TAQA User Guide

prepared for

Mid-Region Council of Governments

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October 2014

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1 INTRODUCTION TO TAQA

The Transportation Analysis and Querying Application (TAQA) supports the ongoing Congestion Management Process and other transportation planning activities undertaken by the Mid-Region Council of Governments (MRCOG). The initial system serves as the foundation for an analysis application with mapping, querying, and performance measure reporting capabilities on travel times and traffic counts.

TAQA is designed as a user-friendly web application that allows general users to display and query MRCOG transportation data. The types of data it contains are described below.

MRCOG offers free use of the transportation data contained in the TAQA. The information contained in the TAQA is for informational purposes only. MRCOG does not warranty or guarantee the information in any manner. MRCOG shall not be responsible for the use or interpretation of the data by any user for any purpose.

Types of Transportation Data

The TAQA currently contains the following types of transportation data:

- **Travel times**
- **Traffic counts**
- **Average Weekday Daily Traffic (AWDT)**

Travel time data may be queried for individual date(s) or to determine average conditions across a larger period of time, such as all weekdays in a month. The data is available by direction for individual roadway segments (i.e. a section of road generally from one intersection mid-point to another intersection mid-point). Travel time data is obtained from INRIX, a commercial vendor that aggregates data from a range of mobile devices. Additional travel time data from "floating car" surveys can be found on the MRCOG website.

Traffic counts data is collected by MRCOG for segments of every federal-aid eligible road (i.e. all roadways classified as collectors or above) using portable traffic monitoring devices with rubber tubes that stretch across the roadway (tube counters). All major roads are counted once every three years. Additional data is collected through a series of permanent count stations, mostly on Interstates. Data is collected across two 24-hour periods to produce average daily and peak period traffic volume levels, as well as directional split values (the percentage of travel in a peak direction for the day or peak period). The observed data differs from Average Weekday Daily Traffic (AWDT) because it reflects a point in time rather than an annual average. Only the most recent observed traffic counts data for each segment can be found in the TAQA.

Average Weekday Daily Traffic refers to the traffic volume along a roadway segment in an average 24-hour weekday. A seasonal and annual adjustment factor is applied to the observed traffic counts data to determine the AWDT for an individual year. TAQA currently contains an inventory of AWDT values from 2000-2012.

2 ACCESSING TAQA

TAQA is implemented as a web application to provide an enhanced user experience with cross-browser compatibility, and improved response times.

To access TAQA, you need:

- A computer with broadband internet connection.
- A HTML5-compatible internet browser:
  - Microsoft Internet Explorer v9 (or greater)
  - Mozilla Firefox v24 (or greater)
  - Google Chrome v30 (or greater)

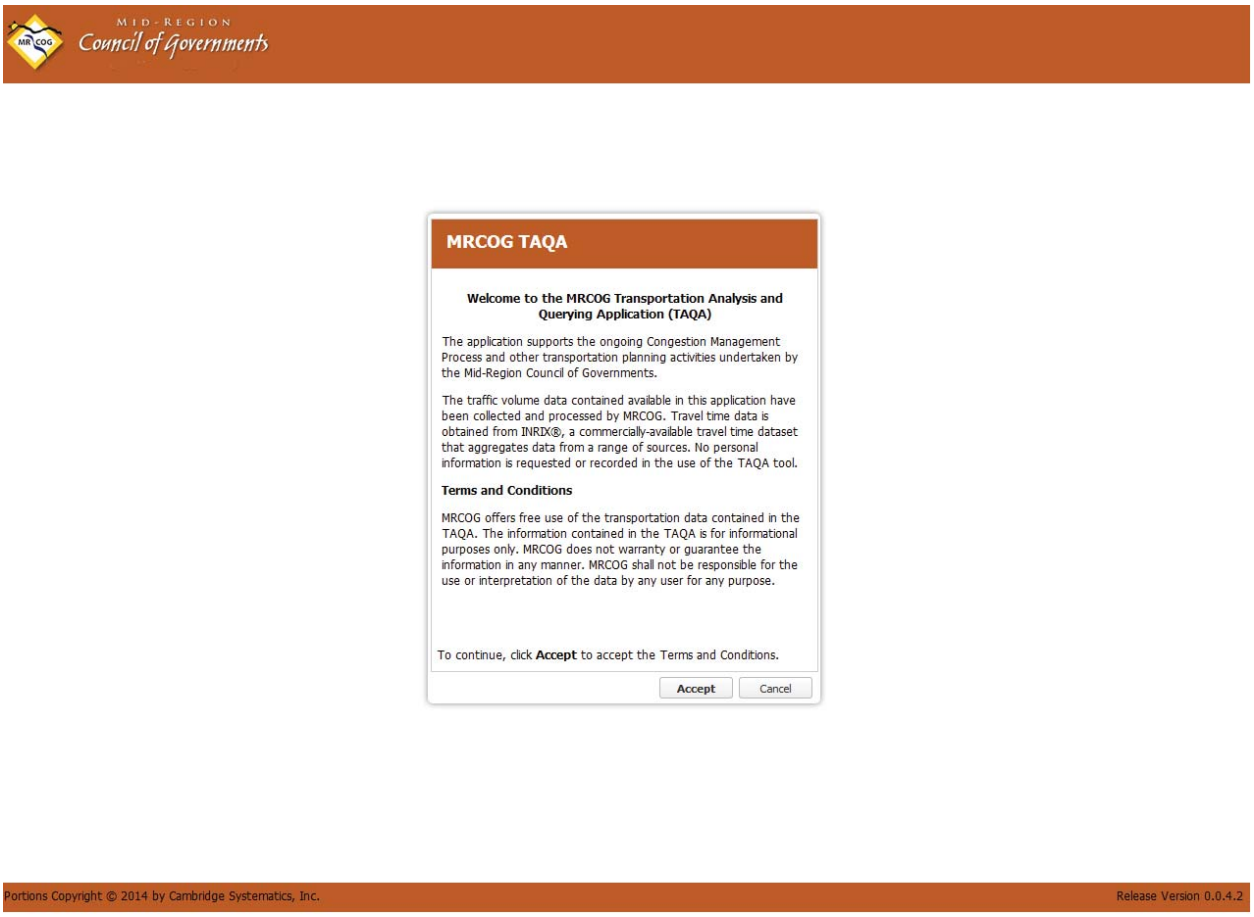
TAQA will work correctly over a slower internet connection; however the speed of data download and display of data will be severely impacted.

TAQA is hosted by the Mid-Region Council of Governments, and can be accessed at:

http://taqa.mrcog-nm.gov

If you have a browser 'Pop-Up Blocker', either disable it or allow http://taqa.mrcog-nm.gov.

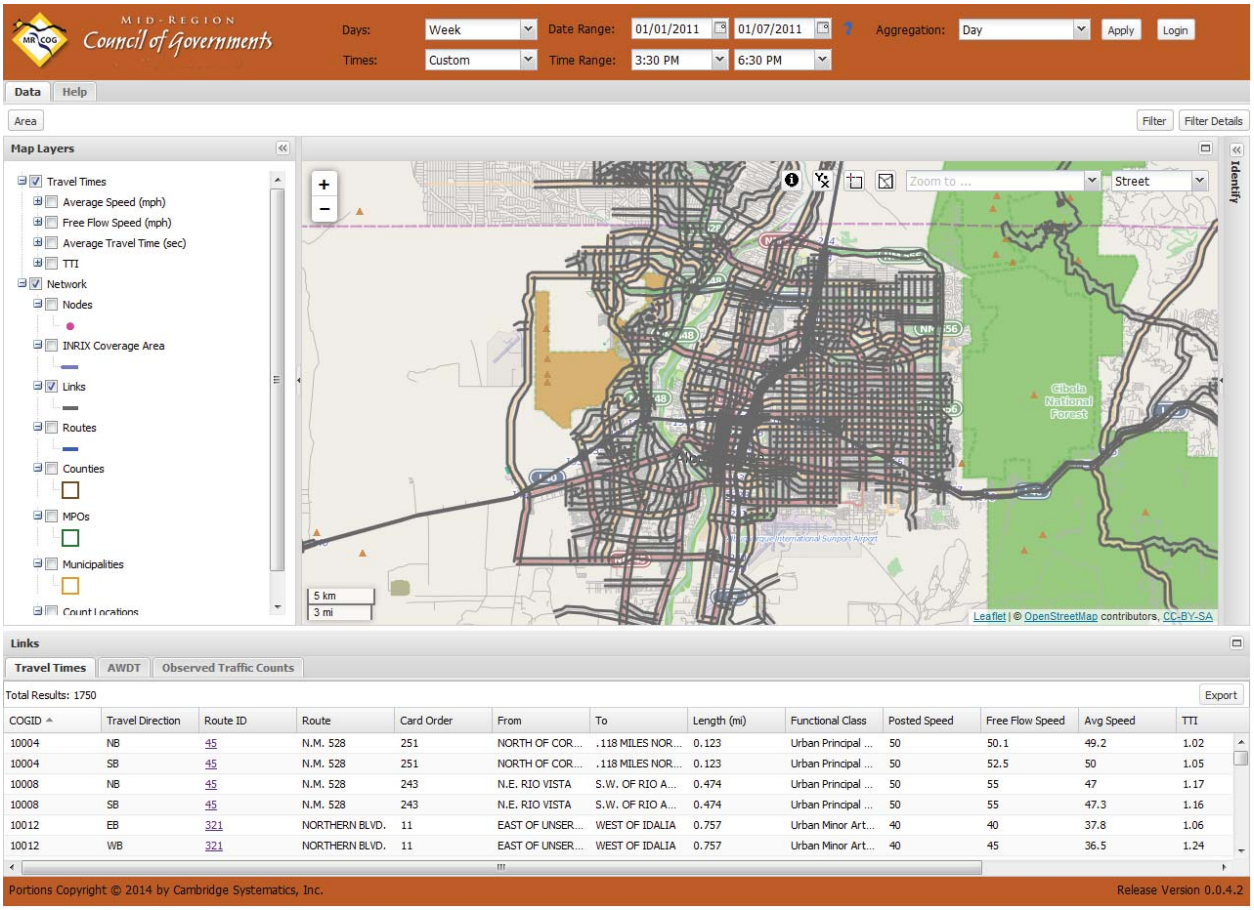
Once TAQA successfully loads in your browser, the splash screen is displayed.



Click Accept to accept the Terms and Conditions and proceed to the main screen.

3 APPLICATION

TAQA uses an intuitive, interactive geographic user interface allowing users to search and display transportation data within MRCOG.



The main user interface provides methods to filter and display transportation data on a map and in a table. This interface is split into a number of top-level tabs:

- Data tab – spatial and tabular display of the filtered transportation data by link.
- Route Details tab(s) – details of individual routes for study. Accessed using the Drill-down to Route Details feature.
- Area tab – details of an area for study.
- Help tab – relevant help information.

Each of these tabs is described in their own sections below. Each top-level tab contains within it sub-tabs that are also described in detail. In addition, an application control panel gives access to frequently used filtering functionality.

The windows within each of the tabs can be resized by clicking-and-dragging the dividing bars. Some panels can be collapsed by clicking the appropriate button:

collapse/expand the window to the left
collapse/expand the window to the right
maximize the window
restore the window to the original size

Application control panel

The application control panel is located in the header above the main user interface tabs. It gives access to frequently used filtering functionality without needing to open the Filter dialog. The transportation data associated with links displayed on the map and in the table can be filtered by date and time. To apply the selected filters, click Apply.

*It is important to note that the queries by date and time apply to **travel time data only**.*

Days

Select the days of the week to filter by. Only a single item may be selected. Available selections are:

- Tue/Wed/Thu
- Week – All days of the week.
- Weekday – Monday through Friday.
- Weekend – Saturday through Sunday.

Date Range

Select the calendar date range to filter by. Choose a start date and end date by typing into the text boxes or by opening the calendar pop-up using the icon. Hovering over the adjacent question mark displays a message giving the available date range, based on the data loaded into the application database:

"INRIX travel time data is available from Jan 1, 2011 to Dec 31, 2012. MRCOG traffic count data is available up to Jun 2014".

The available date range will increase over time as more data is acquired and added to the application.

Times

Select the time period within a day to filter by. Available selections are:

- Custom – User can set a custom time period using the Time Range controls.
- AM Peak Period – Preset time period displayed in Time Range.
- Off Peak Period – Preset time period displayed in Time Range.
- PM Peak Period - Preset time period displayed in Time Range.

Time Range

Select the time range within a day to filter by. These controls are editable only when the Custom time period is selected. Choose a start time and end time from the respective dropdown lists. Times can be selected at 15 minute intervals within the 24 hour day.

Aggregation

Select the aggregation to apply to the data. This affects the charts display and associated data. Available selections are:

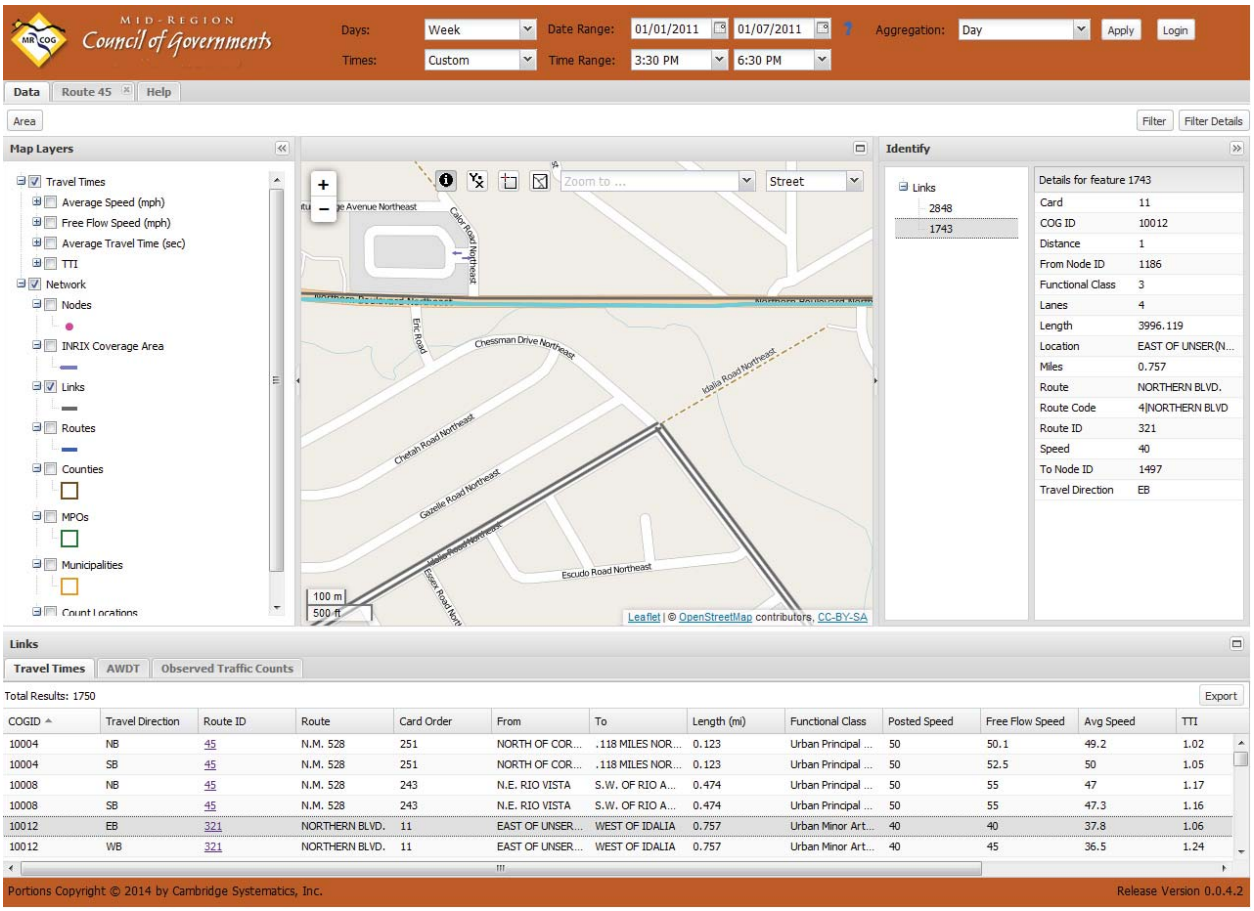
- 15 minutes
- 30 minutes
- 1 hour
- Day
- Month

15 minutes is the lowest aggregation at which the travel time data is stored. Therefore data viewed at higher aggregations is the aggregate of all the 15-minute data bins that comprise the date-time selection. For example, a 30-minute selection is the average of the data for the two 15-minute bins that are contained within it.

Data tab

The Data tab displays an overview of the data contained within the TAQA database. It is composed of a number of different components:

- Toolbar. Button toolbar for accessing filtering and additional functionality.
- Map Layers. The list of spatial layers displayed on the map.
- Map. A map showing the locations of the selected links, plus other relevant spatial data.
- Links. The attributes of the selected links and associated transportation data.



Each of these components is described in detail below.

Toolbar

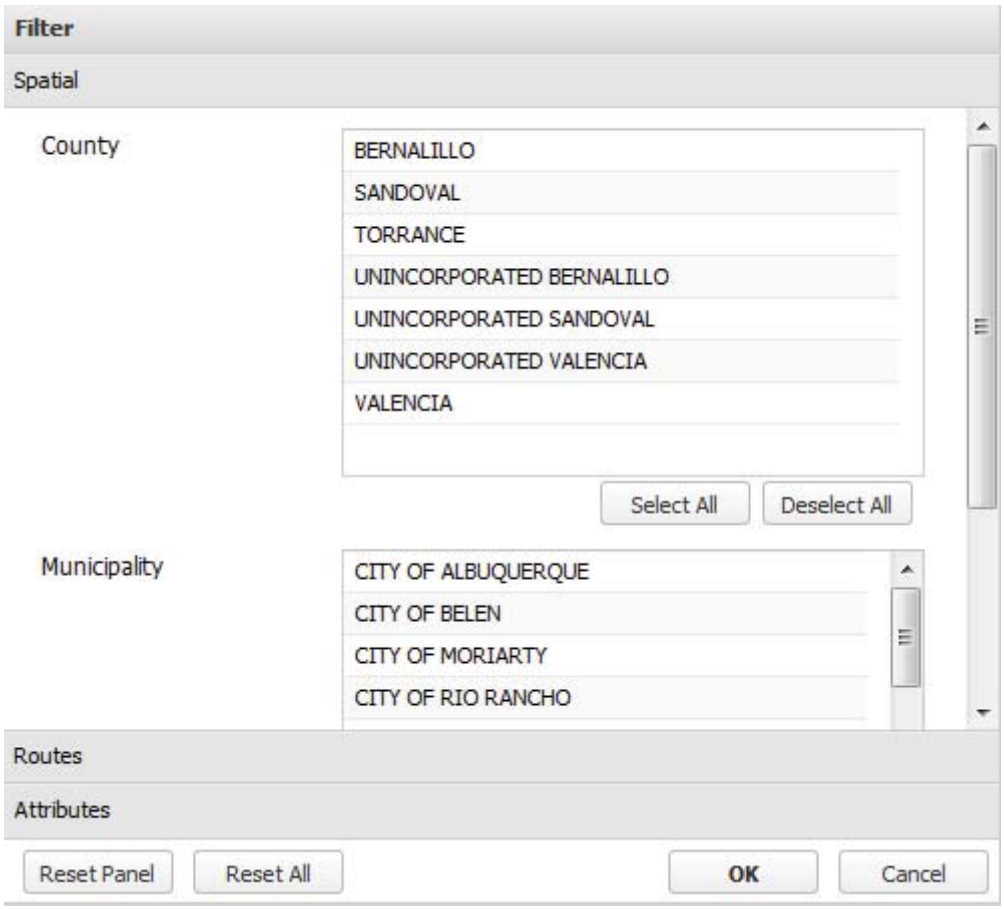
The Toolbar at the top of the Data tab provides access to filtering functionality and the Area tab.

Area

Users can use the filtering functionality to select a subset of the road network links that comprise a study area. Details of the study area can then be viewed on the Area tab. To open the Area tab, click Area.

Filter

The transportation data associated with links displayed on the map and in the table can be filtered by spatial location and defined attributes. To display the Filter dialog, click Filter:

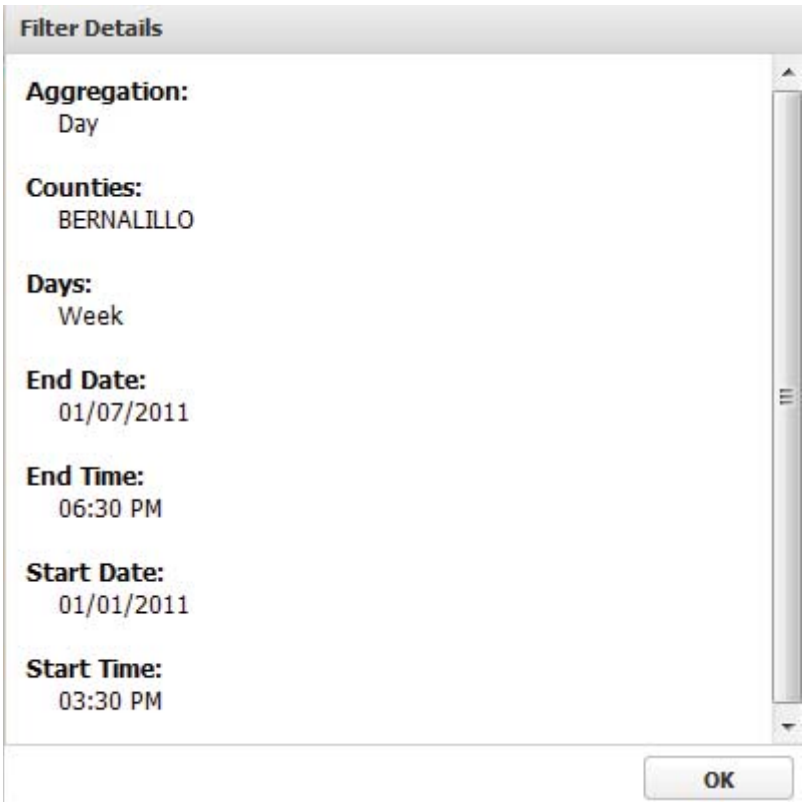


Via the accordion panels in the Filter dialog, you can define the parameters of the filter to apply. Click OK to apply the defined filter. The map and table will automatically update.

To reset the filter parameters within the single displayed form, click Reset Panel. To reset the filter to the default parameters, click Reset All.

Filter Details

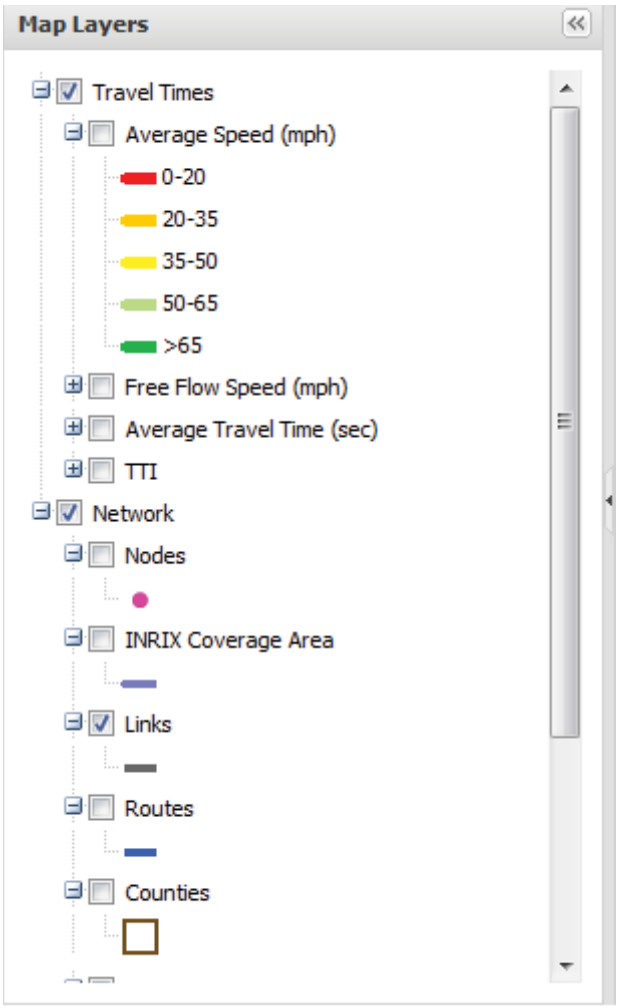
A summary of the currently applied filter may be viewed using the Filter Details button. To view the filter details summary, click Filter Details.



Map Layers

The Map Layers panel displays the list of spatial layers overlaid on the map. These layers include ones derived from the travel time data entered into TAQA, and additional reference layers maintained by MRCOG.

Any of the layers listed can be overlaid on the map by checking the checkbox next to the layer name. To turn off a layer, uncheck the appropriate checkbox. A layer group may also be turned on and off using its checkbox.



Travel Times

The travel times layer group contains performance measures computed using the INRIX travel time data, such as Average Speed and Travel Time Index. Turning on a layer classifies the filtered road network links on the map by the selected performance measure. The classification legend is displayed below each layer node. Only one performance measure may be selected at a time.

Available layers:

- Average Speed (mph)
- Free Flow Speed (mph)
- Average Travel Time (sec)
- TTI

Network

The network layer group contains static layers derived from location data maintained by MRCOG. These include map layers related to the road network, traffic count locations, and other location information. Multiple reference layers may be selected.

Available layers:

- Nodes – Derived from MRCOG road network. The layer contains intersection midpoints, which serve as the termini for roadway segments (classified by MRCOG with a COGID number).
- INRIX Coverage Area – Derived from the TMC conflation process with INRIX data. The layer contains all locations for which INRIX data is available.
- Links– Directional links derived from MRCOG road network.
- Routes – Derived from MRCOG road network. The layer contains all roadways with functional classification of collectors or above.
- Counties – Boundaries for the counties in the MRCOG planning region, as well as the unincorporated portions of each county.
- MPOs – Boundary limits for the Mid-Region Metropolitan Planning Organization
- Municipalities – Boundaries for the incorporated communities in the MRCOG planning region.
- Count Locations – Points defining the locations where traffic counts were collected.

Map

The Map panel contains a map showing, by default, the extent of the MRCOG planning area. Via this map, you can:

- Interactively pan and zoom the map to any area.
- Zoom the map to a boundary.
- Center the map on a given latitude/longitude.
- Change the map background.
- Filter by a rectangular selection.
- Identify any of the overlaid features.

Interactively Pan and Zoom the Map

To pan the map, click-and-drag the map in the required direction.

There are a number of different ways of changing the zoom level for the map:

1. Double-click the mouse pointer on the map. The map will zoom in by one level centered on the clicked point.
2. Click the [+] or [-] buttons at the top-left of the map. The map will zoom in or out by one level per click.
3. With the mouse pointer over the map, scroll the mouse wheel. The map will zoom in (forward) or out (backward).

Zoom to a Boundary

To zoom the map to the extent of a municipality or a county, select the required boundary from the "Zoom to …" drop-down list at the top of the map. The map will automatically update and the selected boundary is highlighted.

Center the Map on a given latitude/longitude

To center the map on a given latitude/longitude, click the tool at the top of the map. Enter the X (Longitude) and Y (Latitude) values into the dialog that is opened.

Change the Background

You can display several different map backgrounds, including Street and Aerial (aerial imagery).

To change the map background, select the required map background from the drop-down list in the top-right corner of the map.

Filter by a Rectangular Selection

To filter by a rectangular selection:

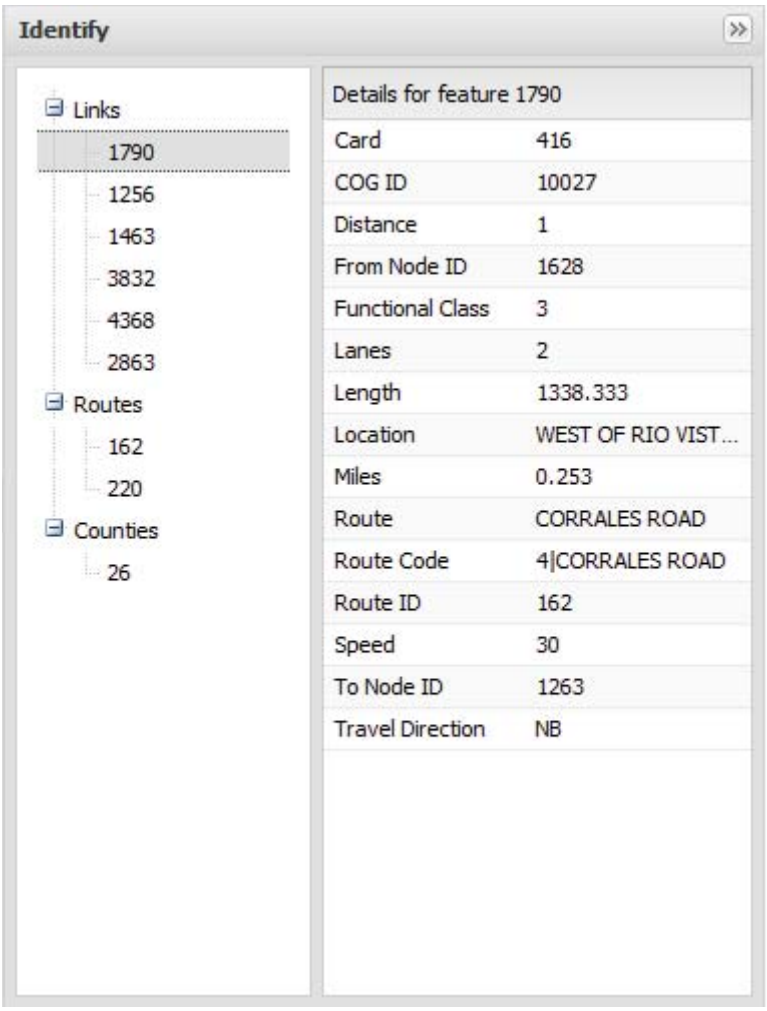
1. Click the rectangular selection tool at the top of the map. The mouse-pointer changes to cross-hairs.
2. Click and drag the mouse on the map to draw a rectangle.
3. Release to finish drawing. The filter is updated to the links within the rectangle. Travel time, AWDT, and traffic counts data for the segments in the selection area can now be found in the various Links tabs.
4. Click the clear selection tool at the top of the map to clear the map selection.

Identify Features

TAQA allows you to identify any of the features overlaid on the map and view the feature attributes.

1. Click the ID tool at the top of the map.
2. Click the mouse-pointer on the feature(s) to identify. If at least one feature was located, the ID panel is opened on the right side of the map.

3. The feature tree in the left panel lists all of the located features. Selecting any feature causes the attributes for that feature to be displayed in the right panel.
4. Click at the top-right of the Identify panel to minimize the panel.



Links table

The Links table displays the summary attributes of the selected road network links. Using the table, you can sort the attributes, adjust column width and order, and export the attributes to Excel. Additionally, the table allows you to drill down to the route details.

The Links table panel is split into a number of tabs:

- Travel Times tab – Travel time performance measures for links that have INRIX travel time data.
- AWDT tab – Inventory of Average Weekday Daily Traffic estimates for all links beginning in the year 2000.
- Observed Traffic Counts tab – Most recent traffic counts for links that have traffic count data.

Hover over a column header with the mouse to view a tooltip description of that column.

Sorting

Sort the table alphabetically by clicking on the column header. Click the column header again to reverse the sort order.

Column Order and Width

- Change a column width by selecting the divider between two column headers and dragging left or right.
- Change the column order by clicking on the column header and dragging the column horizontally left or right.

Export

Click Export above the top-right corner of the table to export all of the visible records to a Comma Separated Values (.csv) file that can be opened in Microsoft Excel.

Drill-down to Route Details

In the Links Travel Times tab, the IDs for each of the routes are displayed as hyperlinks. To display the route details:

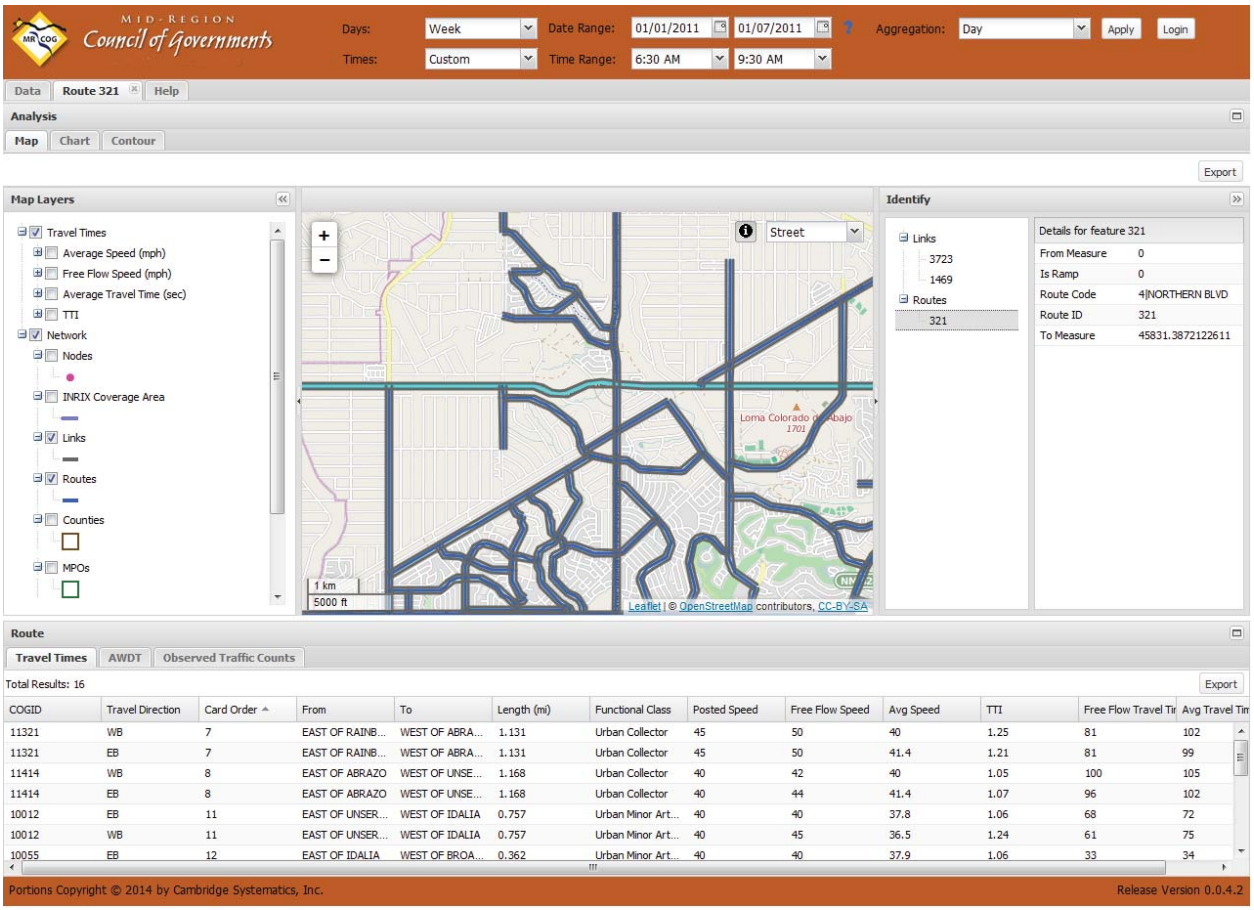
1. Click the ID hyperlink for the required route.
2. A new Route Details tab is opened.

Note that this option is not available for AWDT or traffic counts data tabs.

Route Details tab

The Route Details tab displays all of the information associated with a route via several components:

- Toolbar. Access context-sensitive functionality.
- Map. A map showing the location of the selected route.
- Chart. Charts of the selected route's data.
- Contour. A contour chart of the selected route's data.
- Route Links. Links on the route.



Each of these components is described below.

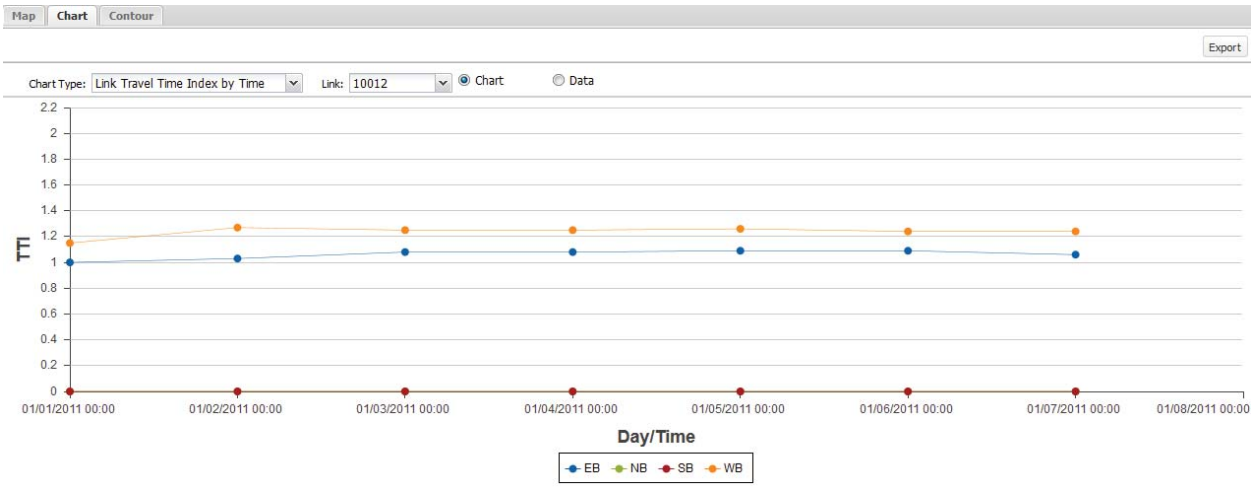
Toolbar

The Toolbar at the top of the Route Details tab provides access to export functionality for the currently displayed chart or chart data inside the Analysis panel. The chart may be exported as a JPEG image, and the chart data as a CSV file.

Map

The Map panel contains a map showing the location of the route. For details on interacting with the map, refer to the earlier Map section. The route map has a more limited set of map tools than the main map.

Chart

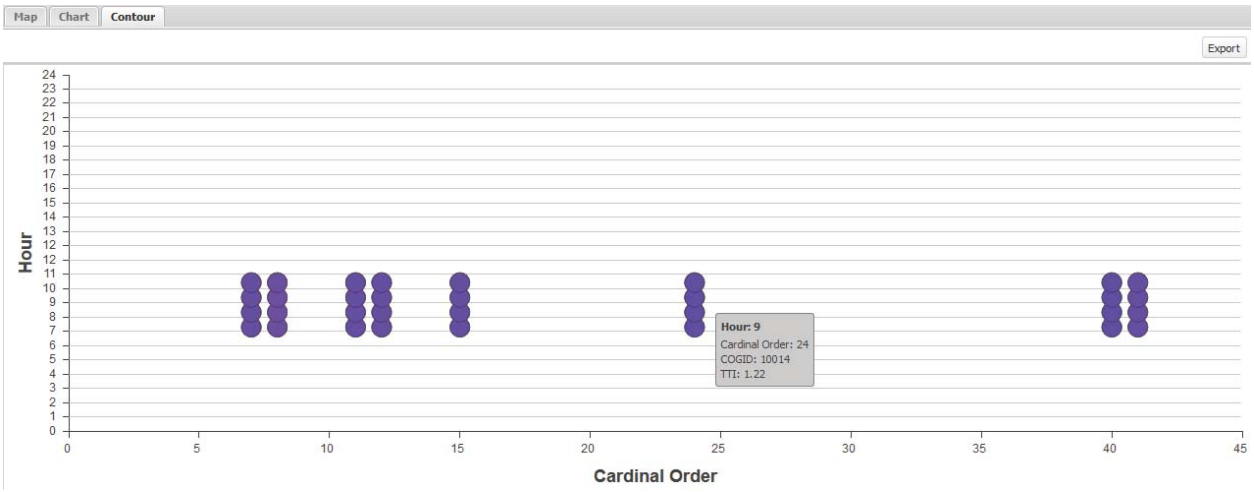


The Chart panel displays charts of the selected route's data, such as Travel Time Index by Time, and lends insight into the variation in travel time across the selection period. The user selects the chart type to view using controls at the top of the panel. The user may opt to view either the chart or the underlying data in tabular form. The data will depend on the selected filter and aggregation applied. Hovering over a data point in the chart will display a tooltip describing the point.

The following chart types are available:

- Travel Time Index by Time
- Average Speed by Time
- Link Travel Time Index by Time
- Link Average Speed by Time

Contour



The Contour panel displays a contour chart of the selected route's travel time data by segment and time. The route's links are plotted along the x-axis in cardinal order, and the y-axis gives the hour of day. The contour color depends on the TTI performance measure. The data will

depend on the selected filter applied. Hovering over a data point in the chart will display a tooltip describing the point.

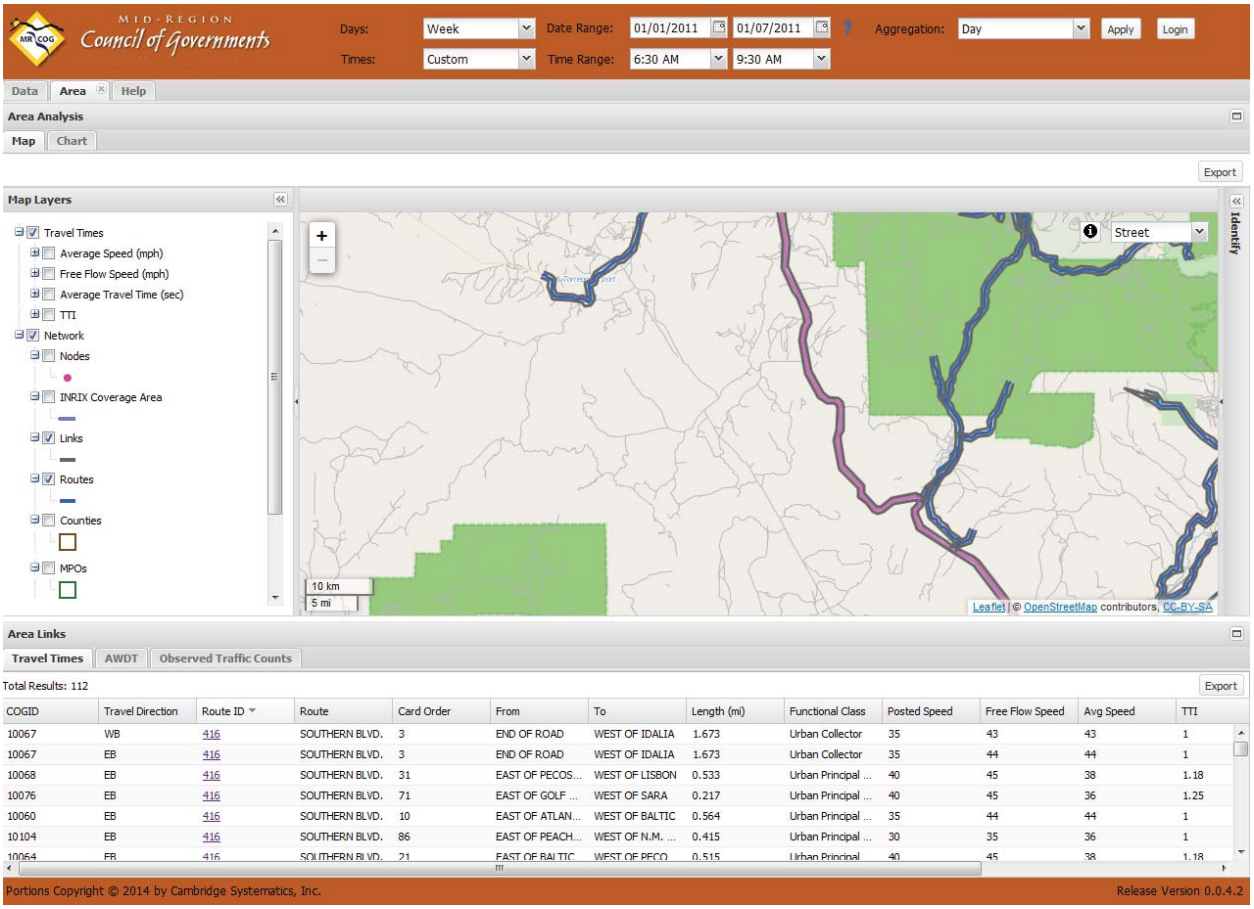
Route Links

The Route panel displays the summary attributes of the selected road network links on the route, in cardinal order. For details on interacting with the table, refer to the earlier Links table section. The route links table has a more limited set of functionality than the main links table. The links it displays depends on both the selected filter and the specific route being viewed.

Area tab

The Area tab displays all of the information associated with a study area via several components:

- Toolbar. Access context-sensitive functionality.
- Map. A map showing the location of the selected area.
- Chart. Charts of the selected area's data.
- Area Links. Links in the area.



Each of these components is described below.

Toolbar

The Toolbar at the top of the Area tab provides access to export functionality for the currently displayed chart or chart data inside the Area Analysis panel. The chart may be exported as a JPEG image, and the chart data as a CSV file.

Map

The Map panel contains a map showing the location of the area. For details on interacting with the map, refer to the earlier Map section. The area map has a more limited set of map tools than the main map.

Chart

The Chart panel displays charts of the selected area's data, such as Link Travel Time Index by Time. The interface is similar to that of the Route Details Chart panel. The user selects the chart type to view using controls at the top of the panel. The user may opt to view either the chart or the underlying data in tabular form. The data will depend on the selected filter and aggregation applied. Hovering over a data point in the chart will display a tooltip describing the point.

The following chart types are available:

- Travel Time Index by Route
- Average Speed by Route
- Link Travel Time Index by Time
- Link Average Speed by Time

Area Links

The Area panel displays the summary attributes of the selected road network links in the area. For details on interacting with the table, refer to the earlier Links table section. The area links table has a more limited set of functionality than the main links table. The links it displays depends on the selected filter.

Help tab

The Help tab provides access to a number of documents that provide details of the TAQA application, and other information that may be of use and/or interest to TAQA users.

Display

Display any of the documents by clicking the appropriate hyperlink in the table.

Sorting

Sort the table alphabetically by clicking on the column header. Click the column header again to reverse the sort order.

Column Order and Width

- Change a column width by selecting the divider between two column headers and dragging left or right.
- Change the column order by clicking on the column header and dragging the column horizontally left or right.

4 ADVANCED APPLICATION

In addition to the base functionality, authorized users can access advanced functionality, described in this section. To find out more information about the advanced functionality or to become an authorized user, contact Aaron Sussman at asussman@mrcog-nm.gov. User accounts are created by MRCOG.

On main screen:

- Login into and Sign Out of the application.
- Maintain your User Account.

On existing tabs:

- Data tab – View additional performance measures from traffic count data.

The advanced functionality specific authorized users can access is based on their user role:

Privilege	Authorized User	Administrator
Display Restricted Attributes	✓	✓
View Admin Notifications		✓
Maintain User Accounts		✓
Maintain Help Documents		✓
Show Additional Performance Measures	✓	✓

Note: One user may have multiple roles.

Each of these pieces of advanced functionality are described in detail below.

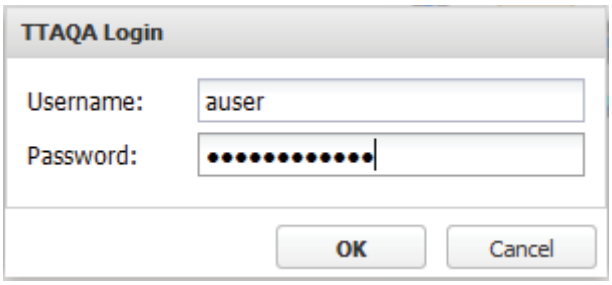
Main Screen

Login

All Authorized Users

To access the advanced functionality, you must be an authorized user with a valid username/password combination. Contact Aaron Sussman at asussman@mrcog-nm.gov to obtain a user login. Login is not required to access general functionality:

1. Click Login at the top-right of the application.
2. The TAQA Login dialog is displayed:



3. Enter a valid username and password.
4. Click OK. If the username and password is validated, the functionality associated with the appropriate user role is made available.

User Account

All Authorized Users

Users can maintain their user accounts via the application, setting contact details and resetting passwords. Users cannot create their own accounts, they must be authorized by MRCOG:

1. Click the button at the top-right of the application that displays your user name.
2. Select My Account from the dropdown. The User Account Details dialog is displayed:

3. Update your user details as necessary.
4. Click OK to save any changes.

Sign Out

All Authorized Users

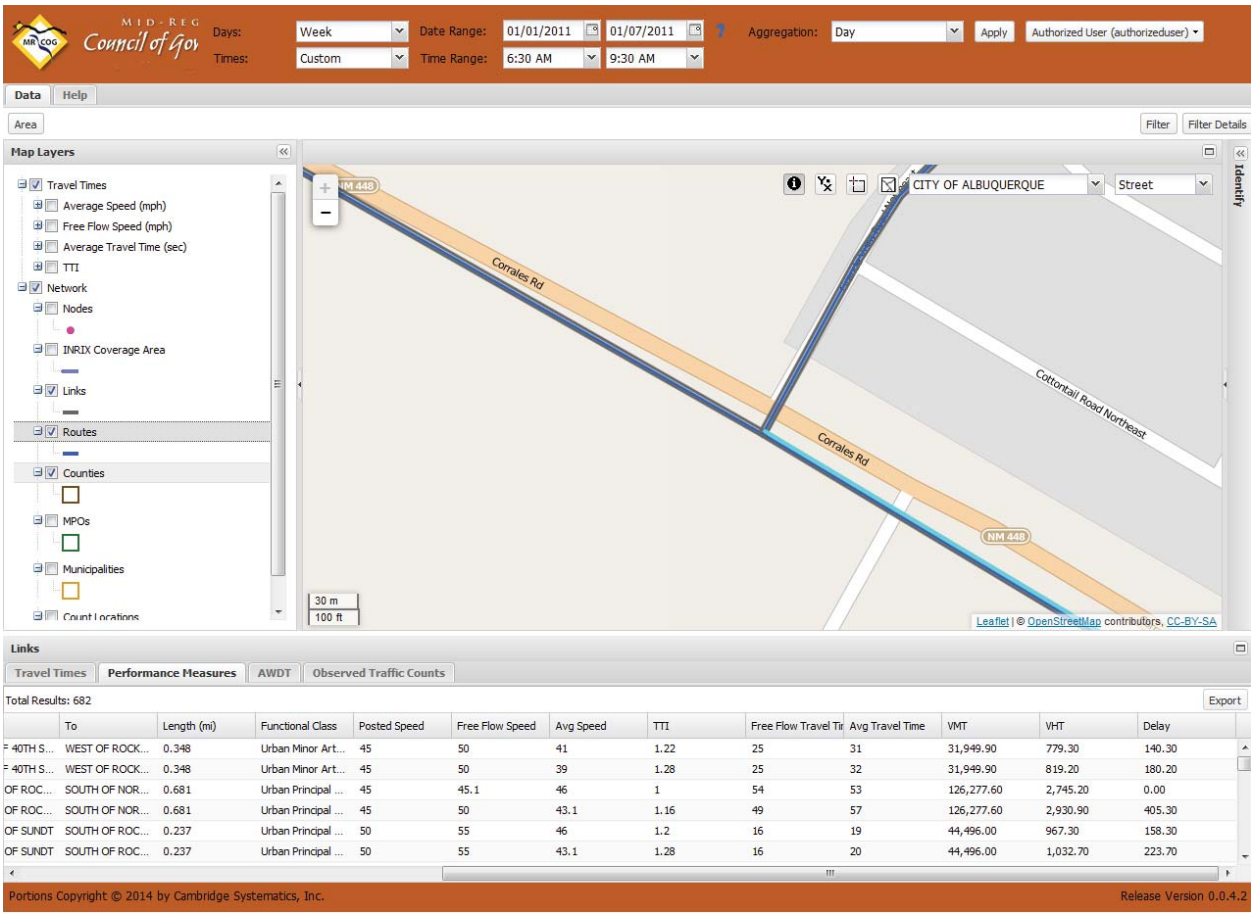
After completing your use of TAQA, you can log out of the application by either closing the TAQA web browser window or:

1. Click the button at the top-right of the application that displays your user name.
2. Select Sign Out from the dropdown. You will be logged out of TAQA.

Data tab

In addition to the base Data tab functionality described previously:

- Authorized users can view additional performance measures from traffic count data in the Links table.



Links table with Performance Measures

All Authorized Users

The Links table panel is split into a number of tabs:

- Travel Times tab, AWDT tab, Observed Traffic Counts tab – General users can see link attributes and performance measures on these tabs.
- Performance Measures tab – Authorized users can view an additional tab showing performance measures for links that have both travel time and traffic count data. The performance measures are calculated using both data sets.

APPENDIX A – PERFORMANCE MEASURE COMPUTATIONS

We present performance measures and associated computations for input and application in the MRCOG TAQA. Source data for the TAQA considers GIS, travel time, and traffic count data. We also describe the performance measure computations with travel times only and available traffic counts.

1.0 Source Data for TAQA

1.1 GIS Data

MRCOG has provided road network GIS data for the TAQA in the form of the majrds shapefile. To allow commercial travel time data to be linked, or conflated, the data needs to be spatially referenced using Traffic Message Channels (TMC) that uniquely define a section of roadway using a TMC code, description of the road, and the longitude/latitude of the end points of the segment. Cambridge Systematics has conflated TMC data with the MRCOG road network using a pre-processing routine. This read-only network and travel time data was then loaded into the application database for use by the TAQA. The GIS data pre-processing routine is described in a separate Technical Memorandum.

- Nodes table – Nodes in the road network.
- Links table – Links in the road network.
- Routes table – Routes in the road network.
- TMCs table – TMCs provided by INRIX.
- TMCLinks table – Mapping table produced by TMC conflation process.
  - The relationship from Route to Link is one-to-many.
  - The relationship from Link to TMC is many-to-many.

Column Name	Description
RouteID	Route id.
FrMeasure	From measure in feet.
ToMeasure	To measure in feet.
TMC	TMC in 9-digit format.
COGID	Link id from MRCOG.
LengthMiles	The length in miles of the TMC on the Link.

1.2 Travel Time Data

MRCOG has purchased travel time data from INRIX for use in the application.

- Travel Time Data table – Travel time data from INRIX for the years 2011-2012 at 1-minute intervals.

Column Name	Description
DateTimeUTC	Date and time in UTC (format yy-mm-dd hh:mm:ss.nnn)
TMC9	TMC in 9 digit format
SpeedMPH	Speed in MPH
Score	Source of individual speed values

- Travel Time Data Staging table – The travel time data from INRIX is processed into a data staging table that aggregates the data to 15-minute intervals. This is to improve the performance of the application.

1.3 Traffic Count Data

MRCOG has an existing SQL Server traffic count database that is the source of the traffic count data in the TAQA.

- Traffic Count fact table – Traffic count data was obtained from the Stats and CountSurveys tables in the MRCOG traffic count database. Initial data is up to mid-2014.
- Traffic Count Locations table – Traffic count locations were provided by MRCOG in the form of the cloc shapefile.

1.4 Terminology used in TAQA Application

- Links – Refers to the GIS Links.
- Routes – Refers to the GIS Routes. Also called "Study Route" in Requirements Memo.
- Areas – A set of Links. Also called "Study Area" in Requirements Memo.

2.0 Performance Measures for TAQA Data Tab

The section presents the performance measures, including data requirements, and computations using travel times only and using travel times with available traffic counts.

2.1 Data Tab - Links Table

The Links table on the Data tab in the application shows a set of Links. Each row corresponds to one Link. The following performance measure columns will be calculated:

$\underline{\text{FreeFlowSpeed}}_{\text{Link}}$	Free Flow Speed per Link.
$\underline{\text{AverageTravelTime}}_{\text{Link}}$	Average Travel Time per Link.
$\underline{\text{AverageSpeed}}_{\text{Link}}$	Average Speed per Link.

TTI_{Link}	Travel Time Index per Link.
$DVMT_{Link}$	Daily Vehicle Miles Traveled per Link. With Traffic Counts available.
$DVHT_{Link}$	Daily Vehicle Hours Traveled per Link. With Traffic Counts available.
$DDelay_{Link}$	Daily Delay per Link. With Traffic Counts available.

2.2 Measure Calculation – Without Traffic Counts Available

Units include:

- Travel time – minutes
- Speed – miles per hour
- Length – miles.

The performance measure computation steps include:

Step 1: Compute Travel Times and Speeds for Links of Interest

This step assumes that link travel times and speeds are computed dynamically for each query. It also assumes that the TMC-to-link relationships have been developed so that the length of each TMC falls on a link is known. The result of these calculations is a table of travel times and speeds for each link at the lowest time interval in the data. These values serve as the basis for the computations of all other performance measures.

$$TravelTime_{TMC(Link)} = \sum_{TMC} \left(\frac{Length_{TMC}}{Speed_{TMC}}\right) \times 60$$

Where: $TravelTime_{TMC(Link)}$ = the travel time for the TMCs present on a link

$Length_{TMC}$ = the length of the TMC that falls on the link – in miles, from TMC conflation

$Speed_{TMC}$ = speed measurement on the TMC

$$Speed_{Link} = \frac{\sum_{TMC} Length_{TMC}}{TravelTime_{TMC(Link)}} \times 60 \; ; Speed_{Link} \geq 5 \; mph$$

$$TravelTime_{Link} = \frac{Length_{Link}}{Speed_{Link}} \times 60$$

Step 2: Compute Free Flow Speeds (FFS) for each Link; Assign to Link Attributes

The FFSs for links are computed a single time from the INRIX data and stored permanently along with other link attributes. First the 85th percentile speeds for each TMC (*Speed85$_{TMC}$)* for the time period 1:00 – 4:00 AM throughout the year is computed. If the data-derived *Speed85$_{TMC}$* is less than the posted speed OR if an 85th percentile speed is unavailable for a TMC, the FFS is calculated as:

$$Speed85_{TMC} = PostedSpeedLimit + 5$$

If the posted speed limit is unavailable, then following default values should be used:

- Freeways: 70 mph
- Arterials: 55 mph
- Collectors: 45 mph
- Local: 40 mph
- Ramp: 30 mph

Then, the procedure from Step 1 is used with the following terms:

$$FreeFlowTravelTime_{TMC(Link)} = \sum_{TMC} \left(\frac{Length_{TMC}}{Speed85_{TMC}}\right) \times 60$$

Where: FreeFlow*TravelTime$_{TMC(Link)}$* = the free flow travel time for the TMCs present on a link

Length$_{TMC}$ = the length of the TMC that falls on the link – in miles, from TMC conflation

Speed85$_{TMC}$ = the 85th percentile speed measurement on the TMC

$$FreeFlowSpeed_{Link} = \frac{\sum_{TMC} Length_{TMC}}{FreeFlowTravelTime_{TMC(Link)}} \times 60$$

Step 3: Compute Link Level Measures: Average Speed, Average Travel Time and TTI for Each Link For the Time Range of Interest

This step and the remaining steps will be conducted dynamically in accordance with the time range selected by the user. Length_Link = The length of the Link as defined in the MRCOG road network – in miles. Then:

$$FreeFlowTravelTime_{Link} = \frac{Length_{Link}}{FFS_{Link}} \times 60$$

$$〚AverageTravelTime〛\_(Link(t))$$

= simple average of all $TravelTime_{Link}$ values for the time range of interest.

$$AverageSpeed_{Link(t)} = \frac{Length_{Link}}{AverageTravelTime_{Link(t)}} \times 60;\ AverageSpeed_{Link(t)} \geq 5\ mph$$

$$TTI_{Link(t)} = \frac{AverageTravelTime_{Link(t)}}{FreeFlowTravelTime_{Link}}; 1.0 \leq TTI_{Link} \leq 12.0$$

The subscript (*t*) represents the time range selected by the user.

Step 4: Compute Route Travel Time and FFS

"Routes" are aggregations of contiguous links, selected by the user. First, the building blocks for the performance measures must be computed. The subscript *l* refers to a link that comprises the route:

$$TravelTime_{Route} = \sum_{l} TravelTime_{Link\,(l)}$$

$$FFS_{Route} = \frac{\sum_l (Length_{Link} \times FFS_{Link})}{\sum_l Length_{Link}}$$

Step 5: Compute Average Speed, Average Travel Time, and TTI for Each Route for the Time Range of Interest

For the time range specified, compute the *AverageTravelTime*$_{Route}$ as the simple average of the route travel times. Then:

$$FreeFlowTravelTime_{Route} = \frac{Length_{Route}}{FFS_{Route}} \times 60$$

$$AverageSpeed_{Route} = \frac{Length_{Route}}{AverageTravelTime_{Route}} \times 60;\ AverageSpeed_{Route} \geq 5\ mph$$

$$TTI_{Route} = \frac{AverageTravelTime_{Route}}{FreeFlowTravelTime_{Route}};\ 1.0 \leq TTI_{Route} \leq 12.0$$

2.3 Measure Calculation – With Traffic Counts Available

These calculations are to be made when a link has both INRIX and traffic count data assigned to it.

Step 1a: Compute Travel Times and Speeds for Links of Interest

This step is the same as for the case where traffic counts are not available. It is needed to get the "unit speed" (i.e., the speed calculated without regard to the number of vehicles) on the link for each 15-minute time period.

$$TravelTime_{TMC(Link)} = \sum_{TMC} \left(\frac{Length_{TMC}}{Speed_{TMC}}\right) \times 60$$

Where: *TravelTime*$_{TMC(Link)}$ = the travel time for the TMCs present on a link

Length$_{TMC}$ = the length of the TMC that falls on the link – in miles, from TMC conflation

Speed$_{TMC}$ = speed measurement on the TMC

$$UnitSpeed_{Link} = \frac{\sum_{TMC} Length_{TMC}}{TravelTime_{TMC(Link)}} \times 60 \; ; Speed_{Link} \geq 5 \; mph$$

Step 1b: Develop 15-minute Volumes and Speeds for Each Link for Weekdays

This calculation can be made once per year as new traffic counts are processed and incorporated into MRCOG's processes and databases. The data can reside in a separate file or be added to the link attribute file. The procedure uses data from the two traffic count files, linked to the travel time data by COGID.

This procedure is based on first developing hourly volumes by direction using the data in Table 1; use the middle range for AADT/C. The direction is determined as follows using the data that reside in the Stats table:

- Assign AM Peak Direction if *AMHrVol* > *PMHrVol*
- Assign PM Peak Direction if *PMHrVol* >= *AMHrVol*

Then, the volume in each 15-minute time slice for the hour is then calculated as:

$$15MinuteVolume_{Link} = AWADT \times WeekdayHourlyFactor \times 0.25$$

Where: *WeekdayHourlyFactor* is from Table 1 below. Note that separate values are used for freeways (*FunctionalClassID* = 7 or 17) and all other highway types.

AWDT is from the MAJRDS.CSV file.

Step 1c: Develop 15-minute Volumes and Speeds for Each Link for Weekends

$$15MinuteVolume_{Link} = AWADT \times 0.777 \times WeekendHourlyFactor \times 0.25$$

Where: *WeekendHourlyFactor* is from Table 2 below. Note that separate values are used for freeways (*FunctionalClassID* = 7 or 17) and all other highway types.

AWDT is from the MAJRDS.CSV file.

0.777 is the factor to convert AWDT to Average Weekend Daily Traffic (AWEDT)[1].

Step 2: Compute Free Flow Speeds (FFS) for each Link; Assign to Link Attributes

This is the same as Step 2 for the case where traffic counts are not available. It is used to calculate $FFS_{Link.}$

Step 3: Calculate Vehicle-Miles of Travel (VMT), Vehicle-Hours of Travel (VHT), Delay, and TTI for Each Link and 15-Minute Time Slice Present in the Data

- 1 AWDT/AADT = 1.0757; AWEDT/AADT = 0.836

$$VMT_{Link} = 15MinuteVolume_{Link} \times Length_{Link}$$

$$VHT_{Link} = \frac{VMT_{Link}}{UnitSpeed_{Link}}$$

$$Speed_{Link} = \frac{VMT_{Link}}{VHT_{Link}}$$

$$TravelTime_{Link} = \frac{Length_{Link}}{Speed_{Link}} \times 60$$

$$Delay_{Link} = ((Length_{Link}/Speed_{Link}) - (Length_{Link}/FFS_{Link})) \times 15MinuteVolume$$

Note that delay is in vehicle-hours.

$$TTI_{Link} = \frac{FFS_{Link}}{Speed_{Link}}; 1.0 \leq TTI_{Link} \leq 12.0$$

Step 4: Compute Link Level Measures: Daily VMT, Daily VHT, Daily Delay, Average Speed, Average Travel Time, and TTI for Each Link For the Time Range of Interest

This step and the remaining steps will be conducted dynamically in accordance with the time range selected by the user.

$$DVMT_{Link(t)} = \Sigma_{(t)} VMT_{(Link)}/N_{VMT}$$

$$DVHT_{Link(t)} = \Sigma_{(t)} VHT_{(Link)}/N_{Speed}$$

$$AverageSpeed_{Link(t)} = VMT_{Link(t)}/VHT_{Link(t)}; AverageSpeed_{Link(t)} \geq 5 \text{ mph}$$

$$TTI_{Link(t)} = FFS_{Link}/AverageSpeed_{Link(t)}; 1.0 \leq TTI_{Link(t)} \leq 12.0$$

$$DDelay_{Link(t)} = \{MAX((\Sigma_{(t)} Delay_{Link}),0)\}/N_{Speed}$$

$$AverageTravelTime_{Link(t)} = Length_{Link}/AverageSpeed_{Link(t)} \times 60$$

Where: $DVMT_{Link(t)}$ is the daily VMT for a link for time period t

$DVHT_{Link(t)}$ is the daily VHT for a link for time period t

$DDelay_{Link(t)}$ is the daily delay for a link for time period t

N_{VMT} is the number of days in the year present in time period t (e.g., 260 weekdays)

N_{Speed} is the number of days for which INRIX speed data are present for time period t

Step 5: Compute Daily VMT, Daily VHT, Daily Delay, Average Speed, Average Travel Time, and TTI for Each Route for the Time Range of Interest

$$DVMT_{Route} = \Sigma_{(l)} DVMT_{Link(t)}$$

$$DVHT_{Route} = \Sigma_{(l)} DVHT_{Link(t)}$$

$$AverageSpeed_{Route} = VMT_{Route}/VHT_{Route}; AverageSpeed_{Route} \geq 5 \text{ mph}$$

$$FFS_{Route} = \frac{\sum_l (Length_{Link} \times FFS_{Link})}{\sum_l Length_{Link}}$$

$$TTI_{Route} = FFS_{Route}/AverageSpeed_{Route}\ ;\ 1.0 \le TTI_{Route(t)} \le 12.0$$

$$DDelay_{Route} = \sum_{(l)} DDelay_{Link(t)}$$

$$AverageTravelTime_{Route} = Length_{Link}/AverageSpeed_{Route} \times 60$$

Subscript *l* represents all links that comprise a route.

Table 1. Hourly Traffic Distributions

	Freeway, Weekday						Other, Weekday					
	AADT/C						AADT/C					
	LE 7.0		7.1 - 11.0		GT 11.0		LE 7.0		7.1 - 11.0		GT 11.0	
	Peak Direction		Peak Direction		Peak Direction		Peak Direction		Peak Direction		Peak Direction	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of
Hour Ending	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume
1	0.42	0.58	0.44	0.57	0.47	0.54	0.34	0.47	0.37	0.47	0.41	0.49
2	0.27	0.33	0.27	0.34	0.27	0.32	0.21	0.28	0.23	0.27	0.24	0.28
3	0.23	0.25	0.22	0.26	0.20	0.24	0.15	0.18	0.17	0.18	0.18	0.20
4	0.23	0.22	0.21	0.21	0.18	0.18	0.14	0.14	0.16	0.15	0.17	0.18
5	0.38	0.29	0.35	0.28	0.31	0.25	0.24	0.18	0.28	0.20	0.33	0.27
6	1.17	0.68	1.12	0.69	1.06	0.72	0.74	0.42	0.81	0.48	1.03	0.67
7	3.26	1.75	3.16	1.90	2.86	2.18	2.23	1.19	2.35	1.27	2.55	1.72
8	4.83	2.90	4.59	3.05	3.90	3.27	4.11	2.28	3.85	2.39	3.57	2.79
9	3.56	2.57	3.80	2.76	3.66	3.04	3.45	2.33	3.42	2.39	3.09	2.78
10	2.58	2.24	2.75	2.30	2.94	2.53	2.64	2.29	2.69	2.31	2.68	2.47
11	2.46	2.33	2.50	2.34	2.68	2.49	2.64	2.56	2.65	2.54	2.62	2.57
12	2.56	2.56	2.61	2.61	2.73	2.69	2.90	3.02	2.90	2.98	2.83	2.89
13	2.65	2.71	2.68	2.75	2.75	2.78	3.20	3.35	3.17	3.30	3.04	3.13
14	2.70	2.77	2.75	2.81	2.82	2.86	3.14	3.24	3.14	3.22	3.06	3.13
15	2.93	3.12	2.93	3.15	2.97	3.15	3.18	3.44	3.116	3.37	3.21	3.34
16	3.26	4.01	3.21	3.87	3.21	3.60	3.40	4.13	3.35	3.93	3.41	3.78
17	3.47	4.81	3.38	4.43	3.28	3.82	3.46	4.78	3.49	4.49	3.47	3.92
18	3.42	4.85	3.32	4.39	3.29	3.77	3.31	4.83	3.45	4.55	3.39	3.86
19	2.66	3.23	2.66	3.20	2.82	3.22	2.68	3.23	2.75	3.31	2.82	3.12
20	1.95	2.23	1.97	2.25	2.12	2.36	2.14	2.41	2.18	2.53	2.28	2.53
21	1.54	1.78	1.54	1.79	1.62	1.86	1.73	1.97	1.75	2.07	1.83	2.09
22	1.40	1.63	1.44	1.69	1.54	1.74	1.49	1.71	1.50	1.77	1.55	1.80
23	1.14	1.30	1.19	1.39	1.27	1.46	1.10	1.26	1.11	1.25	1.22	1.29
24	0.79	0.98	0.83	1.05	0.89	1.07	0.74	0.94	0.75	0.90	0.83	0.97
TOTAL	49.87	50.13	49.92	50.08	49.84	50.16	49.36	50.64	49.67	50.33	49.71	50.29

Table 2. Weekend Temporal Distributions

Table 4-4. Final Weekend/Holiday Temporal Distributions

	TYPE OF FACILITY:	
	FREEWAY	NONFREEWAY
	PCT. OF	PCT. OF
	DAILY VOL.	DAILY VOL.
HOUR		
1	2.16	2.01
2	1.45	1.36
3	1.06	0.90
4	0.69	0.57
5	0.63	0.50
6	1.02	0.79
7	1.98	1.55
8	2.87	2.43
9	3.70	3.42
10	4.69	4.72
11	5.66	5.92
12	6.45	6.85
13	7.06	7.64
14	7.06	7.63
15	7.09	7.62
16	7.19	7.60
17	7.19	7.40
18	6.90	6.87
19	6.22	6.04
20	5.15	5.09
21	4.24	4.22
22	3.77	3.66
23	3.27	2.96
24	2.50	2.26
TOTAL	100.00	100.00

Note: One High AADT/C Site From Seattle, Orlando, and Lexington Added

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