APPENDIX A – MIAMI VALLEY FREIGHT WORKSHOP PARTICIPANTS

Organization

- ODOT District 7
- City of Dayton, Aviation (Dayton International and Dayton Wright-Brothers Airports)
- Greene County Regional Airport
- Phillips Companies
- Miami County Economic Development
- Jet Express
- Ohio Rail Development Commission
- CSX Corporation
- ABF Freight Systems
- Dayton Area Chamber of Commerce
- UPS / Emery
- Delphi Corporation
- MVRPC

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APPENDIX B – MIAMI VALLEY TRUCK MODEL DESCRIPTION

Overview

The truck model developed for the consolidated travel model and described below is a set of procedures that produces truck trip tables for use in a multi-class traffic assignment. The consolidated truck model includes the combined regions of OKI (the Cincinnati MPO)/MVRPC (Cincinnati/Dayton). The methodology is not behaviorally-based, however, due to the non-availability of survey data for commercial vehicle movements. In the absence of such data from which to calibrate truck trip generation and distribution models, synthetic matrix estimation is used to produce trip tables for the base year. The resulting trip tables represent commercial truck origin-destination (O-D) flows that reflect likely truck trip productions and attractions and are consistent with observed truck counts for the regional highway network.

The truck model produces truck trip tables for two types of commercial vehicles: single-unit (six-tire trucks) and multi-unit (three-plus axle combination trucks). Single-unit (SU) and multi-unit (MU) trucks can be identified with reasonable accuracy by automatic traffic recorders, based on the number of axles and distance between them. Generally, SU trucks have six or more tires and are thus differentiated from smaller commercial vehicles, so-called light trucks such as pickups, vans and mini-vans. In terms of behavioral characteristics, SU truck trips are generated at greater rates than MU truck trips; however, MU trucks tend to have substantially greater average trip lengths because they dominate the long-haul trucking market.

The structure of the truck modeling process is illustrated in Figure B-1. The base year is 1995.

Internal-Internal Trips

The generation of daily truck trips for each vehicle type assumes that businesses of different types have a propensity to produce and attract single-unit (SU) and multi-unit (MU) truck trips at rates proportional to the amount of commercial activity being generated by the business. It is further assumed that employment totals are good indicators of the amount of commercial activity being generated by businesses. Likewise, households generate some amount of commercial vehicle traffic for the pick up and delivery of goods and provision of services. These assumptions are implemented in the truck model at an aggregate level by applying truck trip generation equations to the zonal totals for households and employees, by industry grouping, to estimate SU and MU truck trip ends. Lacking commercial vehicle survey data for calibration, the trip generation equations and gravity model impedance functions use modified versions of parameters published in the *Quick Response Freight Manual* (USDOT 1996) to produce initial estimates of SU and MU truck trip tables (see Table B-1). Since the expanded ODOT external station survey was to be used for the external truck trip ends, it was necessary to adjust the trip generation coefficients to reflect rates appropriate for the generation of internal-internal trips only.

External Trips

To produce estimates of truck flows with external trip ends, the ODOT 1995 External Station Survey was expanded and tabulated, resulting in a set of external-external (EE), internal-external (IE) and external-internal (EI) truck trip tables. The expanded data were classified into SU and MU categories by applying the proportions shown in Table B-2, based on the average distribution of SU versus MU trucks for roadways of certain functional classes. The final expanded data were aggregated across origin-destination pairs to produce EE, IE and EI estimates for separate SU and MU vehicle classes.

FIGURE B-1 — TRUCK MODEL DEVELOPMENT AND APPLICATION

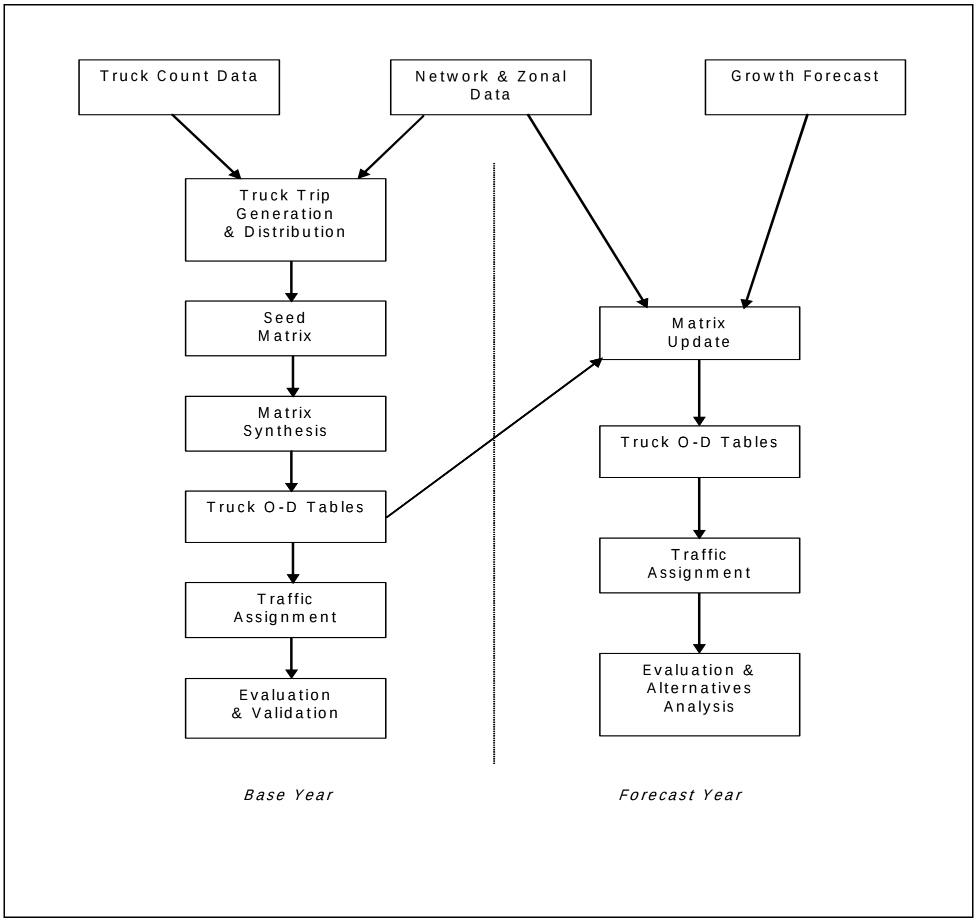

TABLE B-1 — ADJUSTED DAILY TRUCK TRIP GENERATION RATES (ORIGINS OR DESTINATIONS PER UNIT)

Employment Category	Single-Unit Trucks	Multi-Unit Trucks
Agriculture, Mining and Construction (SIC 1-19)	0.275	0.119
Manufacturing, Transportation, Communications, Utilities and Wholesale Trade (SIC 20-51)	0.230	0.071
Retail Trade (SIC 52-59)	0.241	0.044
Offices and Service (SIC 60-88)	0.065	0.006
Households	0.094	0.026

Source: Rates based on *Quick Response Freight Manual*, USDOT, 1996, p. 4-4, multiplied by factors of 0.952 for single-unit trucks and 0.683 for multi-unit trucks to produce internal-internal flows.

TABLE B-2 — EXPECTED PROPORTIONS OF MULTI-UNIT TRUCK TYPES

Functional Class		Factor
Rural	Interstate	0.81
	Other Principal Arterials	0.60
	Minor Arterial, Collector, Local	0.42
Urban	Interstate	0.71
	Other Freeways and Expressways	0.57
	Other Principal Arterials	0.56
	Minor Arterials	0.47
	Collectors	0.45
	Local	0.30

Source: Derived from Table 4.2 "Percent Distribution of Traffic by Vehicle," *Quick Response Freight Manual*, USDOT, 1996, p. 4-13.

Synthetic Matrix Estimation

The truck model is then calibrated using a synthetic matrix estimation (SME) method. SME uses the initial trip table estimate as a "seed matrix," which is then adjusted such that assignment of the table to the highway network results in truck trip flows that come close to matching observed truck traffic counts, through successive iterations. SME adjusts not only the flow pattern, but also the number of trips produced, effectively calibrating both trip generation and distribution stages simultaneously. ODOT, MVRPC, OKI and the Kentucky Transportation Cabinet contributed available truck traffic counts.

Synthetic matrix estimation procedures attempt to adjust the interchange values in a trip table through an iterative process of assigning the table to the network, calculating deviations from coded traffic counts, and using this information to re-factor the trip table. Since the traffic counts coded to the network represent daily link flows that include both trips with both internal and external origins and destinations, the seed matrix used to initiate the process should also include both internal and external origins and destinations.

Initial development of the truck model using the SME procedure in TransCAD was based on a seed matrix in which the internal-internal trip tables generated through the Quick Response truck trip generation and distribution processes were combined with the EE/EI truck trip tables that were formed from the ODOT external station survey.

Truck Forecasting

The procedure used to forecast future truck trips involves factoring the 1995 base year daily trip table estimates, accounting for growth in zonal employment and households as well as expected increases in industrial productivity. Four principal steps are included in this process:

- Forecasting zonal employment by industry grouping for future year
- Calculation of industry-sector productivity deflation factors (Table B-3)
- Calculation of TAZ truck trip growth factors and trip ends
- Two-dimensional matrix balancing (Fratar)

TABLE B-3 — INDUSTRY SECTOR DEFLATION, 1995 TO 2030

Industry Sector	Ratio: 2030 / 1995 Output per Worker
Durable Manufacturing	2.650
Non-durable Manufacturing	1.900
Wholesale Trade	1.806
Finance, Insurance & Real Estate (FIRE)	1.593
Mining	1.472
Transportation, Communications & Utilities	1.421
Services	1.215
Retail Trade	1.203
Construction	1.176
Agriculture, Fishing & Forestry	1.000

Base Year Results

A total of 890 truck traffic counts were available for comparison with assigned daily truck volumes. Comparisons were made for total two-way truck volumes, rather than by SU and MU truck types. ADT counts that were split between pairs of one-way freeway links were matched and comparisons made on the basis of the sum of the truck volumes loaded on the pair of links.

A comparison of observed and estimated daily truck volumes by link functional class is shown in Table 4. The root mean squared error (RMSE) measurements for these facilities reflect the size of the average link-flow error, while the percent root mean squared error (PRMSE) expresses this error relative to the average truck count volume for the classification. The PRMSE statistics for Interstates in general, and I-75 in particular, are very good. The link-flow error measurements on other facilities are not quite as good; however, daily truck flows on arterials, collectors and ramps represent a relatively small proportion of total daily vehicle flows. The ratios of estimated-to-observed traffic indicate that the assigned truck volumes tend to be on the high side for interstates and arterials and on the low side for major collectors, ramps and expressways.

TABLE B-4 — ESTIMATED VS. OBSERVED DAILY TRUCK VOLUMES BY FUNCTIONAL CLASS

Functional Class	Daily Truck Volume		Number of Observations	Root Mean Squared Error	Percent RMSE	Est./Obs.
	Estimated	Observed				
1. Interstates	1,799,116	1,656,772	210	2,250	28.52	1.09
I-75 Mainline	1,126,287	1,031,196	94	2,911	26.53	1.09
2. Major Arterials	192,787	155,172	203	557	72.86	1.24
3. Minor Arterials	141,456	121,721	156	628	80.54	1.16
4. Major Collectors	37,951	41,202	103	346	86.49	0.92
5. Minor Collectors	56	18	1	NA*	NA*	3.11
8. Ramps	93,931	123,975	179	524	75.63	0.76
9. Expressways	68,794	86,236	38	1,279	56.37	0.80
Total Observations	2,334,091	2,185,096	890	1,211	49.32	1.07

* Root mean squared error (RMSE) is not calculable for just one observation.