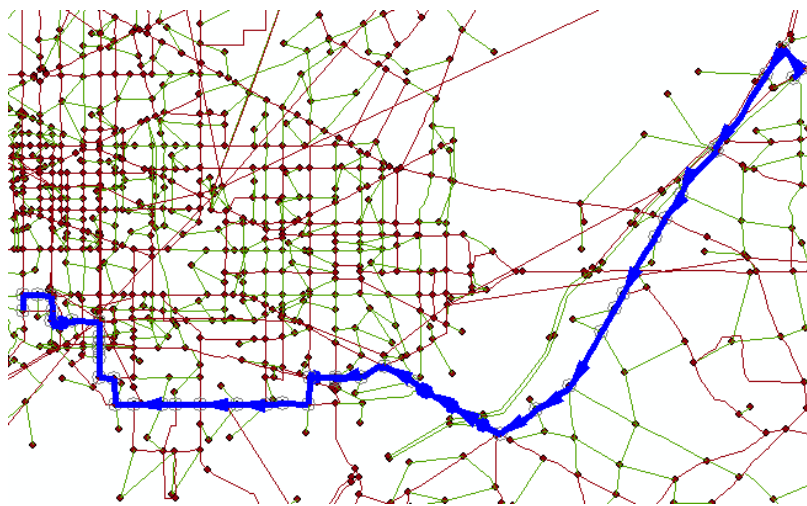
#### 7.4.2 Copy Transit Route

1. Click the *Copy Route* button on the Transit Toolbar, and a dialog window will pop up asking you to provide the information of the copy from route and copy to (new) routes, as shown in Figure 58.



**Figure 60 Copy Route Configuration Window**

2. Fill in all needed information on the dialog and click *OK*, and then a new route will be generated as shown in Figure 59. It should be noted that if any of the links from the copied route do not exist in the network year where the link is being copied then the user will get an error message and the link will not copy.

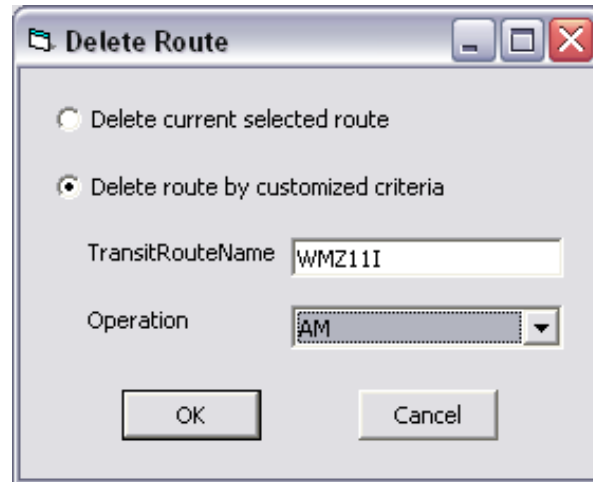


**Figure 61 Completed Copy of the Route Display**

3. Edit the route attributes in the Transit Editor window and click the *Save Route* button to save the new route.

#### 7.4.3 Delete Transit Route

1. Click the *Delete Route* button on the Transit Toolbar, and a dialog window will pop up with two options for deleting a route as shown in Figure 60.

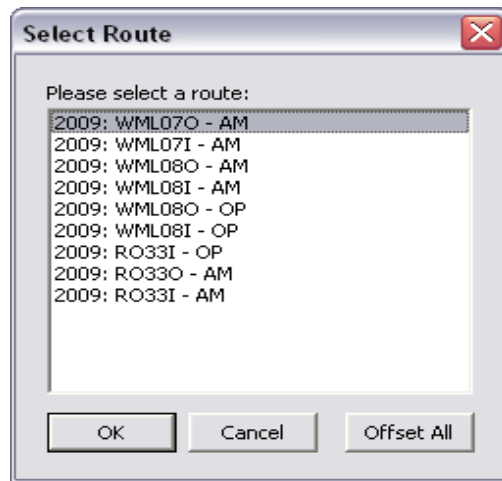


**Figure 62 Delete Route Configuration Window**

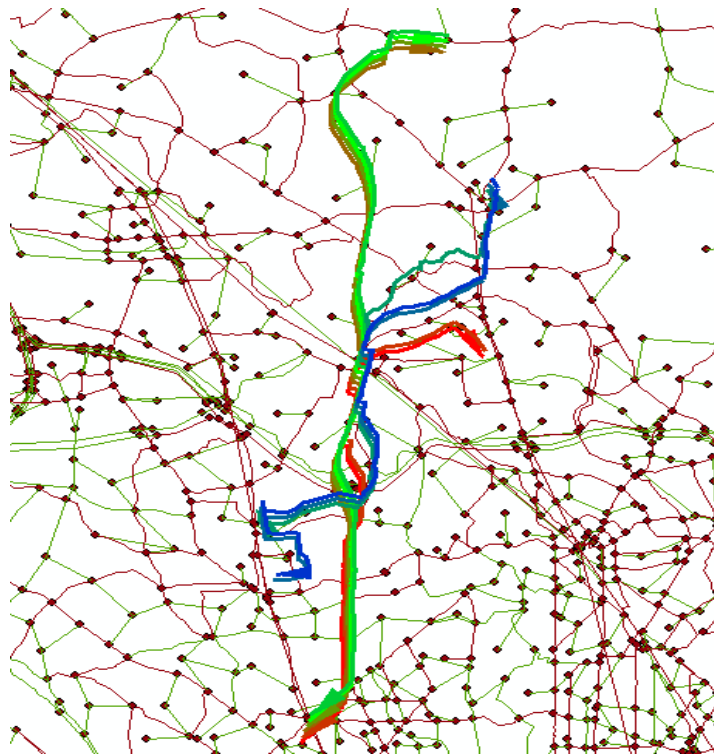
2. Fill in all needed information and then click *OK*

#### 7.4.4 Select Route

1. Click the *Select Route* button
2. Click a link on the map to select one or more routes that operate on that link. If there happens to be no routes operating on that link, a window will pop up indicating that “No route is selected!”.
3. If there is only one route associate with the link, a dialog window with the name of the only route will pop up. Finish the selection by clicking the “OK” button and the attributes of the route will be populated on Transit Editor. Skip next step 4
4. If more than one route is associated with the link, a dialog window with all the associated route names will pop up as shown in Figure 61. Select one route, and then you can either finish the selection by clicking on “OK” or generate a new layer that offsets all the associated routes by clicking on the “Offset All” button, as shown in Figure 62.



**Figure 63 Select Route Window**



**Figure 64 Offset Routes Display**

5. If an offset route layer is generated, continue to select the desired route on the layer to finish your operation.

---

#### 7.4.5 Edit Route – Entering Editing

1. Click the *Edit Route* button
2. The toolbar will be extended to the right end with three new toolbar buttons, *Extend Route*, *Shrink Route*, and *Modify Route*. These three buttons will be enabled, and all other transit editing buttons will be disabled as shown in Figure 63.

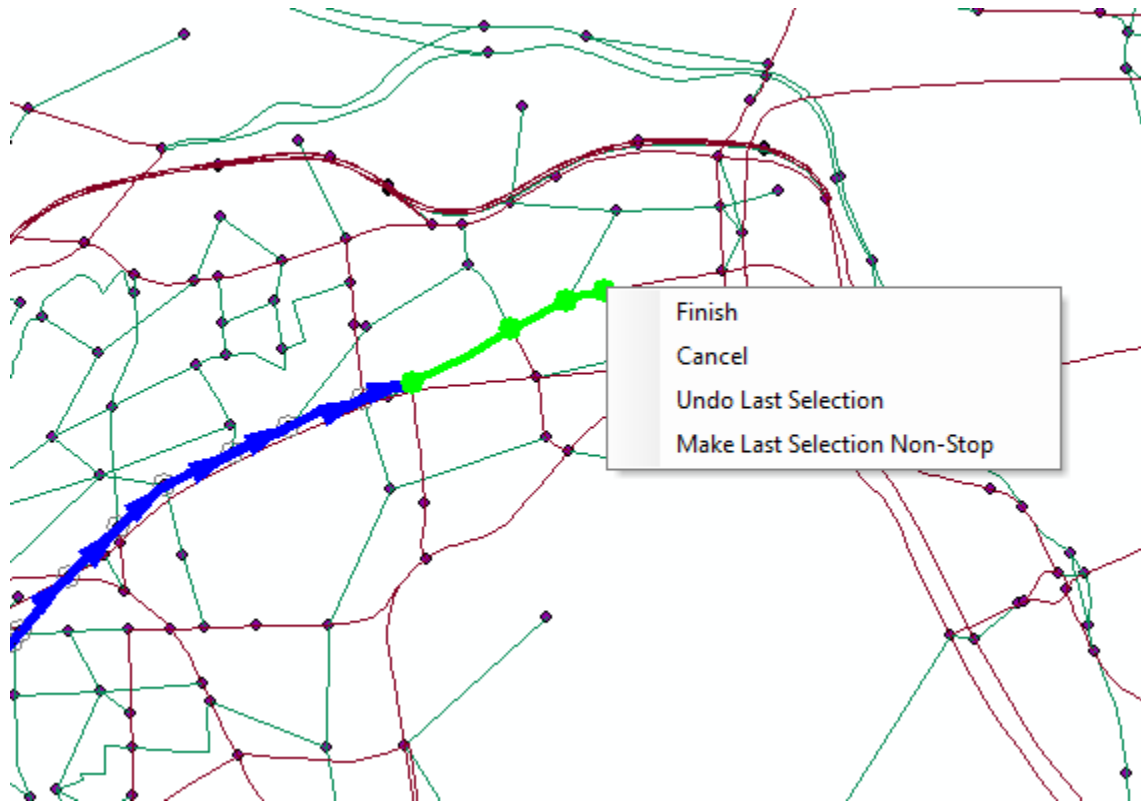


**Figure 65 Route Editing Buttons**

3. The Transit Network Editor window will change accordingly:
  - a. *Route Identification Area* will be disabled
  - b. *Link Editing* and *Node Editing* will be enabled
  - c. Editing buttons will become visible, and all other buttons will be disabled

#### 7.4.6 Edit Route – Extend Route

1. Click the *Extend Route* button after selecting an existing route.
2. Click on the beginning or the end of the existing route where the route needs to be extended, and then select the network nodes that will be on the extended portion of the route in order until reaching the last node of the extended route, as shown in Figure 64.

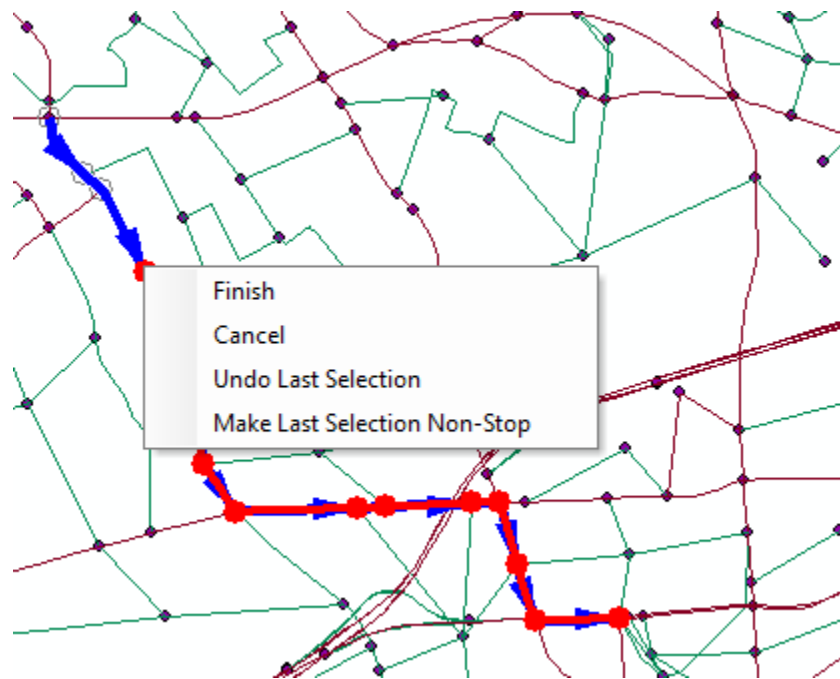


**Figure 66 Completed Extending Route Display**

3. To finish the operation, click the right button on the mouse to pop up the context menu window as shown in Figure 64.
4. Select *Finish menu* to finish extending a route, and the route will be updated.
5. Edit the route attributes in the Transit Editor window and click the *Save Route* button to save the edits. The new origin or destination node will be automatically updated, but the user must manually enter the new origin or destination name as well as update the runtime of the route.

#### 7.4.7 Edit Route – Shrink Route

1. Click the *Shrink Route* button after selecting an existing route.
2. Click on the beginning or end of the existing route where the route needs to be shrunk and select the stops in the backward order until the last stop of the shrunk route is reached, as shown in Figure 65.

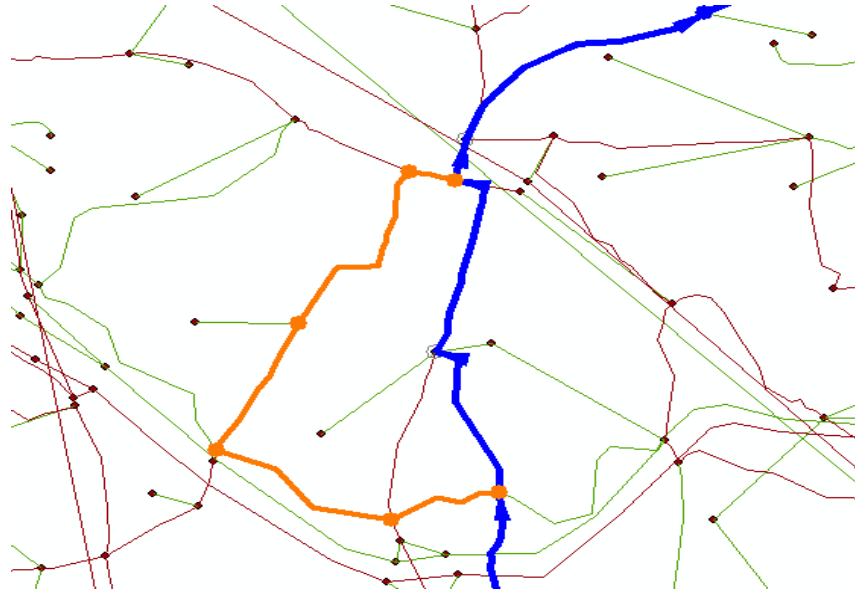


**Figure 67 Completed Shrinking Route Display**

3. To finish the operation, click the right button on the mouse to pop up the context menu window as shown in Figure 65.
4. Select *Finish* on the context menu to finish the Shrink Route operation, and the route will be updated.
6. Edit the route in the Transit Editor and click the *Save Route* button to save it. The new origin or destination node will be automatically updated, but the user must manually enter the new origin or destination name as well as update the runtime of the route.
- 5.

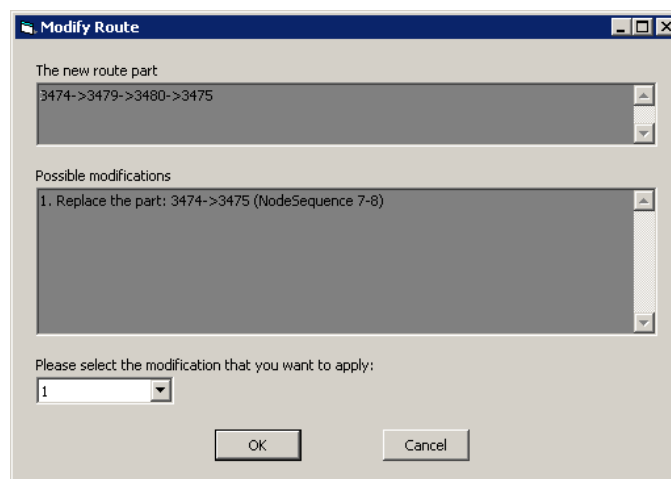
#### 7.4.8 Edit Route – Modify Route

1. Click the *Modify Route* button after selecting a route.
2. Click on a sequence of network nodes on the selected route for modification (both end nodes of the selected node sequence must be stops of the existing route), as shown in Figure 66.



**Figure 68 Completed Modification of Route Display**

3. Click the right button on the mouse to pop up a context menu window.
4. Select *Finish on the context menu*, a dialog window will pop up to display all possible modifications (i.e., all possible new route parts that can replace the selected existing route part), as shown in Figure 67.



**Figure 69 Selecting Modified Route Window**

5. Select one suggested modification in the combo box and click the OK button to accept the modification or click Cancel to discard the modification. Once the modification is accepted, the route will be updated, with the selected route part being replaced with the new route part.

6. Edit the attributes of the modified route in the Transit Editor and click the *Save Route* button to save the route. The user must update the route's runtime as that is not done automatically.

#### 7.4.9 Edit Route – Modify Route related Attributes

1. From the tree view of the Transit Network Editor window (Figure 57), click to select one component of
  - 1) Links, or
  - 2) Stops
2. Modify the corresponding attributes of the selected component (only some attributes are editable)

## 7.5 Export Transit Network

Click the *Export Transit Network* menu on the toolbar, and a configuration window will pop up as shown in Figure 68. The user can specify the following export criteria: *Format* which can be either TRNBUILD or PT, *Network Year* and *Output Folder*. The Output Location box will show the location of exported files.

Export Transit Network

Export Format: TRNBUILD (dropdown menu showing TRNBUILD and PT Transit Network)

Network Year: [text input field]

Output Folder: [text input field] [browse button (...)]

Output Files: [large empty text area]

Export Exit

---

## Figure 70 Configuration Window for Exporting Transit Files

### 7.6 Transit Station File

The Station File<sup>13</sup> is one of the files exported with the Transit Export function. The Station File lists each transit station (rail and BRT) and its accompanying parking lot and connecting bus (highway) nodes. It also lists each bus park and ride lot and connecting bus (highway nodes), as well as other information about the transit stations and park and ride lots.

The Station File is originally created in Cube Voyage as shown in Appendix List 1. Create Station File. COGTools adapt the logic of the Cube Voyage script and implement the function to create the Station.dbf file as the part of the Transit Export Files. Some of attributes, such as STACAP, STAOPCost, etc, in the created Station.dbf can't be extracted from the existing network. A look-up table that holds all the information is used to update the Station.dbf. In COGTools, the look up table is a file called Station Extra. Appendix List 2 is the Cube Voyager script to update station.dbf based on look-up table. Only existing year stations will be exported in the station.dbf file, any station that is projected to open in the future year will not be included in the exported specific year transit network files.

### 7.7 Moving Nodes

Sometimes it is necessary to move a highway or transit node. To do this the user must click the *Editor* button and select “start editing” from the drop-down menu. Then the user must click the *Edit Tool* and then click the node that is to be moved. After moving the node/s the user must click the *Editor* button once again and select “save edits” and then “stop editing” from the drop-down menu. After moving all the nodes it is necessary to update the XY coordinates by right clicking *NetworkNodes* and selecting “Open Attribute Table”. The user must right click the X-Coordinate column and select “Calculate Geometry” and select “yes” and under “property” select X and then click “OK”. Then the user must click the Y-Coordinate column and select “Calculate Geometry” and select “yes” and under “property” select Y and then click “OK”. If the XY coordinates are not updated, then the nodes will shift back into their original position the next time a user opens the network in COGTools.

### 7.8 Reshaping Links

Sometimes it is necessary to reshape a link. To do this the user must click the *Editor* button and select “start editing” from the drop-down menu. Then the user must click the *Edit Tool* and then click the link that is to edited. The selected link will be highlighted. Next the user should right click the highlighted link and select “edit vertices”. The user may then add or move vertices to reshape a link. After moving the node/s the user must click the *Editor* button once again and select “save edits” and then “stop editing” from the drop-down menu.

---

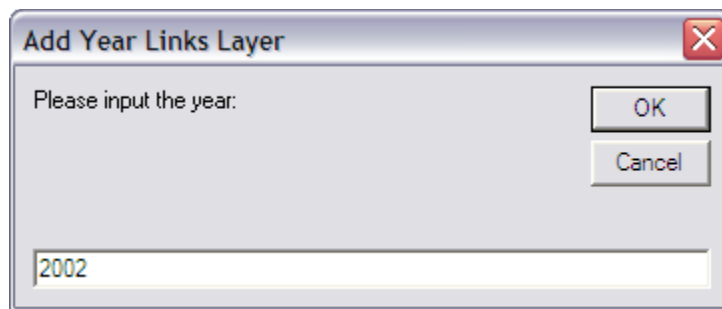
<sup>13</sup> Pages 56-57, “Highway and Transit networks Used in the Air Quality Conformity Analysis of the 2020 Amendment to Visualize 2045 and the FY 2021-2024 TIP (Ver. 2.3.78 Travel Model),” (Washington, D.C.: Metropolitan Washington Council of Governments, National Capital Region Transportation Planning Board, April 10, 2020), <https://www.mwcog.org/transportation/data-and-tools/modeling/model-documentation/>.

## 7.9 Add Special Layers

COGTools provides three menus, *Add Year Link Layer*, *Add Travel Direction Layer*, and *Add Transit Network Layer*, to generate three special layers, Year Network Layer, Year Network Layer with Travel Direction, and Year Transit Network Layer, respectively.

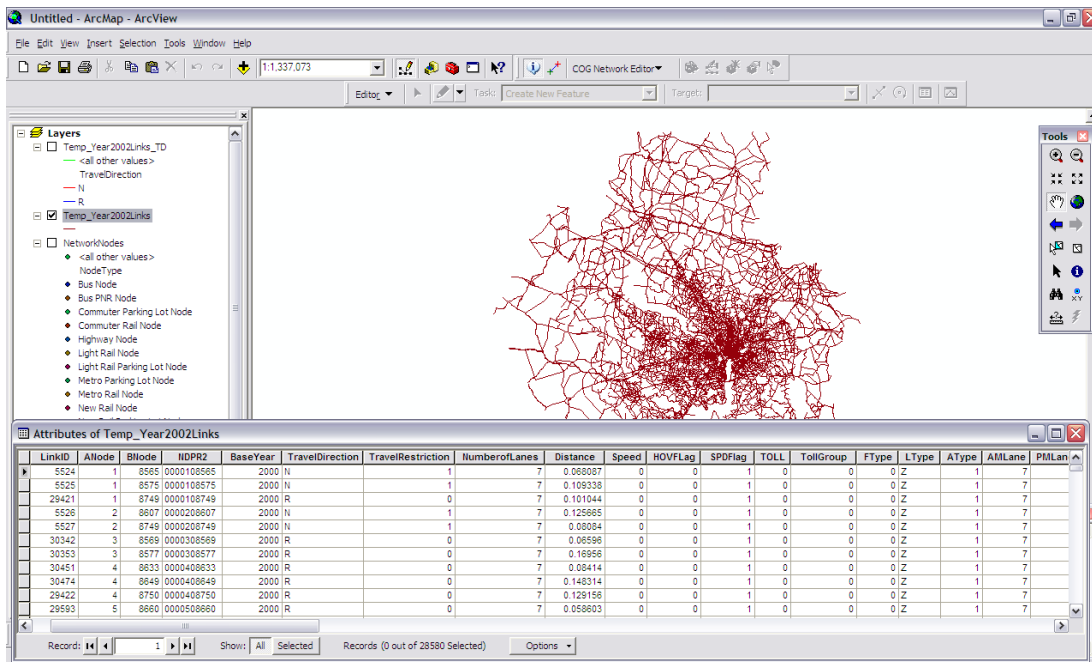
### 7.9.1 Add Year Link Layer

This function will generate a joint view that contains the specific-year geometric network links and corresponding attributes from the logical network. You need to first specify the network year in the window below (Figure 69).



**Figure 71 Add Year Network Layer Dialog**

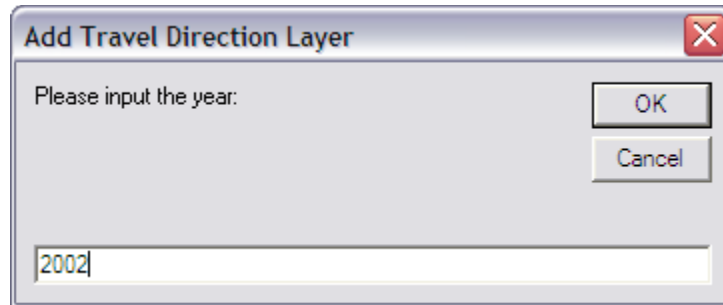
After clicking the OK button, a new view layer will be generated as shown in Figure 70.



**Figure 72 Year Network Layer Window**

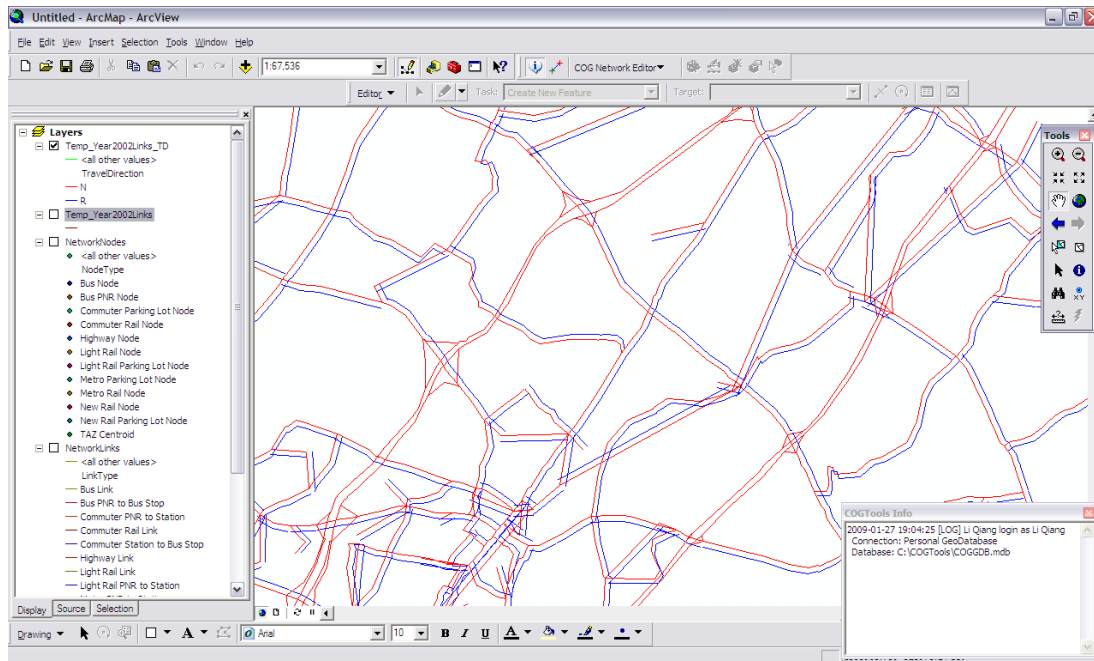
### 7.9.2 Add Travel Direction Layer

This function will generate a view that contains the year-specific network links with two colored travel directions. You need to first specify the network year in the window below (Figure 71).



**Figure 73 Add Travel Direction Layer Dialog**

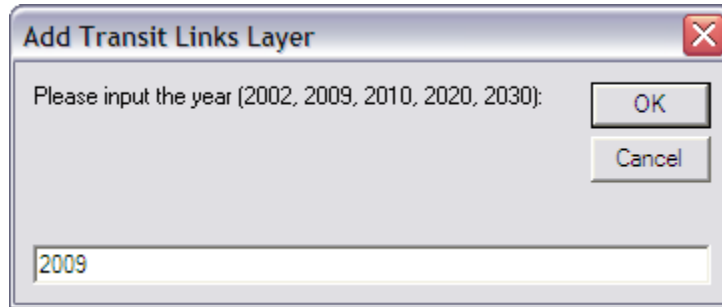
After clicking the OK button, a new view layer will be generated as shown in Figure 72.



**Figure 74 Travel Direction Layer Window**

### 7.9.3 Add Transit Links Layer

This function generates a joint view that contains the specific-year transit network link features and corresponding transit network attributes. You need to specify the network year in the window below (Figure 73).



**Figure 75 Add Year Transit Network Layer Dialog**

After clicking the OK button, a new view layer will be generated as shown in Figure 74.

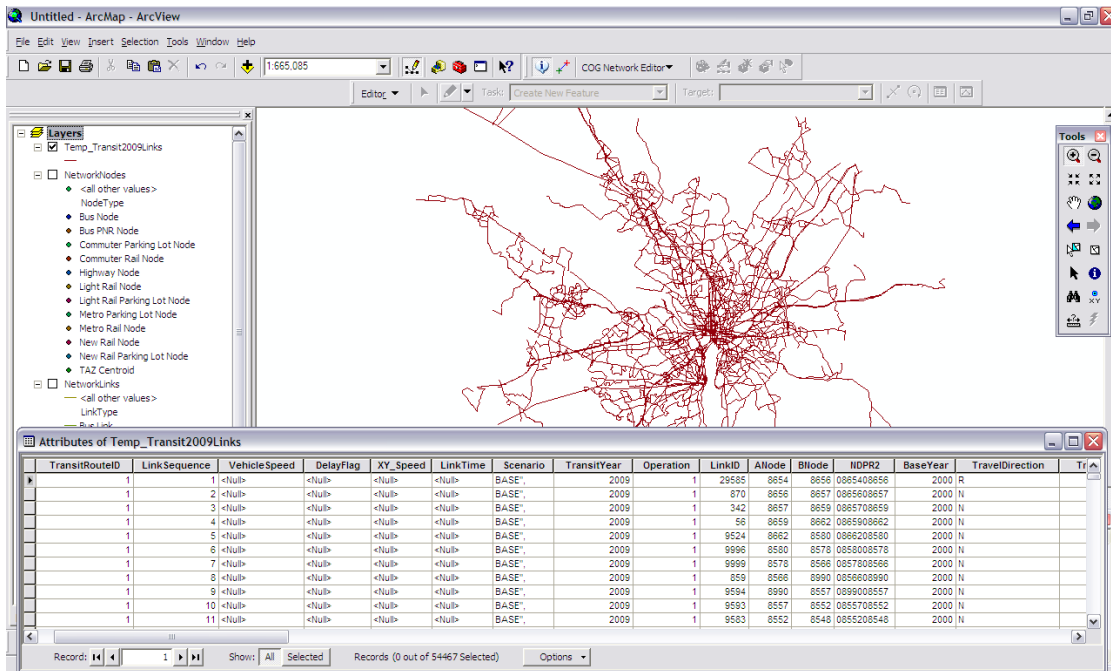


Figure 76 Year Transit Network Layer Window

### 7.10 Highway Editing → Transit Editing

When editing the links of a highway network (e.g., splitting a link), if one or more transit routes are coded on those links, the user is automatically transferred to the transit editing mode and may update the associated transit routes. Five link editing operations are available:

- Create New Link
- Add Record
- Retire Link
- Split Link
- Delete Link

Before the transfer, a dialog window will pop up to inform the user of all the affected routes. The background color of the affected transit routes listed in the dialog window indicates different transfer actions:

- **Green:** The transfer action of the routes in the green color is incurred by a split link (including link splitting incurred by adding a new link) or an add record operation; affected routes will be automatically updated; no manual transfer is needed. (Figure 75)

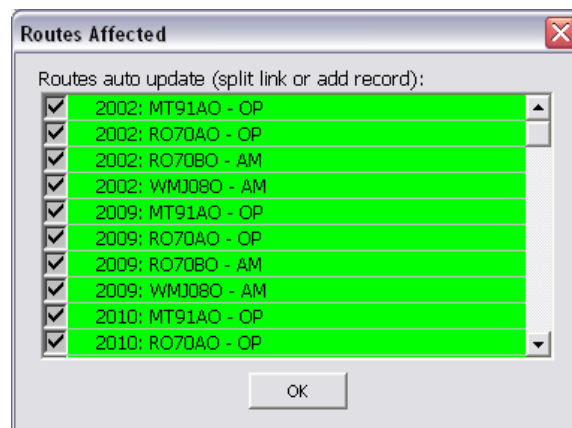
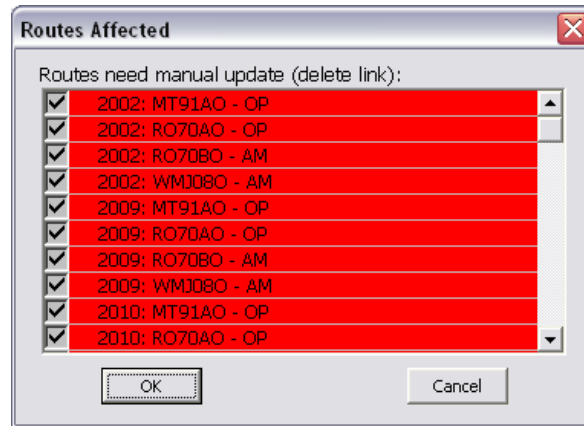


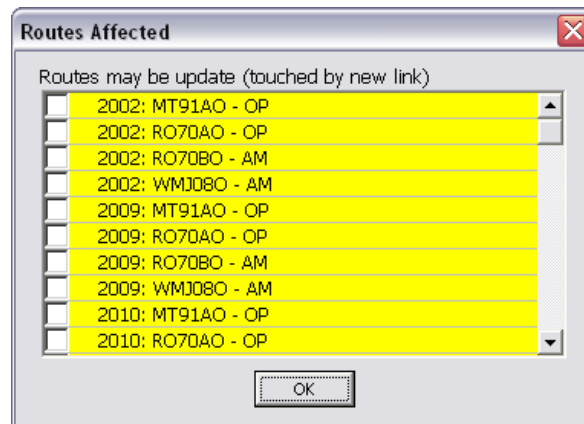
Figure 77 Green Transit Route Update Window

- **Red:** The transfer action of the routes in the red color is incurred by a delete link operation; the affected transit routes must be manually updated. (Figure 76)



**Figure 78 Red Transit Route Update Window**

- **Yellow:** The transfer action of the routes in the yellow color is incurred by a create new link operation that reuses existing node(s); affected routes may be manually updated or kept unchanged. The user can select the affected routes that he/she wants to update by clicking the checkboxes in front of those routes. (Figure 77)



**Figure 79 Yellow Transit Route Update Window**

## 8. APPENDIX

```

;;; Start_Station_File.S - compile the transit dbf files exported from the TPBMAN
;;; and begin to construct station.dbf file
;;; -followup program (Finish_Station_File.s must be applied next, to add
;;; new variables per Version 2.3 model (sta PNR capacity, costs)

*del voya*.prn
;; create station dbf file from component dbf files from the TPBMAN Geodatabase
;; constrained to 2007 out-year

Met_NodeF = 'Met_Node.dbf' ; Metrorail station node XYs
Com_NodeF = 'Com_Node.dbf' ; Commuter rail station node XYs
Bus_NodeF = 'Bus_PNRN.dbf' ; Commuter rail station node XYs

Met_PNRNF = 'Met_PNRN.dbf' ; Metrorail PNR Node XY's
Com_PNRNF = 'Com_PNRN.dbf' ; Commuter rail PNR Node XY's

Met_PNRLF = 'Met_PNRL.dbf' ; Metrorail PNR-station nodes
Com_PNRLF = 'Com_PNRL.dbf' ; Commuter rail PNR-station nodes
Bus_PNRLF = 'Bus_PNRL.dbf' ; Bus PNR-station nodes

Met_BusF = 'Met_Bus.dbf' ; Metrorail station-to-Bus stop nodes
Com_BusF = 'Com_Bus.dbf' ; Comm rail station-to-Bus stop nodes

NodeF = 'I:\ateam\Version2.3\10_19_2010_HighwayNet\2007_Node.dbf' ; Highway Node file

Stasize = 1000 ; no. of stations
ITAZs = 3675 ; highest internal TAZ number
SCens = 3000 ; no. of station (dummy) centroids

yearspec = 2009 ; 2009 is used for now
;;-----

RUN PGM=MATRIX
ZONES=1
array type=c1 MM = @STASize@
array type=c1 stause= @StaSize@
array type=c1 stapark=@stasize@
array type=c27 Sname = @STASize@

ARRAY NCT = @STASize@,
STAT = @STASize@,
STAP = @STASize@,
STAC = @STASize@,
STA_CenD = @STASize@,
STAZ = @STASize@,
STAX = @STASize@,

```

```

STAY    = @STASize@,
STAD    = @STASize@,
SEQNO   = @STASize@,

STAN1   = @STASize@,
STAN2   = @STASize@,
STAN3   = @STASize@,
STAN4   = @STASize@,
STAPCAP = @STASize@,
STAPKCost = @STASize@,
STAOPCost = @STASize@,
STAPKShad = @STASize@,
STAOPShad = @STASize@,
FirstYr = @STASize@, PS_length = @Stasize@

ARRAY TAZ = @Itazs@, TAZX = @Itazs@, TAZY = @ITAZs@,
      Stacent = @SCens@, StacenX = @SCens@, StacenY = @SCens@

FILEI DBI[1] = "@Met_NodeF@", sort = Node,Networkyea
FILEI DBI[2] = "@Com_NodeF@", sort = Node,Networkyea
FILEI DBI[9] = "@Bus_NodeF@", sort = Node,Networkyea
FILEI DBI[3] = "@Bus_PNRLF@", sort = ANode,Networkyea

FILEI DBI[4] = "@Met_PNRLF@", sort = ANode,Networkyea
FILEI DBI[5] = "@Com_PNRLF@", sort = ANode,Networkyea

FILEI DBI[6] = "@Met_busF@", sort = ANode,Networkyea
FILEI DBI[7] = "@Com_BusF@", sort = ANode,Networkyea
FILEI DBI[8] = "@Nodef@", sort = N

RECO[1] = "Station.dbf", form=10.0,
Fields = SEQNO, MM(C1), NCT, STAPARK, STAUSE, SNAME(c27), STAC, STAZ, STAT, STAP,
      STAN1, STAN2, STAN3, STAN4, STAPCAP, STAX, STAY,
      STAPKCost, STAOPCost, STAPKShad, STAOPShad, FirstYr, STa_CenD

cnt = 0

; Metrorail Station Nodes:
LOOP L= 1,dbi.1.NUMRECORDS
  x=DBIReadRecord(1,L)
  cnt=cnt+1
  IF (DI.1.Networkyea <= @yearspec@)
    MM[cnt]   = 'M'
    STAT[cnt] = di.1.node
    Sname[cnt] = di.1.name
    STAX[cnt] = di.1.X_COORD
    STAY[cnt] = di.1.Y_COORD
    FIRSTYR[cnt] = di.1.networkyea
  endif
ENDLOOP

; Commuter rail Station Nodes:

```

```

LOOP L= 1,dbi.2.NUMRECORDS
  x=DBIReadRecord(2,L)
  cnt=cnt+1
  IF (DI.2.Networkyea <= @yearspec@)
  IF (di.2.node != 9022) ;; skip if station is Berwyn for 2007
    MM[cnt]   ='C'
    STAT[cnt] = di.2.node
    Sname[cnt] = di.2.name
    STAX[cnt] = di.2.X_COORD
    STAY[cnt] = di.2.Y_COORD
    FIRSTYR[cnt] = di.2.networkyea
  endif
  endif
ENDLOOP

STA_Cnt = cnt

; Bus PNRN Nodes:
LOOP L= 1,dbi.9.NUMRECORDS
  x=DBIReadRecord(9,L)

  cnt = cnt +1
  IF (DI.9.Networkyea <= @yearspec@)
    MM[cnt]   ='B'
    STAp[cnt] = di.9.node
    Sname[cnt] = di.9.name
    STAX[cnt] = di.9.X_COORD
    STAY[cnt] = di.9.Y_COORD
    FIRSTYR[cnt] = di.9.networkyea
  endif
ENDLOOP

;; Now read in Metrorail PNR-Station Links
LOOP L= 1,dbi.4.NUMRECORDS
  x=DBIReadRecord(4,L)

  Anode   = di.4.Anode ; PNR node
  Bnode   = di.4.Bnode ; sta node
  Length  = di.4.Length

  IF ((DI.4.Networkyea <= @yearspec@) && (Anode >= 11000 && Anode <= 11999) && (Bnode >=
8000 && Bnode <= 8999))
    LOOP sdx = 1,STA_Cnt
      if (STAT[sdx] = Bnode)
        STAP[sdx] = Anode
        STAPark[sdx] = 'Y'
        PS_Length[sdx] = Length
      endif
    ENDLOOP
  ENDIF ;;
ENDLOOP

```

---

```

;; Now read in Comm. rail PNR-station links
LOOP L= 1,dbi.5.NUMRECORDS
  x=DBIReadRecord(5,L)

  Anode    = di.5.Anode ; PNR node
  Bnode    = di.5.Bnode ; sta node
  Length   = di.5.Length

  IF ((DI.5.Networkyea <= @yearspec@) && (Anode>= 12000 && Anode <= 12999) && (Bnode >=
9000 && Bnode <= 9999))
    LOOP sdx = 1,STA_Cnt
      if (STAT[sdx] = Bnode)
        STAP[sdx] = Anode
        STAPark[sdx] = 'Y'
        PS_Length[sdx] = Length
      endif
    ENDLOOP
  ENDIF ;;
ENDLOOP

; Bus PNR-Stop Node Links:
LOOP L= 1,dbi.3.NUMRECORDS
  x=DBIReadRecord(3,L)

  Anode    = di.3.Anode ; PNR node
  Bnode    = di.3.Bnode ; bus Stop node
  Length   = di.3.Length

  IF ((DI.3.Networkyea <= @yearspec@) && (Anode>= 13000 && Anode <= 13999))
    LOOP sdx = 1,cnt
      if (STAP[sdx] = Anode)
        STAN1[sdx] = Bnode
        STAPark[sdx] = 'Y'
        PS_Length[sdx] = Length
      endif
    ENDLOOP
  ENDIF ;;
ENDLOOP

;;-----

;; Now read in Metrorail-Bus connectors
LOOP L= 1,dbi.6.NUMRECORDS
  x=DBIReadRecord(6,L)

  Anode    = di.6.Anode ; sta node
  Bnode    = di.6.Bnode ; bus node
  Length   = di.6.Length

  IF ((DI.6.Networkyea <= @yearspec@) && (Anode>= 8000 && Anode <= 8999))

```

---

```

LOOP sdx = 1,STA_Cnt
  if (STAT[sdx] = Anode)
    if (STAN1[sdx] = 0)
      STAN1[sdx] = Bnode
    elseif (STAN2[sdx] = 0)
      STAN2[sdx] = Bnode
    elseif (STAN3[sdx] = 0)
      STAN3[sdx] = Bnode
    elseif (STAN4[sdx] = 0)
      STAN4[sdx] = Bnode
    else
      print list= 'too many (>4) Metrostation-bus nodes'

    endif
  endif
endloop
ENDIF ;;

ENDLOOP
;; Now read in commuter rail sta -Bus connectors
LOOP L= 1,dbi.7.NUMRECORDS
  x=DBIReadRecord(7,L)

  Anode    = di.7.Anode ; sta node
  Bnode    = di.7.Bnode ; bus node
  Length   = di.7.Length

  IF ((DI.7.Networkyea <= @yearspeg@) && (Anode >= 9000 && Anode <= 9999))
  LOOP sdx = 1,STA_Cnt
    if (STAT[sdx] = Anode)
      if (STAN1[sdx] = 0)
        STAN1[sdx] = Bnode
      elseif (STAN2[sdx] = 0)
        STAN2[sdx] = Bnode
      elseif (STAN3[sdx] = 0)
        STAN3[sdx] = Bnode
      elseif (STAN4[sdx] = 0)
        STAN4[sdx] = Bnode
      else
        print list= 'too many (>4) Commrail station-bus nodes'

      endif
    endif
  endloop
ENDIF ;;

ENDLOOP

;;-----
;; Now read in highway node xy file, fill in TAZ xy arrays and station centroid xy arrays

```

```

LOOP L= 1,dbi.8.NUMRECORDS
  x=DBIReadRecord(8,L)

  N      = di.8.n
  X      = di.8.x
  Y      = di.8.y

  IF (N >= 1 && N <= 3675) ; if node is a TAZ
    TZcnt = TZcnt + 1
    TAZ[TZcnt] = N
    TAZX[TZcnt] = X
    TAZY[TZcnt] = Y
    print list = TZcnt, n, x, y, file=tazarray.txt
  ENDIF

  IF (N >=5001 && N <= 7999) ; if node is a station centroid
    SCcnt = SCcnt + 1
    Stacent[SCcnt] = N
    StacenX[SCcnt] = X
    StacenY[SCcnt] = Y
    print list = SCcnt, n, x, y, file=stacenarray.txt
  ENDIF
ENDLOOP

;; Now check which TAZ and dummy centroid is nearest to each Metro/Comm.
;; and TAZ is nearest to each bus pnr lot

LOOP sdx= 1, @Stasize@

  STAZ[sdx] = 0
  mindist   = 99999999

  loop tdx= 1,@ITAZs@
    IF (STAX[sdx] > 0 && TAZX[tdx] > 0)

      dist = (((STAX[sdx] - TAZX[tdx])^2) + ((STAY[sdx] - TAZY[tdx])^2))^0.5
      if (dist < mindist)
        mindist = dist
        STAZ[sdx] = TAZ[tdx]
      endif
    ENDIF
    ;;print list = stax[sdx],',',stay[sdx],',', tazx[tdx],',', tazy[tdx],',', dist1,',', mindist1,'
    ',staz[sdx],file=tazfile.txt
  endloop

  STAC[sdx] = 0
  STA_CenD[sdx] = 0
  mindist   = 99999999
  loop ddx= 1,SCcnt

```

```

    IF (STAX[sdx] > 0 && STACENX[ddx] > 0 && MM[sdx] ='M' && (Stacent[ddx] >= 5001 &&
Stacent[ddx] <= 5999))
      dist = (((STAX[sdx] - STACENX[ddx])^2) + ((STAY[sdx] - STACENY[ddx])^2))^0.5
      if (dist < mindist )
        mindist = dist

        STA_CenD[sdx] = mindist
        STAC[sdx] = Stacent[ddx]
      endif
    ENDIF
  endloop

  loop ddx= 1,SCCnt
    IF (STAX[sdx] > 0 && STACENX[ddx] > 0 && MM[sdx] ='C' && (Stacent[ddx] >= 6001 &&
Stacent[ddx] <= 6999))
      dist = (((STAX[sdx] - STACENX[ddx])^2) + ((STAY[sdx] - STACENY[ddx])^2))^0.5
      if (dist < mindist )
        mindist = dist

        STA_CenD[sdx] = mindist
        STAC[sdx] = Stacent[ddx]
      endif
    ENDIF
  endloop
ENDLOOP

; write Station Array
LOOP idx = 1,@STaSIZE@

ro.seqno    = idx
RO.MM      = MM[idx]
RO.NCT     = NCT[idx]
RO.stapark = STAPARK[idx]
RO.stause  = 'Y'
RO.Sname   = Sname[idx]
RO.STAC    = STAC[idx]
RO.STAZ    = STAZ[idx]
RO.STAT    = STAT[idx]
RO.STAP    = STAP[idx]
RO.STAN1   = STAN1[idx]
RO.STAN2   = STAN2[idx]
RO.STAN3   = STAN3[idx]
RO.STAN4   = STAN4[idx]
RO.STAPCAP = STAPCAP[idx]
RO.STAX    = STAX[idx]
RO.STAY    = STAY[idx]
RO.STAPKCost = STAPKCost[idx]
RO.STAOPCost = STAOPCost[idx]
RO.STAPKShad = STAPKShad[idx]
RO.STAOPShad = STAOPShad[idx]
RO.FirstYr = FirstYr[idx]

```

```

RO.STA_CenD = Sta_CenD[idx]

if (MM[idx] = 'M' || MM[idx] = 'C' || MM[idx] = 'B') WRITE RECO=1
ENDLOOP

ENDRUN

```

## List 1. Create Station File in Cube Voyage

```

*del voya*.prn
*COPY STATION.DBF STATION_A.DBF
;-----;
; Finish_Station_File.s
; Add Mary Martchouk's refined station names, NCT, peak station costs, offpk station costs,
; station parking capacities to
; pre-existing station file
;
;
;
;
;-----;
;
;-----;
;; Step 1: read Mary's new attributes
;-----;
RUN PGM=MATRIX
ZONES=1

FileI RECI = Station_file_ver3.prn,
ID          = 1, ;STATION ID (STATION NO. (MODES'M'/'C' OR PNR NO. (MODE 'B')
STANAME(C)  = 2, ;NAME
NCT         = 3, ;STATION ACCESS TYPE
STAPK COST  = 4, ;PEAK STATION PARKING COST
STAOP COST  = 5, ;OFF PEAK STATION COST
STACAP      = 6, ;STATION PARKING CAPACITY
DELIMITER[1]=", " SORT=ID

; write out dbf file
FILEO RECO[1] = "STATION_B.DBF",
Fields = ID(8),STANAME(C35),NCT(8),STAPK COST(8),STAOP COST(8),STACAP(8)
WRITE RECO=1

ENDRUN
RUN PGM=MATRIX
ZONES=1
FILEI DBI[1] = "Station_A.dbf"
FILEI DBI[2] = "Station_B.dbf"

RECO[1] = "Station_FINAL.dbf", form=10.0,
Fields = SEQNO, MM, NCT, STAPARK, STAUSE, SNAME(c35), STAC, STAZ, STAT, STAP,

```

---

```

STAN1, STAN2, STAN3, STAN4, STAPCAP, STAX, STAY, ;;; Snamemary(c35),
STAPKCost, STAOPCost, STAPKShad, STAOPShad, FirstYr

scnt = 0

;
LOOP L= 1,dbi.1.NUMRECORDS
  x=DBIReadRecord(1,L)

  IF (di.1.STAT >= 8000 && di.1.STAT <= 9999)
    sidx1 = di.1.STAT
  ELSE
    sidx1 = di.1.STAP
  ENDIF

  LOOP M= 1,dbi.2.NUMRECORDS
    y=DBIReadRecord(2,M)

    sidx2 = di.2.id

    _NCT      = 0
    _StaPKCost = 0
    _STAOPCOST = 0
    _STAPCAP  = 0

    IF (sidx1 = sidx2)
      _SNAMEMary = di.2.staname ;; station file name from Mary (to check with/not
written out)
      _NCT      = di.2.NCT      ;; station access code
      _StaPKCost = di.2.STAPKCost ;; pk parking cost
      _STAOPCOST = di.2.STAOPCost ;; off pk parking cost
      _STAPCAP  = di.2.STACAP   ;; capacity of PNR lot

      print list =sidx1, sidx2,_Sname,_NCT, file=dud.txt
      GOTO writeit
    ENDIF
  ENDLOOP

:Writeit
RO.SEQNO = di.1.SEQNO
RO.MM    = di.1.MM
RO.NCT   = _NCT
RO.STAPARK = di.1.STAPARK
RO.STAUSE = di.1.STAUSE
RO.SNAME  = di.1.Sname
;;; RO.SNAMEMary = _SNAMEMary
RO.STAC   = di.1.STAC
RO.STAZ   = di.1.STAZ
RO.STAT   = di.1.STAT
RO.STAP   = di.1.STAP

```

```
RO.STAN1 = di.1.STAN1
RO.STAN2 = di.1.STAN2
RO.STAN3 = di.1.STAN3
RO.STAN4 = di.1.STAN4
RO.STAPCAP = _STAPCAP
RO.STAX = di.1.STAX
RO.STAY = di.1.STAY
RO.STAPKCost = _StaPKCost
RO.STAOPCost = _StaOPCost
RO.STAPKShad = di.1.STAPKShad
RO.STAOPShad = di.1.STAOPShad
RO.FirstYr = di.1.FirstYr
```

```
WRITE RECO=1
```

```
ENDLOOP
;
```

```
endrun
```

```
*COPY Station_FINAL.dbf Station.dbf
;;end
```

## List 2. Update Exported Station File Attributes

BASELINKS
OBJECTID
LinkIDo
LinkID
EdgeID
EdgeIDo
ANode
BNode
StreetName
NDPR2
BaseYear
TravelDirection
Distance
LinkType
TLinkType
PLinkType
Mode
TMode
PMode
TOLL
TollGrp
FType
TFType
PFType
LType
AType
AMLane
PMLane
OPLane
AMLimit
PMLimit
OPLimit
Screen
NetYear
ProjectID
ZoneID
Status
COGStatus
UpdateDate
Jur
Count_
Speed
TSpeed
PSpeed
match_
TRANTIME
WKTIME
QC_C
QC_Att_Value
m_screen
mm

NetworkLinks
OBJECTID
Shape
EdgeID
EdgeIDo
ANode
BNode
FunctionClass
Oneway
RampFlag
RouteID
RouteName
UpdateBy
Screen
JUR
Length
LinkType
Format
del
m_screen
Shape_Length
m
aM
bM

NetworkNodes
OBJECTID
Shape
Node
NodeType
Jur
UpdatedBy
X_COORD
Y_COORD
Name
NetYear
Format
MRFZONE
CRMZONE
CRVZONE

NetworkNodes_1
OBJECTID
Shape
Node
NodeType
Jur
UpdatedBy
X_COORD
Y_COORD
Name
NetYear
Format
MRFZONE
CRMZONE
CRVZONE



TRANSITLINESDEFINITION
ObjectID
TransitRouteID
TransitRouteName
OriginNode
DestinationNode
OriginNodeName
DestiNodeName
ORI
DEST
Oneway
Mode
Headway
Runtime
Operation
SourceYear
Scenario
TransitYear
SYear
RunSpeed
LineDistance
opName
Operator
GOperator2
GOperator

TRANSITROUTESTOPS
ObjectID
TransitRouteID
Node
NodeSequence
Operation
StopFlag
SourceYear
SYear
Scenario
TransitYear
delt
MM

TRANSITLINKS
ObjectID
LinkID
TransitRouteID
ANode
BNode
LinkSequence
Scenario
TransitYear
SYear
Operation
status
QA_QC
MM
m2017
mBase

