

# Travel Model Update



September 30, 2010



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URBAN DESIGN  
+ Architecture

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## Agenda

- Purpose
- Network
- Model Database
- Trip Generation
- Trip Distribution
- Mode Split
- Time of Day
- Traffic Assignment
- Model Demo (time permitting)



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# Purpose



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CONSULTANTS

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## Model Update Purpose

- **Update the Corridor MPO Model to support the Connections2040 Long Range Transportation Plan**
  - Update model assumptions and methods
  - Review dataset accuracy
  - Use the MPO's NHTS add-on dataset
  - Add new functionality to the model



**CORRIDOR MPO**



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# Roadway Network



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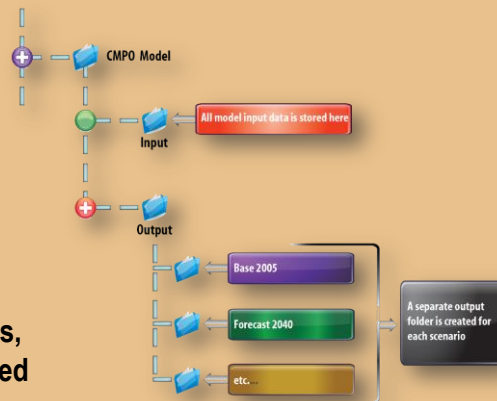


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## Networks Structure

- One file, many scenarios
  - The Roadway networks are contained in one integrated network file.
    - Base year and forecast year networks
    - Different roadway improvements (e.g. committed improvements, alternatives) can be turned on or off.



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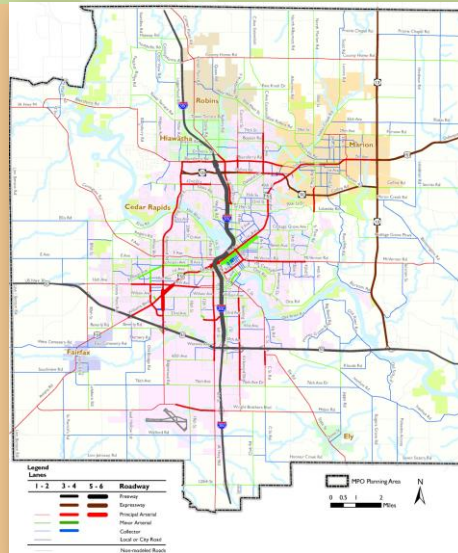
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## Functional Classification

- Base Year: 2005
- Updated using an aerial
- Local facility type from old model grouped with Collectors

Code	Facility Type
1	Freeway
2	Expressway
3	Principal Arterial
4	Minor Arterial
5	Collector
6	Ramps
8	Centroid Connector
null	Inactive Link (does not exist in the specified network)



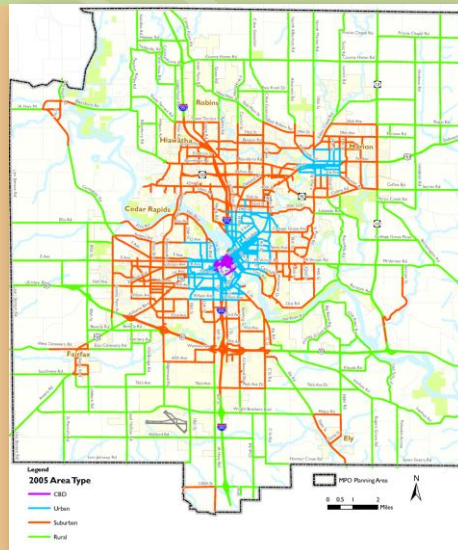
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## Area Type

- Area type determined using the 2005 socioeconomic data at TAZ level and smoothed to be contiguous.
- Tagged from TAZ onto the Network and smoothed.
- Used in the network to determine capacities, free-flow speed factors and volume-delay parameters.

Code	Area Type
1	Center Business District (CBD)
2	Urban
3	Suburban
4	Rural



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## Free-flow Speed Factors

- Free-flow factors are used to convert posted speed limits into free-flow speeds for the model
- This is done to take into account the signal/intersection delays that occur and also the deceleration and acceleration characteristics that occur at intersections



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## Number of Lanes

- Lane information
  - Not available in the old model roadway network
  - Reverse engineered from old model network capacities to obtain number of lanes
  - Checked for accuracy using an aerial
  - Reviewed by the MPO
- Center turn lanes and median were identified on the network with the help of an aerial



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## Parameters

- Cross classified look-up table
  - By FT and AT
- Capacity
  - Adjusted based on the presence of a center turn lane or median
- Alpha, Beta
  - Retained from previous model (PB review)
- Posted speed → Freeflow speed factor



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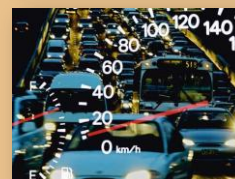
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## Capacities

- Hourly capacities for AM and PM peak hour
  - Based on HCM guidance
  - Account for median/center turn lane
    - $\frac{3}{4}$  of a through lane
    - Major: Add  $\frac{1}{4}$  or subtract  $\frac{1}{2}$
    - Minor: Add  $\frac{1}{2}$  or subtract  $\frac{1}{4}$
- Off-peak period capacities
  - Daily capacity based on 0.09 factor
  - Two peak hours removed



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## Hourly Lane Capacities

Facility Type	CBD	Urban	Suburban	Rural
Freeway	2100	2200	2200	2100
Expressway	1100	1200	1200	1452
Principal Arterial	740	920	960	1162
Minor Arterial	650	760	790	956
Collector	590	680	710	850
Ramp	650	750	800	800



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## Traffic Counts

- Different Traffic Count Sources
  - 2004 MPO Counts
  - 2005 DOT AADT
  - 2005 DOT Counts
  - Old Model Adjusted Counts
- Priority of Counts was in the above listed order
- Count coverage was good



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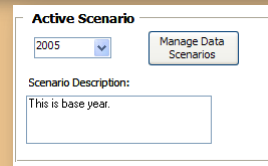
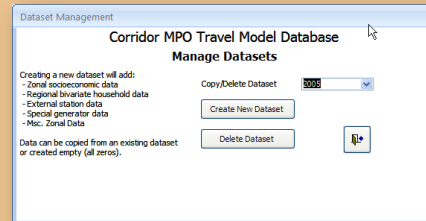
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## Year-Specific Data

- Data for multiple “Data Scenarios” are stored in the model database
  - Copy or delete existing datasets
  - Datasets contain:
    - Socioeconomic data
    - External station data
    - Special generator data
    - Other Zone Data
      - Area Type, summary boundaries
- A description can be stored for each scenario



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## Trip Generation



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## Socioeconomic data

- Households

- Updated 2000 to 2005 using following data sources

- Cedar Rapids Building Permits
- Linn County Building Permits
- American Community Survey (ACS)
- 2005 Aerial and 2000 Census Block information



- Geocoded and aggregated to TAZs
- Applied a vacancy rate of 5% (based on 2000 MPO average) across the whole MPO region to convert new dwelling units to households.



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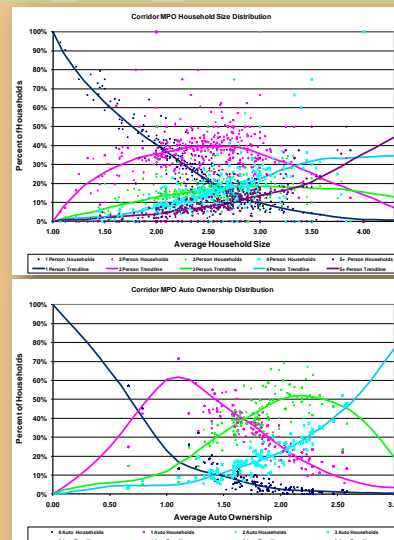
## Household Disaggregation Models

- Household disaggregation models

- Based on 2000 Census data
- Produce distributions by income and auto ownership
- Combined to produce a *bivariate* distributions of households

- Additional Required Input

- The model requires average size and auto ownership data as an input
- These variables can be held constant over time if necessary



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## Socioeconomic data

- **Employment**
  - Replaced 2000 with 2005 using the only data source available
    - 2005 geocoded DOT employment data set
  - Some geocoding errors were found.
  - Updated those employer locations to the right place using Google
    - example: Rockwell Collins (7,200 employees)
      - Originally placed in downtown
      - Moved to the correct location on Collins Rd
  - SIC codes were used to categorize the employment into Basic, Retail and Service categories



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## Trip Purposes

Old Trip Purpose	New Trip Purpose
Home-Based Work (HBW)	Home-Based Work (HBW)
Home-Based Other (HBO)	Home-Based Other (HBO)
	Home-Based Shop (HBS)
Non Home-Based (NHB)	Work-Based Other (WBO)
	Other-Based Other (OBO)
Commercial Vehicle (CV)	Commercial Vehicle (CV)



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## Trip Production Rates

- Person trip production rates
- Based on NHTS analysis (except CV)
- Commercial Vehicle (CV) rates borrowed from the Colorado North Front Range (based on Transearch data from IHS Global Insight)
- Cross-classified
  - 5 Household size groups (1, 2, 3, 4, and 5+Persons)
  - 4 Auto Ownership groups (0, 1, 2, 3+ Autos)

HBW Production Rates	1 Person	2 Person	3 Person	4 Person	5+ Person
0 Autos	0.714	0.644	2.324	4.578	1.904
1 Auto	0.714	0.644	2.324	4.578	1.904
2 Autos	1.144	0.648	2.988	4.347	2.407
3 Autos	2.054	0.998	5.24	9.262	4.542



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## Trip Attraction Rates

- Obtained from NHTS analysis (except CV)
  - Manual identification of employment types
- Classified by
  - Retail Employment
  - Service Employment
  - Basic Employment
  - Total Households

Attraction Rates	HBW	HBS	HBO	WBO	OBO	WBO PA	CV	CV P
Retail	0.834	8.758	0.7	1.056	4.55	0.366	0.072	0.072
Service	0.862	0.974	3.062	0.453	1.514	0.345	0.021	0.021
Basic	0.671	0.038	0.612	0.093	0.089	0.27	0.095	0.095
Total Households	0.021	0.011	0.322	0.111	0.155	0.021	0.003	0.003



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## Special Generators

- Only one Special Generator was used
  - St Luke's Methodist Hospital in downtown
- No other special generators were deemed necessary
  - Based on review of traffic counts
  - The previous model had 4 special generators (Airport, Lindale Mall, etc.)



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## External Stations

- External Stations locations were retained
- Updated with 2005 traffic counts
- Updated the IE and EE splits
- Updated IE Trips by purpose



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# Trip Distribution



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## Trip Distribution

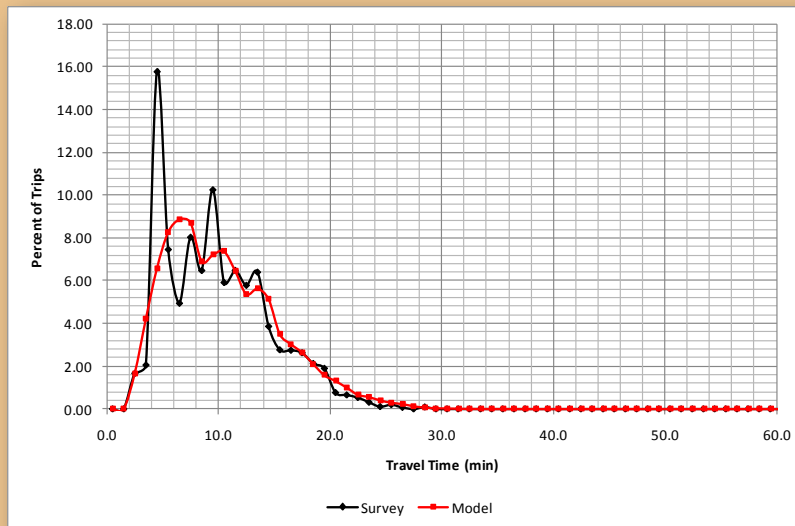
- **Shortest Paths**
  - Separate Peak (AM) and Off-peak paths
  - Minimize travel time
- **Gravity Model Approach**
- **Trip Length Distributions calibrated to NHTS data**
  - Calibration of TLDs to daily trips
  - Calibration by purpose
  - Distribution performed separately for Peak and Off-trips



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## Trip Length Distribution - HBW



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## Mode Split



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## Mode Split

- **Non-Motorized**
  - Walk
  - Bike
- **Distance based**
  - Shorter trips = More likely to walk or bike
  - Models vary by:
    - Bike vs. Walk (bike trips can be longer)
    - Trip purpose
- **Targets obtained from NHTS data**



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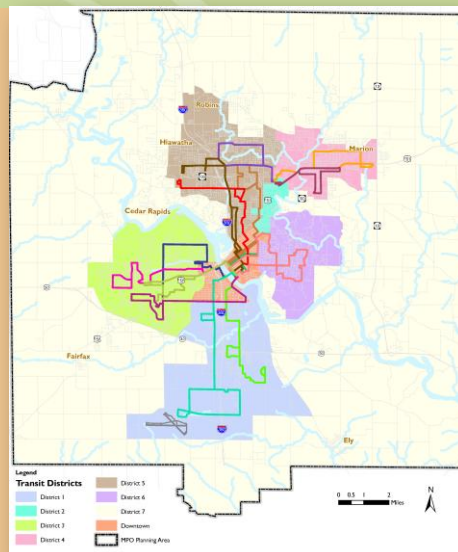


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## Mode Split

- **Basic Transit Model**
  - NOT a mode choice model
  - TAZ-based transit availability factors
- **District-based approach**
  - More transit usage within districts
  - More transit usage to/from the CBD
- **Variable mode split factors**
  - 5 possible service levels
    - 2 exist today
  - Elasticity-based
  - Calibrated to match ridership data
- **Auto occupancy obtained from NHTS**



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# Trip Assignment



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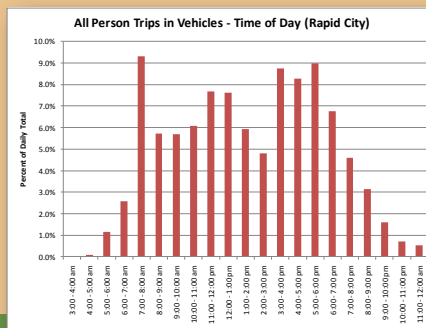
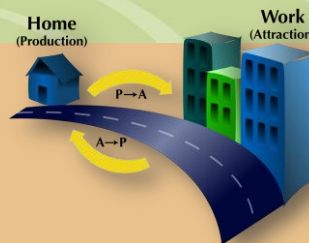
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## Time of Day

- Directional time of day factors
  - Reflect directional peaking
  - Reflect peak period congestion
- Performed in two steps
  - Prior to trip distribution
    - Peak (AM and PM) vs. Off-peak
    - No PA to OD conversion
  - Prior to trip assignment
    - AM, PM, and off-peak
    - PA to OD conversion
- Data borrowed from other regions:
  - Rapid City NHTS
  - Colorado North Front Range MPO
  - Ann Arbor Michigan / SEMCOG



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## Traffic Assignment

- **Equilibrium Assignment**
  - AM, PM, and off-peak assignment
  - Daily total – sum of three periods
- **OUE Option:**
  - New: Origin User Equilibrium
  - Allows interactive select link/zone analysis
- **Speed feedback**
  - Assignment / Distribution consistency
  - Impacts travel model sensitivity



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## Validation

### Modeled Volume / Count Volume

#### Entire Model

	CBD	Urban	Suburban	Rural	Total
Freeway	106.3%	94.9%	92.8%	92.6%	94.8%
Expressway	--	--	120.3%	100.4%	117.2%
Major Arterial	86.3%	101.6%	91.4%	89.7%	93.1%
Minor Arterial	108.4%	90.6%	85.4%	128.4%	91.3%
Collector	109.0%	88.2%	87.3%	198.7%	97.0%
Ramps	--	--	--	--	--
Centroid Connectors	--	--	--	--	--
Total	99.8%	95.8%	92.4%	98.9%	94.4%

### % Root Mean Square Error

#### Entire Model

	CBD	Urban	Suburban	Rural	Total
Freeway	11.5%	9.0%	10.2%	10.7%	10.5%
Expressway	--	--	29.6%	5.4%	29.3%
Major Arterial	22.9%	29.7%	22.7%	27.3%	25.4%
Minor Arterial	42.1%	51.0%	38.8%	76.3%	47.9%
Collector	93.6%	65.1%	45.9%	193.3%	78.3%
Ramps	--	--	--	--	--
Centroid Connectors	--	--	--	--	--
Total	26.2%	34.3%	25.4%	30.6%	29.8%



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# Tools and Utilities

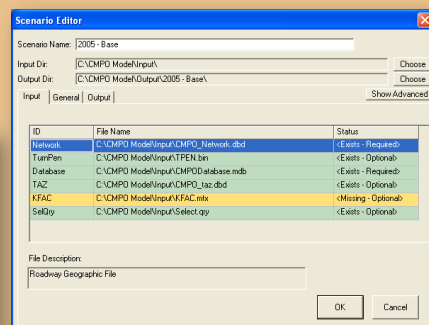
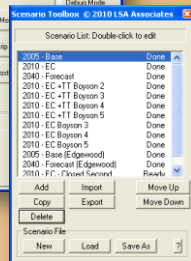
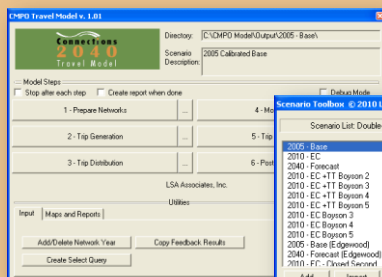


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## Connections 2040 Model Interface

- All model steps are fully automated
- A scenario manager helps keep things organized



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# Performance Report

- Summarizes key model data
  - Inputs
  - Intermediate Data
  - Output Summary
  - Validation Report
- View in a web browser
- Tables can be copied to Excel

**Connections**  
2040  
Travel Model

**Summary Report for the Corridor MPO Travel Model**  
Developed by LSA Associates for The Corridor MPO(CMPO)

Scenario Name:

Scenario Directory: C:\CMPO Model\Output\2005 - Base\

Report File: C:\CMPO Model\Output\2005 - Base\Summary.html

Report Created on: Saturday, July 31, 2010 at 4:18 pm

Scenario Description: --Multiple--

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2. Input Network Summary

3. Socioeconomic Data Summary

4. Trip Generation Summary

5. Trip Distribution Summary

6. Mode Split Summary

7. Assigned Trip Summary

8. Daily Assignment Summary

9. Assignment Speed Summary

10. Validation Summary

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LSA Associates, Inc. - Corridor MPO Travel Model -  
Input and Output File Name Summary Page 1.1

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**Input Files:**

Roadway Geographic File	CMPO_Network.dbf
Turn Penalty File	TPEN.tbl
Access database containing model input parameters and data	CMPODatabase.mdb
Traffic analysis zone layer	CMPO_taz.dbf
K-Factor Matrix (Kov=WFAC_Index=Taz)	WFAC.mtx
Select Link/Node Query file	Select qry

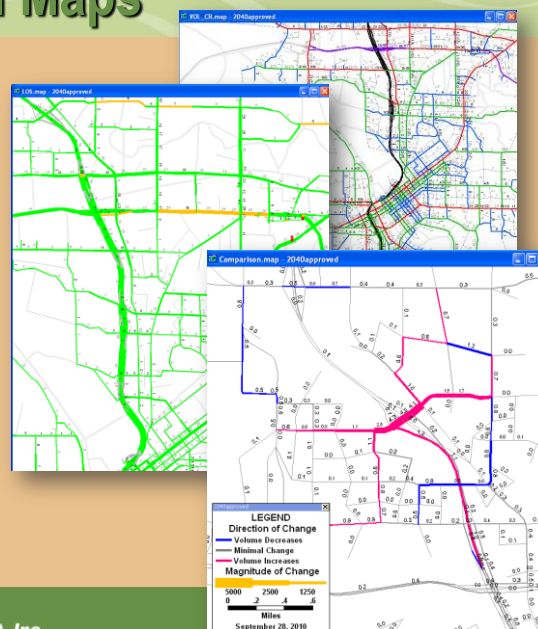


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# Automated Maps

- Maps created for quick review of results
  - Volumes
  - Bandwidths
  - Level of Service
  - Scenario Comparison

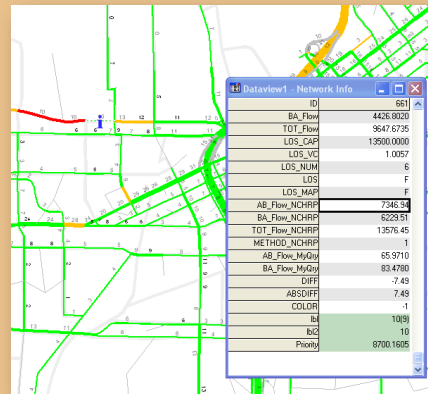


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## Link-level Volume Adjustments

- NCHRP-255 approach
  - Uses average approach in most cases
  - Uses difference approach in some cases (e.g., very high error or growth)
- Adjusted volumes populated in the assignment result table



A screenshot of a map showing a network of roads. A data window titled "Datawindow1 - Network Info" is open, displaying various traffic volume and assignment data for a specific link.

ID	Value
BA_Flow	4426.9033
TOT_Flow	9647.5735
LDS_CAP	13500.0000
LDS_VC	1.0057
LDS_NUM	6
LDS	F
LDS_MAF	F
AB_Flow_NCHRP	7346.54
BA_Flow_NCHRP	6229.51
TOT_Flow_NCHRP	13576.45
METHOD_NCHRP	1
AB_Flow_MyGdy	65.9710
BA_Flow_MyGdy	83.4780
DIFF	-7.49
ABSDIFF	7.49
COLOR	1
IB	1038
IC	10
Priority	8700.1605



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## Turn Movements

- Synchro / Excel interface
  - Runs via CSV files
  - Save model data (raw or adjusted turn movements)
  - Read count data from file
- NCHRP Processor
  - Intersection forecasts
  - NCHRP-255 Iterative procedure



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