PID 81258

Ohio Department of Transportation

Office of Technical Services

Ohio Certified Traffic Manual

April 2007

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Chapter 1 Introduction

The Ohio Certified Traffic Forecasting Manual is intended to support and document the Ohio Certified Traffic process managed by the Ohio Department of Transportation's (ODOT) Office of Technical Services (OTS). The Manual will document the state-of-the-practice for Ohio's traffic forecasting process and serve as guidelines for other entities producing traffic forecasts.

Traffic Forecasting dates back to the 1930s when the Bureau of Public Roads first started the federal financing of highway projects. From the very beginning, traffic counts were collected and growth rates were applied to produce a travel demand forecast used for planning and design purposes. Over 70 years later, the fundamental process is very similar although it has grown significantly more complex.

1.1 Purpose of Traffic Forecasting

The purpose of traffic forecasting is to produce future estimates of average daily traffic (ADT), design hour volumes (DHV) and truck percentages (TD and T24) for use in design and planning.

Design engineers use the traffic forecasts to determine the number of lanes needed for a project; the need for, the length and number of turning lanes; and as one of the inputs to pavement design. Planners use traffic forecasts primarily to determine the need for a project or to determine the proper location of alternatives. In both case, traffic forecasts are critical to making an informed decision.

1.2 Customers of Traffic Forecasting

The customers of traffic forecasting in Ohio are primarily the district and central office design staff. Other customers include the Division of Planning staff, metropolitan planning organizations (MPOs), local project sponsors, and consultants.

1.3 Overview of the Manual

The manual consists of the following components:

Chapter 1 Introduction

Chapter 2 Assessment/Coordination

Chapter 3 Traffic Forecasting Parameters and Source Data

Chapter 4 Traffic Forecasting Tools

Chapter 5 Traffic Forecasting Analyses/Final Product

Appendix A Customer Agreement Form

Appendix B Traffic Monitoring Data

Appendix C Guidelines for the Use of Models for Traffic Forecasting

Appendix D Traffic Forecasting Tools Information

Appendix E Example Traffic Forecasts

Appendix F Glossary/Acronyms

1.4 Review of the Ohio Traffic Forecasting Process

A flow chart showing the Ohio traffic forecasting process is shown in Figure 1-1, and each step in the process is listed below. Steps 1-6 are covered in detail in Chapter 2. Step 7 is covered in Chapter 4. Step 8 is covered in Chapters 3 and 4. Steps 9-11 are covered in Chapter 5.

1. **Request**
   The request for certified design traffic is made by district office and sent to the Project Analyses Administrator, Office of Technical Services (OTS).

2. **Forecast Tracking**
   The request is entered into a database, known as, "Traffic Tracker."

3. **Forecast assignment**
   The Project Analyses Administrator assigns the request to a traffic forecaster. A time limit of 45 working days is put on the forecast.

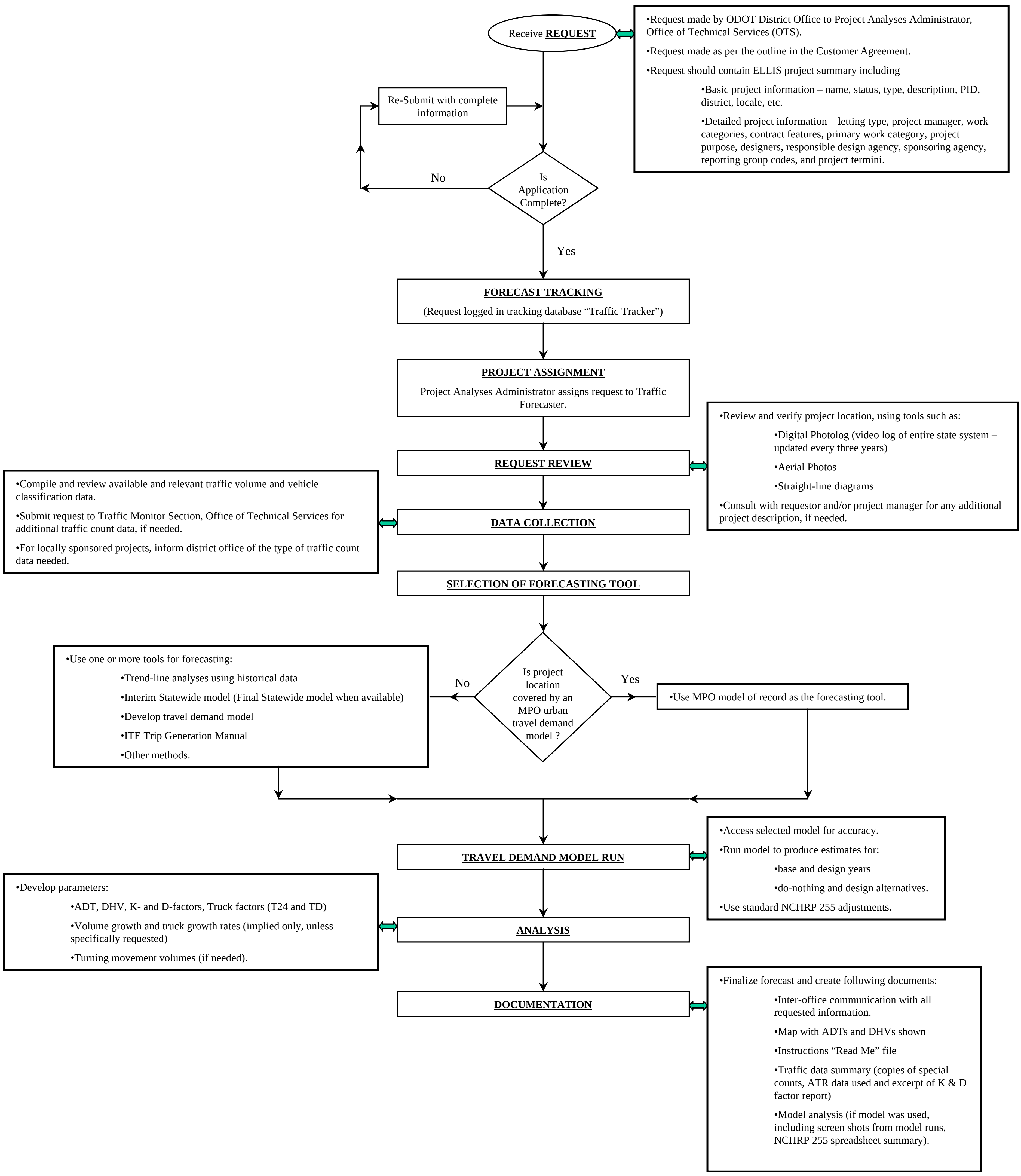


Figure 1-1: ODOT Traffic Forecasting Process – Current Procedure Flow Chart

4. Review Project Description and Location

The forecaster uses tools such as Digital Photolog (video log of entire state system that is updated every three years), aerial photos, and straight-line diagrams, to review the project location.

5. Forecast data collection

The forecaster reviews the available traffic volume and vehicle classification data and assesses the need for additional information.

6. Select forecasting tool(s) for project.

A. If the project is located in an area that is covered by an MPO urban travel demand model, then the forecaster uses the MPO model of record.
B. If project is not located in an area that is covered by an MPO urban travel demand model then other options such as trend line analysis or use of the statewide model are considered, as discussed in Chapter 4.
C. The forecaster may use a combination of tools, (e.g., trend-line analysis may be used to determine truck volumes while total volumes are determined using a MPO model of record.)

7. Travel demand model runs

The forecaster will follow the *Guidelines for the Use of Models for Project Traffic Forecasting* (1), included in Appendix C, which contains detailed model usage instructions. For complex projects the model runs should have been completed during earlier planning steps. If model runs have not yet been conducted, additional time (beyond the 45 working days) will be needed for generating traffic forecasts.

The raw model volumes will then be adjusted – using methods described in *NCHRP Report 255 Highway Traffic Data for Urbanized Project Planning and Design* (2) – to produce opening year and/or design year estimates for the no-build alternative and for the build alternative(s).

8. Analysis

The forecaster will develop the following parameters:

- **Opening Year ADT(s)**
- **Design Year ADT(s)**
- **Design Hour Volume(s) (DHV)**
- **K-factor(s) (K)**
- **D-factor(s) (D)**
- **Daily Truck factor(s) (T24)**
- **Design Hour Truck factor(s) (TD)**
- **8^{th} Highest Hour factor(s) (if needed)**
- **Turning movements (if needed)**

9. Documentation

The forecaster will complete the forecasting analysis and create the following documentation:

- **Inter-Office Communication**
- **Diagram with ADTs/DHVs shown**
- **Traffic data summary**
- **Model analysis (if used)**

10. Forecast Transmitted to Requestor

An inter-office communication (IOC) including any diagrams are sent to the requestor, with a copy to the Administrator, OTS and any other persons specified in the individual District Customer Agreements (Appendix A).

11. Forecast information logged in database

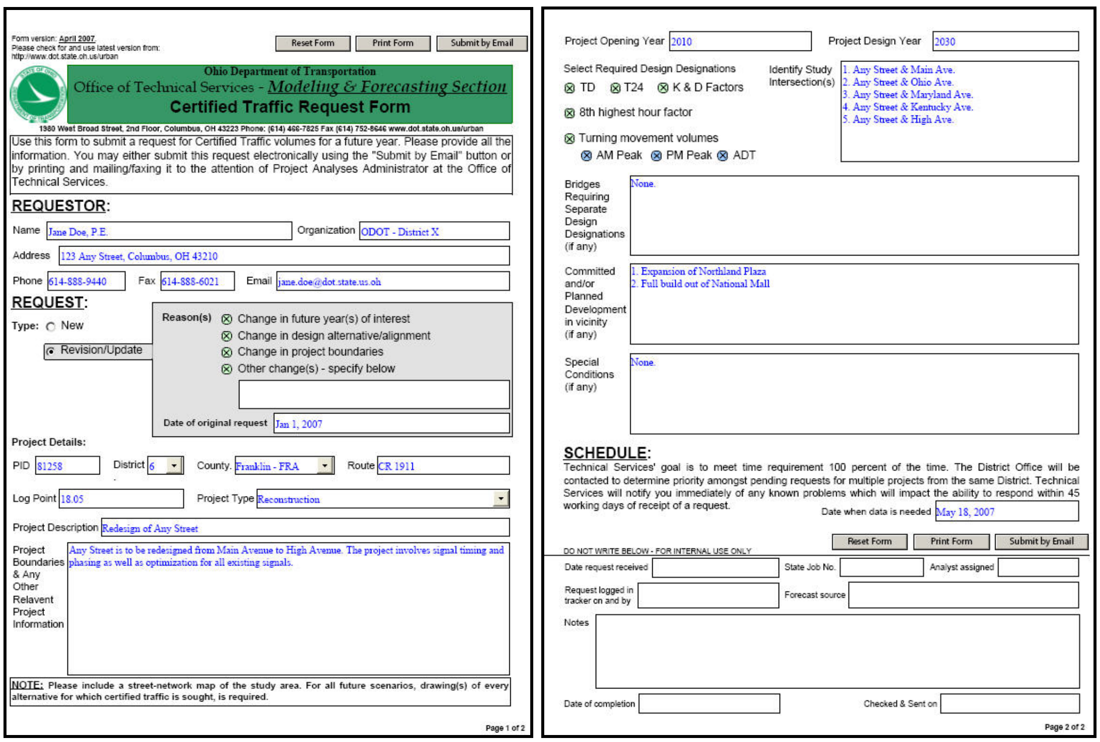
The forecaster marks the request as complete in the Traffic Tracker database, indicating the forecaster initials and date of completion (should be the same as the date as shown on the IOC).

Chapter 2 Assessment/Coordination

This chapter discusses the certified traffic request process, the traffic count request process, and the evaluation of the available tools. It will also discuss the assessment of existing data and coordination with the project manager. This chapter reviews the first six steps of the certified traffic forecasting process (Figure 1-1).

1. The Request

The certified traffic request is made by the district office and sent to the Project Analyses Administrator in the OTS. See a sample request form in Figure 2-1.



Form version: April 2007.
Please check for and use latest version from:
http://www.dot.state.oh.us/urban

Reset Form | Print Form | Submit by Email

Ohio Department of Transportation
Office of Technical Services - *Modeling & Forecasting Section*
Certified Traffic Request Form
1980 West Broad Street, 2nd Floor, Columbus, OH 43223 Phone: (614) 466-7825 Fax (614) 752-8646 www.dot.state.oh.us/urban

Use this form to submit a request for Certified Traffic volumes for a future year. Please provide all the information. You may either submit this request electronically using the "Submit by Email" button or by printing and mailing/faxing it to the attention of Project Analyses Administrator at the Office of Technical Services.

REQUESTOR:

Name: Jane Doe, P.E.
Organization: ODOT - District X
Address: 123 Any Street, Columbus, OH 43210
Phone: 614-888-9440
Fax: 614-888-6021
Email: jane.doe@dot.state.us.oh

REQUEST:

Type: ○ New ◉ Revision/Update

Reason(s):
- ⊗ Change in future year(s) of interest
- ⊗ Change in design alternative/alignment
- ⊗ Change in project boundaries
- ⊗ Other change(s) - specify below

Date of original request: Jan 1, 2007

Project Details:

PID: 81258
District: 6
County: Franklin - FRA
Route: CR 1911
Log Point: 18.05
Project Type: Reconstruction
Project Description: Redesign of Any Street
Project Boundaries & Any Other Relavent Project Information: Any Street is to be redesigned from Main Avenue to High Avenue. The project involves signal timing and phasing as well as optimization for all existing signals.

NOTE: Please include a street-network map of the study area. For all future scenarios, drawing(s) of every alternative for which certified traffic is sought, is required.

Page 1 of 2

Project Opening Year: 2010
Project Design Year: 2030

Select Required Design Designations
⊗ TD ⊗ T24 ⊗ K & D Factors
⊗ 8th highest hour factor
⊗ Turning movement volumes
⊗ AM Peak ⊗ PM Peak ⊗ ADT

Identify Study Intersection(s):
1. Any Street & Main Ave.
2. Any Street & Ohio Ave.
3. Any Street & Maryland Ave.
4. Any Street & Kentucky Ave.
5. Any Street & High Ave.

Bridges Requiring Separate Design Designations (if any): None.

Committed and/or Planned Development in vicinity (if any):
1. Expansion of Northland Plaza
2. Full build out of National Mall

Special Conditions (if any): None.

SCHEDULE:

Technical Services' goal is to meet time requirement 100 percent of the time. The District Office will be contacted to determine priority amongst pending requests for multiple projects from the same District. Technical Services will notify you immediately of any known problems which will impact the ability to respond within 45 working days of receipt of a request.

Date when data is needed: May 18, 2007

Reset Form | Print Form | Submit by Email

DO NOT WRITE BELOW - FOR INTERNAL USE ONLY

Date request received:
State Job No.:
Analyst assigned:
Request logged in tracker on and by:
Forecast source:
Notes:
Date of completion:
Checked & Sent on:

Page 2 of 2

Figure 2-1: Sample Request Form for Certified Traffic.

The request should contain all necessary information as outlined in the Standard Customer Agreement (see Appendix A).

The request should contain the PID number that will enable access to the ELLIS project summary (see Figure 2-2) which has basic and detailed project information (such as, name, status, type, description, work categories, , project purpose, designers, responsible design agency, sponsoring agency, project manager, and project termini).

Ohio Department of Transportation: ELLIS Reporting

User: loesterl
Date: 09/21/2006

Basic Project Information

Project Name:	ASD SR 0060 00.68	**PID:**	80173
Project Status:	Active	**Responsible District:**	D3
Project Type:	Let	**Locale:**	ASD
Project Description:	Resurface SR60 from SR3 (0.68) to Hayesville South Corp (10.56)		

Detailed Project Information

Letting Type:	ODOT Let	**Project Manager:**	STOVER, DAVID E
Work Categories:	**Preservation** • Minor Rehabilitation - Pavement Gnrl Sys	**Contract Features:**	
Primary Work Category:	Minor Rehabilitation - Pavement Gnrl Sys	**Environmental Document Type:**	
Project Purpose:	Preservation	**Trac Tier:**	
Designers:	• DISTRICT 3 PRODUCTION	**Program Family:**	
Responsible Design Agency:	DISTRICT 3 PRODUCTION	**Federal Congressional District:**	16
Sponsoring Agency:	ODOT SPONSORING AGENCY	**Demo ID:**	
Plans Measurement Type:	English Units	**Reservoir Year:**	
FHWA Oversite:		**FHWA Project Type:**	
Reporting Group Codes:	• TMS 16 Minor Rehab - General & Urban Sys • CO PDP Class - "Minor"	**Primary MPO:**	
Project Termini:	SR3 (0.68) to Hayesville South Corp (10.56)		

Figure 2-2: Example of ELLIS Project Summary.

2. Forecast Tracking

The request is entered into the tracking database, Traffic Tracker.

3. Forecast assignment

The Project Analyses Administrator assigns request to a forecaster. A time limit of 45 working days is put on the forecast.

4. Review Project Description and Location

The forecaster uses tools such as Digital Photolog (a video log of entire state system, updated every three years), aerial photos, and straight-line diagrams, to review the project location. The forecaster also coordinates with requestor and/or project manager regarding the project description, if needed.

5. Forecast data collection

The forecaster reviews the available traffic volume and vehicle classification data. A request for traffic counts may be sent to the Traffic Monitoring Section, OTS. Or, if the project is locally sponsored, the forecaster informs the district office that additional traffic count data is needed.

6. Select forecasting tool(s) for project.

A. If the project is located in an area that is covered by an MPO urban travel demand model, then forecaster uses the MPO model of record.

B. If the project is not located in an area that is covered by an MPO urban travel demand model, then options include:
   1. Trend-line analyses using historical data
   2. Interim Statewide model and/or Final Statewide model (when available)
   3. Develop a travel demand model
   4. ITE Trip Generation Manual
   5. Other methods

C. The forecaster may use a combination of tools, (e.g., trend-line analysis may be used to determine truck volumes while total volumes are determined using a MPO model of record.)

Chapter 3 Traffic Forecasting Parameters and Source Data

This chapter will review the certified traffic forecasting parameters and the data needed to derive those parameters. Examples are provided showing how to derive the parameters.

3.1 Traffic Forecasting Parameters

The design values (or parameters) for certified traffic forecasts are:

- **Average Daily Traffic (ADT)** The ADT reflects the average number of vehicles that travel through a segment of roadway over a 24 hour period. The ADT is sometimes called the average annual daily traffic (AADT) to show that the data has been factored to an annual average (using seasonal factors developed from automatic traffic recorders (ATRs) that collect data continuously throughout the year). The ADT is the most basic unit of traffic monitoring and is essential for developing traffic forecasts.

- **Design Hourly Volume (DHV)** The DHV is the number of vehicles that travel through a segment of roadway during the design hour. The DHV is the volume unit which is used for making roadway structural and capacity design decisions. The AASHTO guide, *A Policy on Geometric Design of Highways and Streets* (3) also known as the Green Book, states that the 30th highest hour of the year be used for designing highways.

  As explained in the Green Book, the traffic volume varies considerably during different hours of the day. Additionally, the traffic volume during any particular hour varies from day to day throughout the year. The DHV is a key criterion in roadway design, since using the highest hourly volume in an entire years' worth of volume data might result in over design. Similarly, using the average of all hourly volumes in a year as DHV might result in an inadequate roadway design. The Green Book determined a best suited hourly volume for DHV purposes by comparing the relationship between the highest hourly volumes against ADT from a wide range of traffic data collected under various geographic conditions. The charted curves from this data were reviewed and it was determined that the 30th Highest Hourly Volume of the year, abbreviated 30 HV, was best suited for use as DHV in roadway design designations.

  The Green Book data also showed that the 30 HV, as a percentage of ADT (known as the **K-factor**, see definition below), varied only slightly from year to year even though the ADT itself might change considerably. Hence the percentage of ADT that constitutes 30 HV for current traffic volume conditions at a given facility can be generally applied to opening and design year ADTs to determine DHV. The exception to this rule is when there are major changes in landuse served by the roadway in question.

The 1965 Highway Capacity Manual was the source of most of the original research on selecting the optimal design period. The analysis is based on the graphical observation that traffic seems to change between the highest hour of the year and about the 200th highest hour of the year as shown in Figure 3-1 below. Figure 3-1, taken from an ATR in Ohio (4), shows hourly traffic volumes for all of the hours in the year 2006 at ATR Station 153 (I-270 log point 16.030 in Franklin County) as well as volumes from the top 500 and 100 hours in the same year at the same location.

Looking at the top 100 hours in the year allows you to see a large change in the traffic volumes between the first hour and the thirtieth hour. This change in traffic is sometimes referred to as the “knee” in the curve.

The formula for calculating the design hour volume is:

$$DHV = K \times ADT$$

- **K-factor (K)** The K-factor represents the proportion of traffic occurring during the 30th highest hour of the year. K-factors are derived from ATR data as mentioned above. Since most locations will not have an ATR on its facility, it is necessary to estimate a K-factor from statewide ATR data as discussed below in Section 3.3, Traffic Forecasting Parameter Estimation.

- **Directional factor (D)** The D-factor represents the proportion of traffic moving in the peak direction during the design hour. The directional factor is also derived from ATR data, and can be estimated with short-term count data. It is needed since the design hourly distribution of traffic on most roads is not evenly split (50%/50% in both directions) during the design hour. Therefore highway design is based on proportion of traffic in the peak direction during the design hour i.e., D-factor.

- **Directional Design Hour Volume (DDHV)** The DDHV is the amount of traffic moving in the peak direction during the design hour. As mentioned above, the critical design volume has a directional component.

The formula for calculating the directional design hour volume is:

$$DDHV = K \times D \times ADT$$

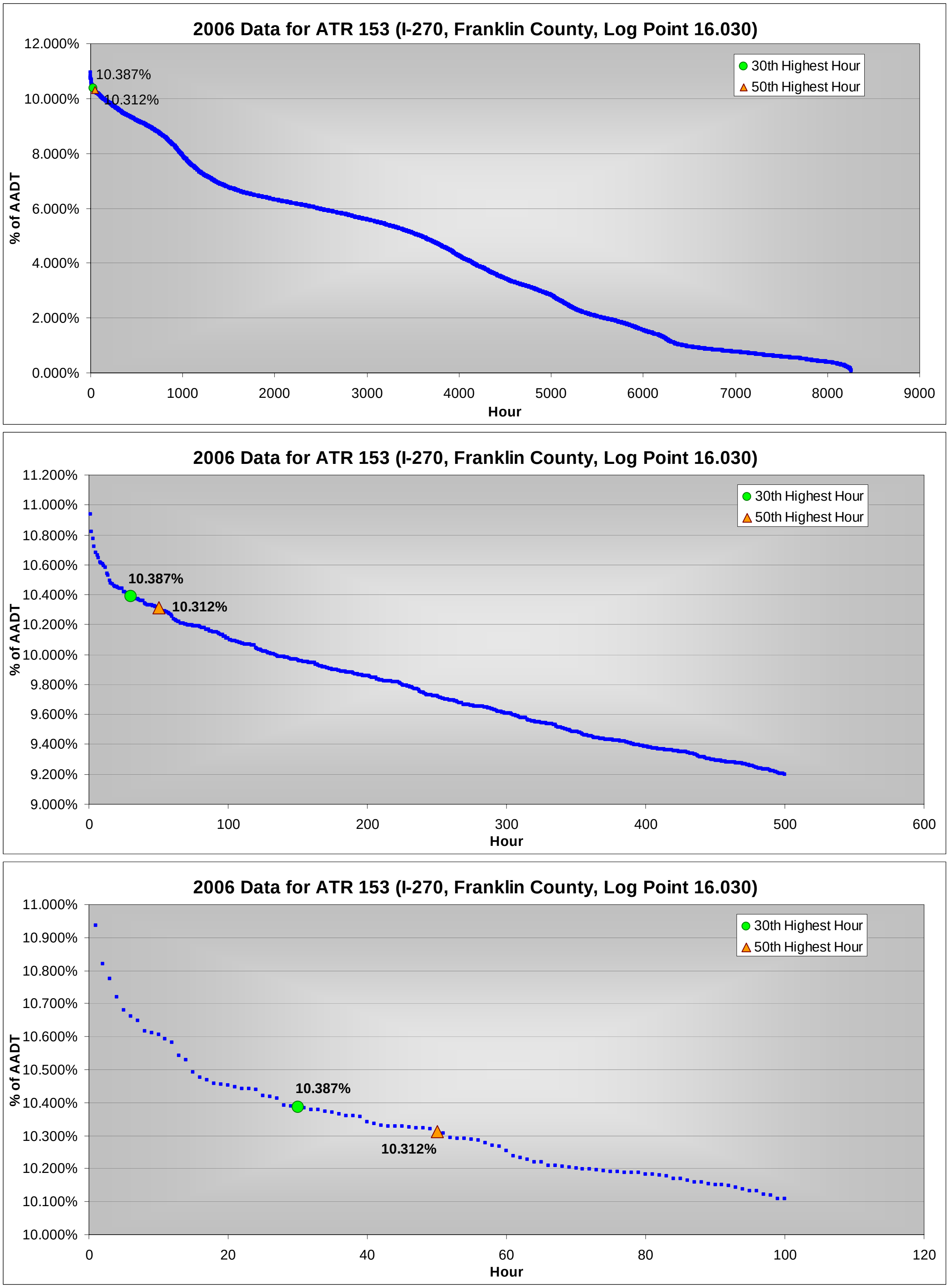


Figure 3-1: DHV Calculation Based on 30th Highest Hour Volume.

- **8th Highest Hour:** The 8th highest hour of the day factor, expressed as a percentage, is used for traffic signal warrants. The default value for 8th highest hour is 0.056. More specific values can be determined by reviewing the hourly distribution of traffic reports by functional class.

- **Daily Truck Percentage (T24)** T24 represents the percentage of ADT that is comprised of heavy and commercial trucks (B&C commercial classes), and is another important factor in highway design and transportation planning. Since trucks take up more space and are heavier vehicles than passenger cars, the most common purpose of T24 is in the design of pavement thickness in highway design projects. The daily truck percentage is derived from vehicle classification counts on the actual facility or functional class averages.

- **Design Hour Truck Percentage (TD)** The design hour truck percentage or TD represents the percentage of DHV that is comprised of heavy and commercial vehicles (B&C commercial classes). Typically this percentage is less than the daily truck percentage since the percentage of truck traffic is not evenly distributed throughout the day, as shown in Table 3-1 and Figure 3-3.

Table 3-1: Car and Truck Traffic Distribution by Hour of Day.

Hour	Hour of Day	FC	P& A (Cars)	% P&A (Cars)	B&C (Trucks)	% B&C (Trucks)	Total	% Total
0	Mid-1A	2	26099	0.8%	12131	1.8%	38230	0.9%
1	1A-2A	2	16869	0.5%	11020	1.6%	27889	0.7%
2	2A-3A	2	13143	0.4%	10923	1.6%	24066	0.6%
3	3A	2	14581	0.4%	12428	1.8%	27009	0.7%
4	4A	2	32868	1.0%	15900	2.3%	48768	1.2%
5	5A	2	101342	3.0%	21478	3.1%	122820	3.0%
6	6A	2	196922	5.8%	29169	4.3%	226091	5.5%
7	7A	2	235272	6.9%	34660	5.1%	269932	6.6%
8	8A	2	186865	5.5%	38608	5.6%	225473	5.5%
9	9A	2	166188	4.9%	43257	6.3%	209445	5.1%
10	10A	2	165076	4.8%	45592	6.7%	210668	5.1%
11	11A-Noon	2	180727	5.3%	47466	6.9%	228193	5.6%
12	Noon	2	182305	5.3%	46252	6.8%	228557	5.6%
13	1P-2P	2	187858	5.5%	43529	6.4%	231387	5.7%
14	2P-3P	2	214661	6.3%	43012	6.3%	257673	6.3%
15	3P	2	266766	7.8%	40420	5.9%	307186	7.5%
16	4P	2	282435	8.3%	35944	5.2%	318379	7.8%
17	5P	2	267208	7.8%	31745	4.6%	298953	7.3%
18	6P	2	194414	5.7%	26635	3.9%	221049	5.4%
19	7P	2	142068	4.2%	23198	3.4%	165266	4.0%
20	8P	2	117954	3.5%	20902	3.1%	138856	3.4%
21	9P	2	99798	2.9%	18823	2.7%	118621	2.9%
22	10P-11P	2	71462	2.1%	16823	2.5%	88285	2.2%
23	11P-Mid	2	47432	1.4%	14774	2.2%	62206	1.5%
			3410313	100%	684689	100%	4095002	100%

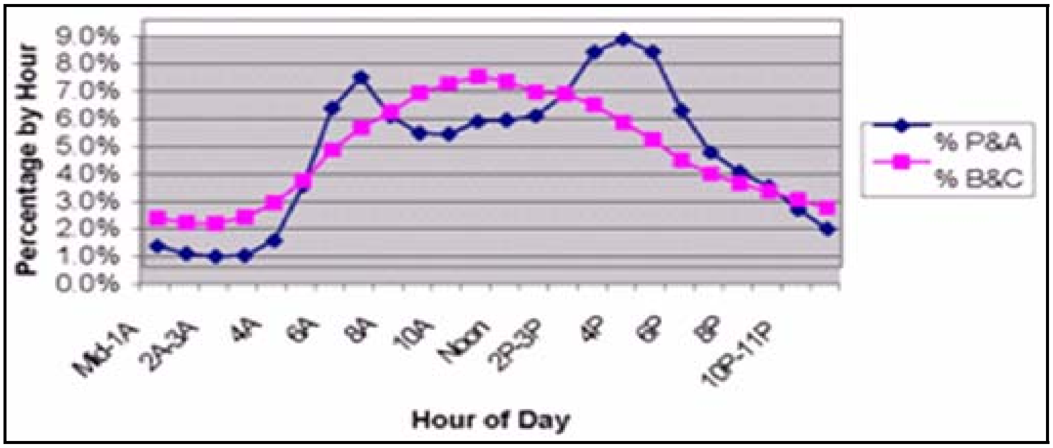


Figure 3-2: Car and Truck Traffic Distribution by Hour of Day.

These parameters interrelate to each other and while simple in concept, require some sophistication to derive from field data. The next section will describe the data needed to estimate the forecasting parameters.

3.2 Data Needed for Traffic Forecasting

To estimate ADTs, DHVs, K, D, T24 and TD, one needs high quality traffic monitoring data. The ODOT-OTS is responsible for collecting and maintaining traffic monitoring data in Ohio. It maintains most of its available traffic monitoring data on its web site at:

http://www.dot.state.oh.us/techservsite/availpro/availpro.htm#Traffic%20Monitoring%20Reports

Ohio's traffic monitoring section is responsible for programming, collecting, analyzing and reporting traffic volume, vehicle classification and weigh-in-motion data on Interstate, US highways and state highways in the state of Ohio. Data is collected using manual methods, portable equipment (road tube), permanent Automatic Traffic Recorders (ATRs), and Intelligent Transportation Systems (ITS).

For traffic forecasting purposes, the major uses of this data are as follows:

Manual counts: These counts are made at intersections in order to determine turning movements. These counts are used to estimate future turning movements.

Tube counts: These counts are made at 13,000 locations on a 3-year cycle across the state (4,300 tube counts annually). The information from these counts is the main source of data for developing traffic forecasts.

ATRs: There are 200 ATRs in Ohio. These stations collect data continuously (24 hours per day/365 days per year). ATR's, when functioning properly, provide a 100% sample of the year's worth of traffic data at their location. ATRs are the source of seasonal adjustments factors used to factor shorter term (e.g., 24-, 48-hours, etc.) tube counts to average daily traffic (ADT). ATRs also provide K factors, D factors, and TD factors (at some locations).

All of the data mentioned above is available on an interactive basis from the ODOT Traffic Monitoring Section web site for all Ohio counties. Data is available from 1990 through the present year (or the most recently collected data). An AADT count map for Athens County for the year 2006 is shown in Figure 3-3 below as an example.

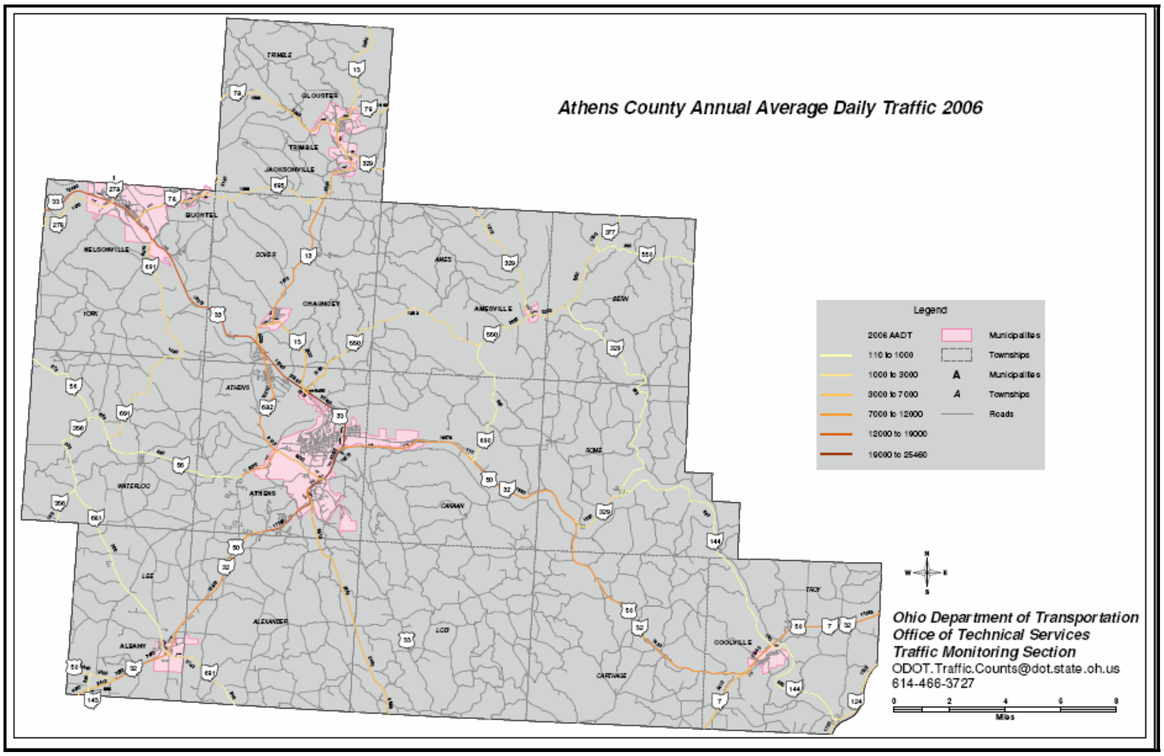


Figure 3-3: ATR Obtained AADT Data for the Year 2006 for Athens County.

Available on this Traffic Monitoring Section web site are:

- **K & D factors report** This is a listing of K & D factors derived from Ohio's automatic traffic recorders (ATR). It is sorted by functional class.

- **Traffic Survey Report** This report - also known as the Traffic Counts or Traffic Volume Report – contains an estimate of annual average daily traffic (AADT) volumes separated by cars (Passenger & Type A Commercial) and trucks (B&C Commercial) for all state, US and interstate routes, throughout the State of Ohio. Data is selected by county.

- **FHWA Vehicle Classification Scheme F Report** This report shows the 13 different vehicle types collected by ODOT's vehicle classification counting equipment.

- **Hourly Percentage by Vehicle Type Report** This report shows the percentage of car and truck distribution by each hour of the day, by roadway functional classification.

- **Short Term Count AADT Data** This report includes site specific count data from each of ODOT's 12 districts. This data, selected by county, is used to generate the official AADT estimate in the Traffic Survey Report.

- **Short Term Count Hourly Data** This report, selected by county, includes site specific hourly count data from each of ODOT's 12 districts. The data contained in the hourly data reports is raw, unadjusted data. Appropriate adjustment factors need to be applied to the data to derive an AADT.

Excerpts from these data reports can be found in Appendix B.

If turning movements or tube counts (beyond what is available on the web site) are needed, the project sponsor should provide the needed counts. If the project sponsor is not able to provide the necessary counts a count request is sent to the manager of the Traffic Monitoring Program. An example of a count request memorandum is shown in Figure 3-4 below.

INTER-OFFICE COMMUNICATION

TO: James E. McQuirt, Administrator, Office of Technical Services

ATTN: Dave Gardner, Traffic Monitoring Section

FROM: Leigh A. Oesterling, Modeling & Forecasting Section, Technical Services

SUBJECT: Traffic Counts

DATE: September 20, 2005 **DATE RECEIVED:** ____________

I request traffic counts at the following locations:

	Location					Type of Count	
Station No.		**County**	**Route**	**Intersecting Road**	**Log Point**	**Turning Movement**	**Machine Count**
	1	SUM	CR 50	btw Hanna Pkwy and Turkeyfoot Road			X
	2	SUM	CR 50	south of Turkeyfoot Road			X

	Count Information		
	Ped. Count	**Length of Count**	**Reason For Count**
1		48 hours *Vehicle Class*	SUM-CR 50-8.01, PID 24504
2		48 hours *Vehicle Class*	SUM-CR 50-8.01, PID 24504

Figure 3-4: Example of a Traffic Count Request Memorandum.

3.3 Traffic Forecasting Parameter Estimation

This section gives examples of estimating the needed traffic forecasting parameters.

- **ADT** There are several ways for a forecasting analyst to obtain ADT data for the roads in the study area.

  For Interstate, US and State routes, the easiest method of obtaining existing, or current year, ADT volumes is for the analyst to refer to the latest traffic survey report (see Figure 3-5 below) which documents the latest traffic count data collected by ODOT.

  If there is a travel demand model available, the forecasted 24 hour volumes obtained from the model will need to be adjusted (see Appendix D, Modeling Spreadsheet and Chapter 4 for discussion on the adjustment process).

If there is no model available, trend line analysis can be used to produce an estimate of current and future year traffic based on historical volume counts (see Appendix D and Chapter 4).

Traffic Survey Report - Microsoft Internet Explorer

2003 ADAMS CO 1
AVERAGE 24-HR TRAFFIC VOLUME

	SECT. BEGINS	TRAFFIC SECTION	SECT. LENGTH	PASS & A COM'L	B & C COM'L	TOTAL VEH.
		SR-32				
	00.00	BROWN CO. LINE	.35	9010	1320	10330
U	00.35	W. CORP. WINCHESTER	.31	9010	1320	10330
	00.66	LEAVE WINCHESTER	.47	9010	1320	10330
U	01.13	RE-ENTER WINCHESTER	.58	9010	1320	10330
U	01.71	SR 136	.62	6520	1150	7670
	02.33	E. CORP. WINCHESTER	3.81	6520	1150	7670
U	06.14	S.W. CORP. SEAMAN	.15	6520	1150	7670
U	06.29	SR 247	.08	5380	1060	6440
	06.37	LEAVE SEAMAN	.19	5380	1060	6440

Figure 3-5: Sample Traffic Survey Report.

- **DHV & DDHV**. In order to calculate DHV and/or DDHV, one needs a K-factor and/or a D-factor, both of which can be found in the K&D report.

  An example of using the K&D report (shown in Figure 3-6) to find these two parameters is explained below.

K and D Factors by Functional Classification for the 30th Highest Hour

FN CL	STA	CO-RT-LG	YEAR	ADT	30 HR VOL	HR	PEAK DIR (D)	K
1	41	CLA-70R-25.81	1993	36480	3620	17	52.5%	9.923%
1	41	CLA-70R-25.81	1994	38980	3740	19	54.5%	9.595%
1	41	CLA-70R-25.81	1995	39380	3850	17	54.5%	9.777%
1	41	CLA-70R-25.81	1996	41510	3910	17	50.6%	9.419%
1	41	CLA-70R-25.81	1997	42460	3850	16	51.0%	9.067%
1	50	AUG-75-7.70	1992	28090	2820	20	57.8%	10.039%
1	50	AUG-75-7.70	1993	26870	2590	15	56.8%	9.639%

Figure 3-6: K & D-factors – used to Compute DDHV.

In Figure 3-6, for ATR Station 41 located on IR-70 (functional class 1) at log point 25.81 in Clark County, the 1997 ADT is shown as 42,460 vehicles. From the same ATR report, the 30th Highest Hour Volume (30

HR) in 1997 is shown to be 3,850 vehicles (occurring between 3 and 4 pm or the 16th hour of the day). Since the K-factor is the proportion of traffic occurring during 30HR, it can be computed as follows:

K-factor = 30HR/ADT = 3,850 vehicles/42,460 vehicles = 0.09067 or 9.067%

This K-factor of 9.067%, as well as the D-factor of 51.0%, must be compared with the historic trend for the same location (as shown in the report) to determine the appropriate K- and D-factors in design designations or certified traffic forecasts.

If there is no ATR station near the study location, K and D factors can be also estimated by other methods. ODOT's State Highway Access Management Manual (Chapter 5, Section 5.6., Issued December 2001, Version 3-12-03) mentions a couple of methods for estimating DHV and K-factor. One of the methods involves determining DHV by multiplying the higher of the a.m. and p.m. peak hour volume by a factor. These factors are based on statewide average peak hour to design hour ratios by functional class. Table 3-2 shows the factors for each functional class.

Table 3-2: Factors to Determine DHV from Peak Hour Volume Counts.

Rural			Urban		
Functional Class		Factor	Functional Class		Factor
01	Interstate	1.43	11	Interstate	1.30
02	Principal Arterial	1.32	12	Freeway	1.19
06	Minor Arterial	1.25	14	Principal Arterial	1.27
07	Major Collector	1.22	16	Minor Arterial	1.25
08	Minor Collector	1.27	17	Collector	1.21
09	Local	1.23	19	Local	1.19

As an example, if the peak hour volume on a rural principal arterial (roadway functional class 02) is 1,400 vehicles in the a.m. peak hour and 1,800 vehicles during the p.m. peak hour, then the DHV for this roadway can be determined as follows:

Higher of a.m. / p.m. peak hour volume = 1,800 vehicles (from p.m. peak)
Factor for Rural Principal Arterial = 1.32 (from Table 3.2)
DHV = 1,800 * 1.32 = 2,376 ≅ 2,380 vehicles per hour.

The ODOT State Highway Access Management Manual also suggests the following alternate method of estimating DHV. This method is actually the preferred method, as the values are site specific, rather than relying on statewide averages. As a first step, compute the ratio of the higher of the a.m. and p.m. peak hour volume against the ADT from a site-specific volume count. Next, determine an appropriate K-factor from ODOT 30th highest hour report data by functional class for a route with a similar functional class and similar ADT. If there are multiple similar routes, use the one with the highest K-factor. Divide the K-factor by the ratio computed in the first step. If the resultant value is greater than one (1), factor the peak hour volume (higher of the a.m. and p.m. peak hour volumes) by the resultant value to obtain DHV. If the resultant value is equal to or less than one (1), use the higher peak hour volume as the DHV. This method is demonstrated below with hypothetical data:

> Let's assume that volume counts in a study area show the ADT to be 45,000 vehicles and the highest peak hour (p.m.) volume for the same site is 4,300 vehicles. Computing the ratio of these two volumes gives 4,300/45,000 = 0.09555 or 9.555%.
>
> Now, let's assume that the K-factor for a route with a similar functional class and similar ADT (as obtained from ODOT K & D Factors report) is 10.045% or 0.10045. Dividing the K-factor from the ratio computed in the previous step gives a value = 0.10045/0.09555 = 1.05. Since the value is greater than one, DHV can be estimated by factoring p.m. peak hour volume by 1.05. Thus, DHV = 4,300 x 1.05 = 4,515.
>
> If the K-factor in the above hypothetical example was only 9.067% instead of 10.045%, then dividing K-factor by ratio from first step would result in a value of 0.09067/0.09555 = 0.95, i.e., a value less than one. In this case the DHV should be estimated as being equal to the p.m. peak hour volume of 4,300 vehicles.

- **D-factor** If an ATR exists for the roadway being analyzed, its D-factor can be obtained from the K & D report. However, in most cases ATR reports are not available for the roadway section being analyzed. If there is no ATR available for a roadway, D-factors can be estimated.

  As a general rule, the most common D-factor observed during a peak hour ranges from 0.55 to 0.60. This means that during a typical peak hour 55-60% of the traffic volume flows in one direction, i.e., the peak direction.

  The preferred way to estimate the D-factor is to examine the directional distribution of traffic from the peak hour volume counts. The following is an example of determining the D-factor from a traffic count as illustrated in Figure 3-7 which shows the traffic counts at for the intersection of Street 1 and Street 2. The example will compute the D-factor for the roadway segment Street 1 east of Street 2.

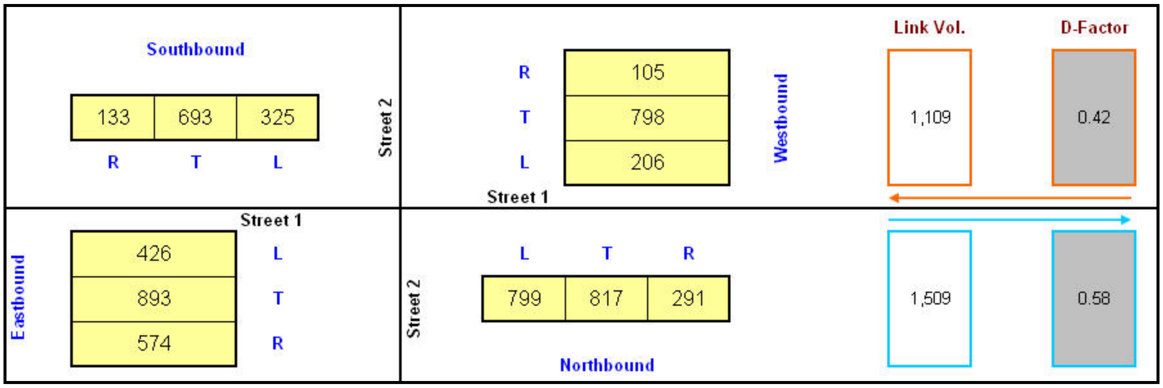


Figure 3-7: Example of Computing D-factor from a Traffic Count.

The first step is to determine the volume on Street 1, east of Street 2, by direction.

WB volume = WBR + WBT + WBL = 105 + 798 + 206 = 1,109
EB volume = NBR + EBT + SBL = 291 + 893 + 325 = 1,509

Then, determine the total volume for Street 1, east of Street 2.
The total volume on Street 1 (east of Street 2) = 1,109 + 1,509 = 2,618.

Since the EB direction has the higher volume, the D-factor can be computed as 1,509/2,618 = 0.58. Hence, in this example, the D-factor is 0.58 indicating that 58% of the traffic on Street 1 is in the peak direction.

Though peak hour traffic volumes may vary daily or yearly, the directional distribution or D-factor on a roadway remains fairly consistent. Accordingly the D-factor obtained from a peak hour volume count may be safely used as an estimate for a design year D-factor on the same roadway. While this approach may work for most projects, it cannot be blindly applied to roadway improvement projects that involve new facilities, new access points, and /or land use redevelopment.

For example, roadways being designed (or redesigned) for a new shopping mall will have a different directional distribution of traffic volume than that seen from an existing traffic volume count on the same roadway. A comprehensive understanding of the current and proposed land use in the vicinity of the study area, the functional classification of the existing/proposed roadway, as well the type of project for which the traffic forecast is being sought, will enable the forecast analyst to provide a more accurate directional distribution. As a result D-factor estimates can sometimes vary from 0.50 to 0.75 and even higher in certain cases.

In some cases a recommendation can be made for vastly different directional distributions during the a.m., p.m., and design hours. When the traffic forecast analyst estimates and reports such varying directional distribution, it will give planners and engineers an opportunity to propose and investigate non-standard solutions such as directional travel lanes on the roadway.

- **8th Highest Hour** The 8th highest hour of the day factor, expressed as a percentage, is used for traffic signal warrants. The default value for 8th highest hour is 0.056. More specific values can be determined by reviewing the hourly distribution of traffic reports by functional class.

- **Truck Percentages (T24 & TD)** If a TDM with a well validated truck purpose is not being utilized, the source of the daily truck percentage (**T24**) information can be found in the Traffic Survey Report (under B&C). Trend line analyses, can be applied specifically to daily truck volumes to estimate future year T24 values.

  The design truck percentage (**TD**) can be estimated by examining the Hourly Percentage by Vehicle Type report (see Section 3.1), or the peak hour volume vehicle classification counts. The peak hour percentage of trucks can serve as a proxy for the percentage of trucks in the design hour.

  As a general rule, the TD usually ranges from 50% to 70% of the T24. However, to estimate TD, the forecast analyst must once again rely on his or her knowledge of the type and location of the project. The analyst must also know when the design hour occurs (i.e., the HR value shown in Figure 3-6 above). The time of day when the design hour occurs should then be compared to current (or most recent) traffic volume counts to look for the percent of trucks during that hour. This knowledge, combined with information on the type and location of the project, will enable the forecast analysts to estimate the most appropriate TD design designations for the opening and design year.

Chapter 4 Traffic Forecasting Tools

This chapter will review the primary traffic forecasting tools and give guidance for how each will be used. The tools covered are:

- Non-interstate bridge forecasting procedure;
- Turning movements;
- Trend line analysis; and
- Modeling.

The recommended spreadsheets are provided in the user CD.

4.1 Non-Interstate Bridge Forecasting Procedure

This procedure only applies to bridge replacement projects on US highways, state routes, county routes, township routes or local streets. This simplified method allows an appropriate level of effort to be made on simple traffic forecasts.

This method relies heavily on default growth rates, default K-factors, and default D-factors along with actual traffic volume/vehicle classification data.

The growth rates range from 0.25% per year (low end of the “stable” category) to 3% per year (top end of “high” category). The K-factors are based on ADTs and range from 12% for low volume (<1,000 ADT) to 9% for higher volumes (>15,000 ADT). The D-factors are based on whether the bridge is within an MPO (0.60) or outside of an MPO area (0.55).

This procedure is contained in Appendix D (5) and the worksheet is shown below in Figure 4-1.

NON-INTERSTATE BRIDGE PROJECT DESIGN WORKSHEET			
1A	Enter the PID:		1A
1B	Enter the County-Route-Log or other identifier:		1B
2A	Enter the Existing ADT (Total Vehicles):		2A
2B	Enter 24-hour B&C (commercial) volume if available:		2B
2C	Enter the Existing Year:		2C
3	Enter the Opening Year:		3
4	Enter the Design Year:		4
5A	Enter the number of years from the Existing Year to the Opening Year: **(3) - (2C) =**		5A
5B	Enter the number of years from the Existing Year to the Design Year: **(4) - (2C) =**		5B
6	Select a growth rate from the following range of rates: Stable .0025-.0050 Moderate .0100-.0200 Low .0050-.0100 High .0200-.0300		6
7	Enter the Opening Year Factor: **[(6) x (5A)]+1 =**		7
8	Enter the Design Year Factor: **[(6) x (5B)]+1 =**		8
9	Enter the Opening Year ADT: **(2A) x (7) =** Round to nearest 100 vehicles (nearest 10 vehicles if < 1000)		9
10	Enter the Design Year ADT: **(2A) x (8) =** Round to nearest 100 vehicles (nearest 10 vehicles if < 1000)		10
11A	Enter K, selected from the following table of Design Year ADT : < 1000 .12 5001 - 15000 .10 1001 - 5000 .11 15001 < .09		11A
11B	Enter the DHV: **(10) x (11A)**		11B
12	Enter the D factor (for DDHV): within an MPO area: .60 outside an MPO area: .55 any one-way bridge: 1.00		12
13	Enter the T24 factor (the proportion of B&C vehicles in ADT): **[(2B)/(2A)]** or **.03** if (2B) is blank		13
14	Enter the TD factor (the proportion of B&C vehicles in the design hour): **(13) x 0.6**		14

Figure 4-1: Non-Interstate Bridge Project Design Designation Worksheet.

4.2 Turning Movements

4.2.1 Background

Traffic forecasts involving intersections, generally require the calculation of turning movements for the current (or opening year) and future design year. It is very important to have recent manual turning movement counts since intersections are typically the capacity chokepoint on most highways and the turning movement forecasts are used to determine whether turn lanes are needed, how long they should be and if multiple lanes are needed.

Ohio uses the procedure documented in Chapter Eight of the NCHRP Report 255. This procedure has been used to develop a spreadsheet for producing turning movements that is included in the enclosed CD-ROM and discussed in great detail in Appendix D.

4.2.2 Parameters Needed

The parameters needed for turning movement calculation are current year turning movement ADTs, future year ADTs, K-factors, and D-factors.

4.2.3 NCHRP Report 255 Spreadsheet Overview

A Microsoft Excel spreadsheet was developed to compute intersection turning movement volumes based on ADTs and K-factors. The spreadsheet is based on methodology outlined in the NCHRP Report 255. The Excel file “NCHRP 255 turning movements - 4 approach example.xls” is included in the CD-ROM accompanying this manual. The spreadsheet works as follows:

1. Gather existing/base year turning movement volumes. This usually requires a request for data collection although in some cases there is data already collected (perhaps from a signal warrant analysis, a traffic impact study, or a previous traffic forecast). This is input into the Volumes tab of the spreadsheet.
2. Obtain future year ADTs and K-factors. This is input into a table in the lower left-hand side of the Volumes tab. The future year ADTs will normally be obtained from traffic models or trend line analysis as discussed in Chapter 3 of this report. K-factors will be found in the K & D report, or estimated as described in Chapter 3 of this report. These two parameters are used to compute a future DHV for each intersection approach.
3. Current year turning movements are derived using the manual data and then directional factors are calculated for each approach.
4. Future year DHV are computed using the current year D-factors and the future DHV.

5. Future year directional link volumes are then automatically input into the NCHRP 255 calculation tab.
6. The NCHRP 255 calculation procedure iterates until a convergence is reached.
7. The final result is automatically transferred to the Volumes tab.

This spreadsheet is meant for forecasting turning movements on four-legged intersections but can also be used for three-legged intersections. Separate spreadsheets are included in the CD-ROM for five and six-legged intersections.

A detailed example of how this NCHRP Report 255 based spreadsheet is to be used is included in Appendix D. The turning movement input screen is shown below in Figure 4-2.

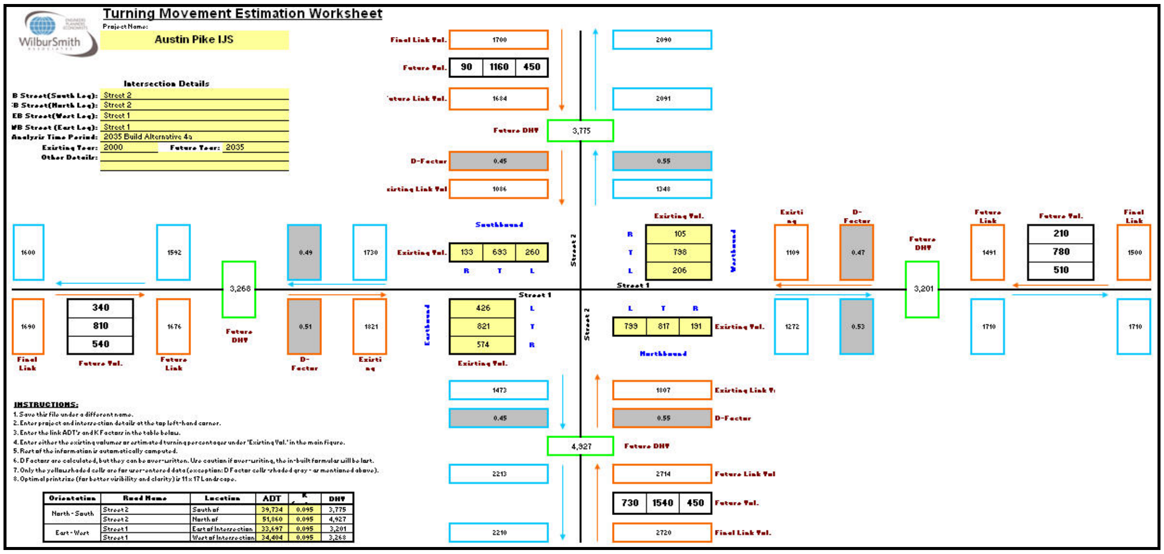


Figure 4-2: Turning Movement Computation Spreadsheet.

4.2.4 General Rules

There are several principles worth remembering as one calculates turning movements:

- Turning movements should be balanced within a corridor. If intersection A is the northernmost intersection and intersection B is the intersection immediately to the south and there are no driveways, minor intersections or other traffic sources (e.g., parking lots or garages, etc.) in between them, then the directional volumes for A's south approach must match the directional volumes for B's north approach. Judgment must be used to ensure that any difference in volumes between study intersections reflects conditions in the field accounting for traffic generators.
- Intersection volumes should be rounded to the nearest 10. It is easier to understand rounded values, and, more importantly, unrounded values imply accuracy that is misleading.

- All numbers used in traffic forecasts are estimates since the only comprehensive values are automatic traffic recorder volumes (AADTs). Therefore it is necessary to use sound judgment when computing turning movements.
- Field trips are useful for assessing traffic patterns for turning movements, especially on major corridors. An acceptable substitute is an interview with someone else familiar with the area.
- The ITE trip generation report is a good source of directional factors for new facilities lacking existing count data.
- Commercial areas frequently have high mid-day peaks that may exceed the normal high peaks found in the AM or PM periods. If possible, consult the hourly volume distribution from a 48-hour count to assess the need for including a mid-day peak period.
- Mixed land use areas sometimes have lower K-factors and flatter (close to 50/50) directional distributions.
- Schools and factories frequently produce untypical K-factors and D-factors. It is not unusual for D-factors to exceed 0.70 on roads with much of the traffic coming from a school or factory.

4.3 Trend Line Analysis

4.3.1 Background

Trend line analysis is used to estimate future traffic volumes and truck percentages when a travel demand model is not available. Ohio uses the NCHRP Report 255 procedure for trend line analysis. Other procedures – like the Box-Cox method – can be found in the report, *Introduction to Statewide Travel Forecasting* (6).

4.3.2 Parameters needed

The parameters needed for trend line analysis calculation are current year ADTs, historical ADTs, current year B & C volumes and historical B & C volumes.

4.3.3 255 Spreadsheet Review

An example of using the NCHRP Report 255 trend line analysis spreadsheet is included in Appendix D. The main steps in using the spreadsheet are listed below:

1. Gather historical data for the subject locations from ATR data reports or other sources.
2. Plot a chart with volumes on the y-axis and the year on the x-axis.

3. Use regression analyses to estimate a line with coefficients that best fits the historical traffic volumes. Linear regression is the most commonly used method for trend line.
4. Repeat the analyses for B & C volumes (truck volumes).
5. A preliminary estimate of future volumes can be computed using the trend line analyses.
6. Determine the growth rates for passenger traffic and B & C volumes.

A typical trend line analysis graph is shown below in Figure 4-3. The linear regression equation takes the form:

$$y = bx \pm a$$

where,
y = Future ADT
x = Future Year
a = the y-intercept
b = slope of the line

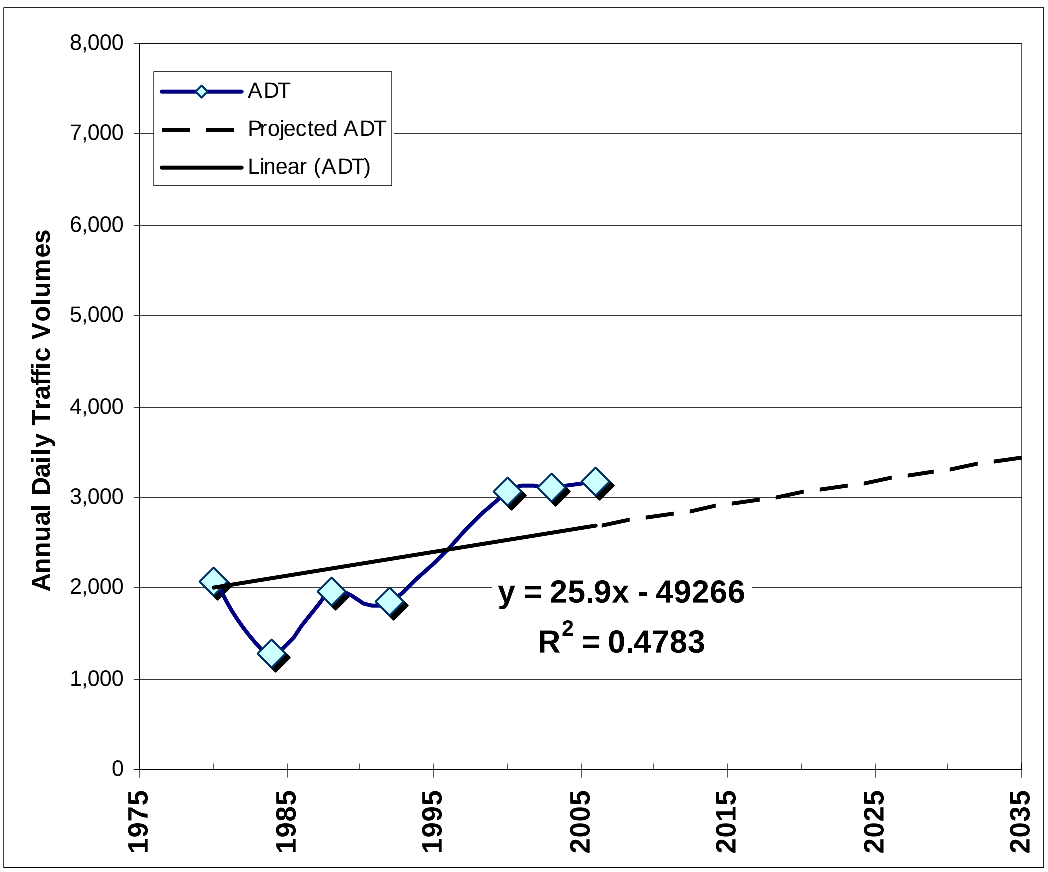


Figure 4-3: Typical Trend Line Analysis using Linear Regression.

4.3.4 Rules of Thumb

Caution must be exercised when using this method. There must be an adequate number (at least five) of data points. Sometimes data outliers must be discarded. There always needs to be reasonableness check applied such as:

- Review of land use and land use changes
- Review of other forecasts in adjacent facilities
- Review of potential changes to future roadway capacity and geometry.

4.4 Modeling

Most traffic forecasts will involve the use of a travel demand model to determine future design volumes since the interaction of land use changes and changes to various transportation facilities are too complex to assess using simple trend line analysis techniques. Ohio has a very comprehensive system for modeling highways that involve not only passenger traffic but also truck traffic.

For more information on Ohio's modeling, see the Modeling and Forecasting's web link:
http://www.dot.state.oh.us/techservsite/offceorg/urbanstudies/urbanstudies.htm

Available are:

- Technical reports and documents;
- Information on products and services;
- Information on the Ohio Model Users Group;
- Staff members; and
- Much more information.

4.4.1 Choice of Models

Models are available for all of Ohio's 17 MPOs. These MPOs are listed in Appendix D along with their website addresses and other contact information and a map of the study areas.

For areas not in a MPO the Ohio interim statewide travel demand model is available for use. This model is primarily used for corridor studies and regional analysis. A graphic of the interim statewide model network is shown below in Figure 4-4.

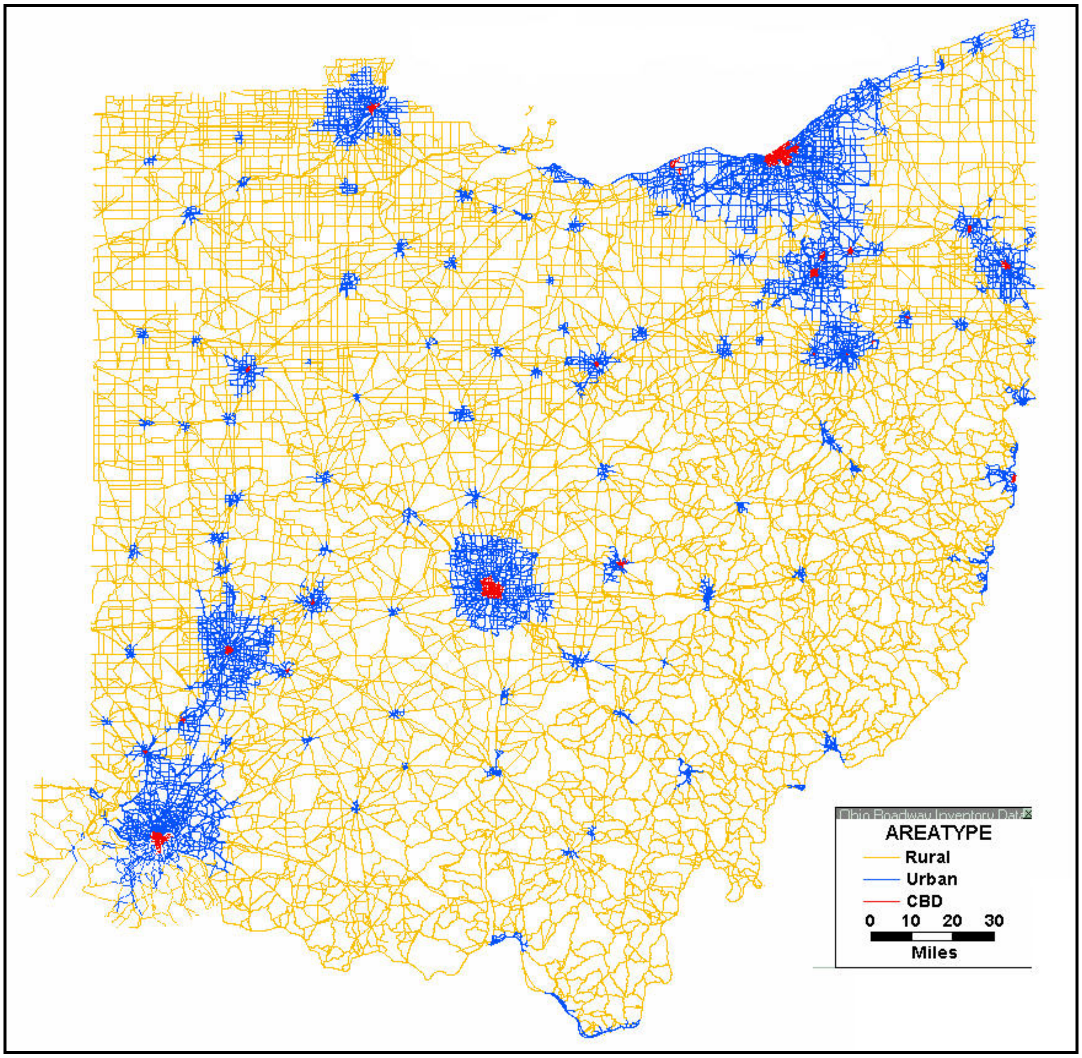


Figure 4-4: A Screen Shot from Ohio's Statewide Travel Demand Model.

4.4.2 Use of Models

Travel demand modeling requires detailed instructions in view of the complexity of the process. A detailed report entitled *Guidelines for Planning Level Traffic and the Use of Models for Project Traffic Forecasting* has been developed by a committee of the Ohio Model Users Group. This report is included in its entirety in Appendix C.

4.4.3 Modeling Spreadsheet

A spreadsheet for developing certified traffic from traffic data and model assignments using screenline analysis is included on the user CD. A procedural explanation for using this spreadsheet is given in Appendix D. This spreadsheet is based on the procedures discussed in Chapter Four of NCHRP Report 255. An excerpt from the spreadsheet is shown below in Figure 4-5.

	Road/Link	COUNT year	COUNT	2000 Ab	Ab [illegible]	2030 Af	RATIO	DIFF	RAf	Selected Adjustment		most recent count data	most recen count year	2009 opening year	2029 design yr	growth factors opening yr	growth factors design year
(east leg)	Road A	2000	40000	42390	42390	45560	42991	43170	43081	RAf		40000	2005	40493	42957	1.0123	1.0739
(north leg)	Road B	1995	16300	13060	10791.667	26670	40283	32178.333	36231	RAf		16300	2005	19489	35433	1.1956	2.1738
(south leg)	Road C	2000	3300	6640	6640	14060	6988	10720	8854	RATIO		3650	2005	4184	6854	1.1463	1.8778
(west leg)	Road D	2001	4000	4590	4921.3333	14530	11810	13608.667	12709	RAf		4000	2005	5393	12361	1.3483	3.0903

Figure 4-5: Spreadsheet Based on Chapter 4 of NCHRP Report 255.

This method acknowledges that the travel demand model is a tool that produces volumes that, for design purposes, require interpretation with existing traffic counts. The method accounts for the over- or under-simulation of the model at any one location when compared to traffic counts in the base year, and applies the same correction for the over- or under-simulation to the future year modeled volumes.

4.4.4 Process for Obtaining Model Work

It is important to determine when the traffic forecasts for a project will require model work because such work can involve significant lead times. As stated in *Guidelines for Planning Level Traffic and the Use of Models for Project Traffic Forecasting* (Appendix C), the types of project that typically involve model work are those that might be classified as major capacity enhancements and include elements such as:

- Major New Bridge
- New Interchange
- Removal/Addition of Connections for Certain Movements at an Interchange
- Any New Freeway
- One or More Miles of New Non-Freeway Road
- Increase of 50% or More to the Number of Through Lanes

For such projects, coordination with the Office of Technical Services at project inception (prior to hiring of consultants) will help clarify the need for model work, ensure that the proper model is used, and expedite the refinements needed to develop a project ready model. Further details on the coordination of modeling work within the Project Development Process can be found in, *Guidelines for Planning Level Traffic and the Use of Models for Project Traffic Forecasting* (Appendix C).

4.4.5 Types of Traffic Forecasts

Projects that are large enough to require model work usually proceed through a more complex traffic forecasting process that involves the production of preliminary forecasts based upon more limited information and less manual refinement of the results. It is important to understand the distinction between these preliminary estimates and certified design traffic.

Traffic forecasts can generally be placed into one of the following four levels: 1) Raw Model Output; 2) Planning Level Traffic; 3) Refined Alternative Level Traffic; and 4) Design Traffic. The level of refinement is non-existent at the first level and increases with each increase in level, with Design Traffic having the most checking, adjustments, and refinement.

Raw Model Output is defined as model results that have not been subjected to any of the checking/adjusting/refining procedures as documented in the *Guidelines for Planning Level Traffic and the Use of Models for Project Traffic Forecasting* (Appendix C). Growth rates are often calculated by comparing the base year and forecast year raw model volumes for use in minor projects. Raw model outputs are also sometimes used for making system-wide or gross corridor level decisions. Unless otherwise directed by Modeling and Forecasting Section (M&F) of the ODOT Office of Technical Services, raw model results should not be used for reporting actual location specific volumes.

Planning Level Traffic includes traffic forecasts that have been subjected to various checks and adjustments (as documented in the *Guidelines for Planning Level Traffic and the Use of Models for Project Traffic Forecasting* (Appendix C)). However, planning level traffic has not necessarily been refined to produce reasonable values at all locations within a study area. Planning level traffic is designed to answer questions on the order of magnitude of the addition of a general purpose travel lane in a certain location. If more detailed decisions such as location and length of turn lanes, auxiliary lanes, traffic control devices, etc. are being made then refined alternative level or design traffic is required.

Refined Alternative Level Traffic typically involves using matrix estimation or other techniques to refine travel demand to more precisely match study area traffic counts. This level of refinement results in forecasts that are suitable for use in operational level models. Because the process to obtain refined alternative level traffic is extremely labor intensive, it is generally only produced for certain large major projects that involve highly complex traffic operations such as occurs with major changes in the central business district of a large urban area.

Design Traffic consists of the final traffic forecasts and related information (including turn volumes, direction factors, 30th highest hour factors etc., as discussed within this document) needed to inform the final detailed design of a project. All of the checking, adjusting, and refining documented in *Guidelines for Planning Level Traffic and the Use of Models for Project Traffic Forecasting* (Appendix C) (as appropriate for the project type) will have been conducted for the feasible alternatives in order to produce design traffic. As with Refined Alternative Level Traffic, the process for developing design traffic is extremely labor intensive; therefore it is usually only completed for the feasible and/or preferred alternatives. Design traffic is “certified” when the ODOT Office of Technical Services, Modeling & Forecasting Section indicates such.

Chapter 5 Traffic Forecasting Analyses/Final Product

This chapter will review the analysis process. It will also describe the recommended final product (format and contents). Finally, it will discuss forecast archiving.

5.1 Forecast Analysis

It should be noted that traffic forecasting is based on dynamic data that is estimated rather than on static data that can be measured easily. Thus all traffic forecasts have error built into them. However, there are many excellent techniques, methods, and tools available that can help to reduce the error and make the best possible estimate.

It is desirable for the forecaster to have experience in statistics, travel demand modeling, traffic monitoring, traffic engineering and transportation planning. These skills along with basic common sense help assure a good forecasting product.

5.1.1 Data Analysis

The data analysis is mostly performed with spreadsheets and with travel demand models. The traffic forecaster serves as a quality control and quality assurance (QC/QA) source for the traffic monitoring program since the traffic monitoring program rarely has the opportunity to look at the data in as much depth as the forecaster.

5.1.2 Reasonableness checks

Here is where common sense and the ability to intuitively grasp what the “right” answer should be are very useful. Knowledge of the area being forecasted, the highway corridor, possible development, and other factors can serve as a check on the final product. It is also always useful to keep in mind how and where the forecasts will be used in order to devote the proper amount of effort to the forecast.

5.1.3 Consistency with previous work

It should be noted that for most projects, a particular traffic forecast is just one piece of a massive traffic puzzle. Therefore it is incumbent upon the forecaster to discover what has been done in the past and to make use of the previous work. Of course there are some cases where the magnitude of a development or the examination of new facilities renders previous work irrelevant. In most cases, the previous analysis is important. There are some cases, for instance where there is a record of decision on a Major Investment Study, where it is crucial for the forecast to be consistent with previous work.

The traffic forecaster should make use of the following sources:

- MPO planning studies
- Traffic impact studies
- Long range transportation plans
- Planning studies done by other agencies
- Previous work done by ODOT.

With the combination of data analysis, reasonableness checks and providing consistency with previous work, traffic forecasting can be considered as much an art as a science. However, it is important to remember, that scientists have always used intuition, creativity and common sense after they have done everything possible in the areas of data collection and analysis.

5.2 Final Product

The final product will typically consist of a memo and turning movement diagrams, as well as summary documentation for the file. It is important for complex traffic forecasts to be well organized with assumptions and data sources well documented for the other users to understand. It is also important for the traffic forecast to be presented in a clear, attractive manner. With the development time for new highway facilities increasing and average per mile construction costs increasing and with public involvement increasing, traffic forecasting is undergoing increasing scrutiny from other disciplines and the public. Therefore, a high quality presentation adds to the basic credibility of the traffic forecasting product.

Examples of a simple and complex traffic forecast are included in Appendix E. The IOC for a simple traffic forecast is shown below in Figure 5-1.

INTER-OFFICE COMMUNICATION

TO: Mike Schafrath, P.E., Roadway Team Leader, Production-District 3

FROM: Leigh A. Oesterling, Transportation Planner, Office of Technical Services

SUBJECT: ASD-60-0.68, PID 80173

DATE: August 22, 2006

In reply to an e-mailed request dated August 2, 2006, please use the following design designations:

PID 80173
ASD-SR 60

	0.68 -1.22	1.22 - 5.61	5.61 - 10.56
2009 ADT =	3280	3550	2900
2021 ADT =	3590	4530	3450
DHV =	360	450	350
(K =	*0.10*	*0.10*	*0.10)*
D =	0.55	0.55	0.60
T24 =	0.09	0.09	0.09
TD =	0.05	0.05	0.05

If you have any questions, please contact me at (614) 752-5747.

LAO:lo

c: J. McQuirt, OTS - P. Siddle, OTS - File

Figure 5-1: An Inter-Office Communication to Convey the Forecasted Traffic Data.

5.3 Archiving

Traffic forecasting products are used repeatedly by many different customers. Therefore it is essential to make electronic copies of the final products, and to track traffic forecasts in a database ODOT's certified design traffic forecasts are now retained as a printable document format "pdf" files on a central computer server. Traffic forecasts have been tracked by ODOT-OTS in a database called "Traffic Tracker" for many years. The "Traffic Tracker" database attributes can be found in Appendix A.

Additionally, hard copy files are maintained for every certified design traffic forecast. Hard copy files contain the memo and diagram with the certified design traffic, and also contain existing traffic counts, hardcopy pages of spreadsheets, correspondence between OTS and the project manager, and any other items needed to clearly document the forecasting process.

Chapter 6 References

1. *Guidelines for Planning Level Traffic and the Use of Models for Project Traffic Forecasting*, ODOT Division of Planning, Modeling and Forecasting Section, November 2006.
2. *NCHRP Report 255 Highway Traffic Data for Urbanized Project Planning and Design*, N. J. Pedersen and D. R. Samdahl, TRB, December 1982.
3. *A Policy on Geometric Design of Highways and Streets,* AASHTO, Fifth Edition, 2004.
4. *2006 ATR Station 153 Data*, ODOT Traffic Monitoring Section, obtained from Dave Gardner, Section Manager.
5. *Procedures for Developing Design Designations for Non-Interstate Bridge Replacement/Rehabilitation Projects*, ODOT Office of Technical Services, Revised September 11, 1998.
6. *Introduction to Statewide Travel Forecasting*, FHWA, Alan Horowitz and Bob Gorman, 2002 Workshop.
7. *Florida Project Traffic Handbook*, Florida DOT, 2002.

Appendix A

Customer Agreement, Request Forms & Tracker Database

Reports:

1) Standard Customer Agreement
2) Certified Traffic Request Form
3) Tracker Database

1) Standard Customer Agreement

Agreed Customer Requirements: Certified Traffic District X/Technical Services

January 22, 1999

I District X responsibilities:

1. All requests will be sent in an IOC format to the Technical Services' Office Administrator, to the attention of the Project Analyses Administrator. An e-mailed request directly to the Project Analyses Administrator can substitute for an IOC if all the necessary information in (2) below is included in the request (the map will be faxed concurrently). District X will be responsible for the distribution of copies of the responses within District X.

2. Each request will include the following information:

a) County-Route-Log or other project identifier and PID number;
b) opening and design years;
c) request design values (K, D, T24, TD, 8th highest hour factor) as needed;
d) provide map(s) clearly showing project limits;
e) list intersections requiring turning movements, if any, or indicate them on the map(s) and indicate the time periods required (P.M. peak, both peaks, etc.) if needed in addition to the ADT;
f) for Interstate Route resurfacing projects, identify those bridges requiring separate design designations [e.g., bridges under roadways which cross over interstate routes, etc.] by route number or name;
g) provide details on planned developments or other known factors which may impact the project
h) provide an accurate "need by" date (Note: normal turn around is 60 days from day of receipt in Technical Services for all projects.)

3. District X will notify Technical Services via e-mail or phone of any changes or cancellation of requests already submitted to Technical Services immediately or as soon as possible after the changes or cancellation become known to District X.

II Technical Services responsibilities:

1 Technical Services will respond in kind (e.g., if an IOC is from individual A, the responding IOC will be to individual A; etc). Technical Services will provide copies for each individual in District X listed as being copied on the request. An e-mail message will be responded to via an e-mail. Turning movement plates in this case will be faxed.
2 Technical Services will respond to requests received directly from consultants.

However, in the response, Technical Services will instruct the consultant to make future requests through the District X Office.

3 Technical Services' goal is to meet District X's time requirements 100 percent of the time. Technical Services will notify District X immediately upon receipt of a request of any known problems which will impact Tech Services ability to respond within 60 days or the "need by" date. If problems arise later in the process, Technical Services will advise District X immediately.

4 If turning movements are requested, Technical Services will provide clearly labeled schematic diagrams of turning movements. Turning movement plates will be clearly identified with the County-Route-Log or other project identifier and the PID number. Roadways will be identified. The legend will indicate the time periods of the depicted data. Revisions or addendums to previously provided plates will be labeled as such. Legible hand-drawn schematics may be provided to meet deadlines if necessary, but CADD-generated diagrams will follow as soon as possible unless deemed unnecessary by District

page 1 of 2

X. Turning movements will be provided for the ADT only unless specified otherwise. Turning movements for complex projects with multiple alternatives will only be provided for the design year.

These requirements are current as of January 22, 1999. They may be modified in the future as agreed by both offices.

District X   Technical Services

Date: _______________   Date:_______________

page 2 of 2

2) Certified Traffic Request Form

Form version: **April 2007**.
Please check for and use latest version from:
http://www.dot.state.oh.us/urban

Reset Form | Print Form | Submit by Email

Ohio Department of Transportation

Office of Technical Services - ***Modeling & Forecasting Section***

Certified Traffic Request Form

1980 West Broad Street, 2nd Floor, Columbus, OH 43223 Phone: (614) 466-7825 Fax (614) 752-8646 www.dot.state.oh.us/urban

Use this form to submit a request for Certified Traffic volumes for a future year. Please provide all the information. You may either submit this request electronically using the "Submit by Email" button or by printing and mailing/faxing it to the attention of Project Analyses Administrator at the Office of Technical Services.

REQUESTOR:

Name ______ Organization ______

Address ______

Phone ______ Fax ______ Email ______

REQUEST:

Type: ○ New

○ Revision/Update

Reason(s)
- ○ Change in future year(s) of interest
- ○ Change in design alternative/alignment
- ○ Change in project boundaries
- ○ Other change(s) - specify below

Date of original request ______

Project Details:

PID ______ District ______ County. ______ Route ______

Log Point ______ Project Type ______

Project Description ______

Project Boundaries & Any Other Relavent Project Information ______

NOTE: Please include a street-network map of the study area. For all future scenarios, drawing(s) of every alternative for which certified traffic is sought, is required.

Page 1 of 2

Figure A-1: Certified Traffic Request Form – Page 1.

Project Opening Year | | Project Design Year |

Select Required Design Designations

○ TD ○ T24 ○ K & D Factors

○ 8th highest hour factor

○ Turning movement volumes

○ AM Peak ○ PM Peak ○ ADT

Identify Study Intersection(s)

Bridges Requiring Separate Design Designations (if any)

Committed and/or Planned Development in vicinity (if any)

Special Conditions (if any)

SCHEDULE:

Technical Services' goal is to meet time requirement 100 percent of the time. The District Office will be contacted to determine priority amongst pending requests for multiple projects from the same District. Technical Services will notify you immediately of any known problems which will impact the ability to respond within 45 working days of receipt of a request.

Date when data is needed

Reset Form | Print Form | Submit by Email

DO NOT WRITE BELOW - FOR INTERNAL USE ONLY

Date request received | State Job No. | Analyst assigned

Request logged in tracker on and by | Forecast source

Notes

Date of completion | Checked & Sent on

Page 2 of 2

Figure A-2: Certified Traffic Request Form – Page 2.

3) Tracker Database

Field Name	Data Type	Description
PID	Text	50 Project Identification
District	Number	I*8 District Which contains project
County	Text	C 50 3 Letter Abbr. for county
Route	Text	C 50 Route(s)
Log	Text	C 50 Mileage Log, Linear reference
Description	Text	C 80 Project description
Date_Recd	Date/Time	Date the request was recieved
Date_data	Date/Time	Date all needed data made available
Date_Due	Date/Time	Date Certification due
Analyst	Text	C 50 Name or initials of analyst
Date_Done	Date/Time	Date Certification Transmitted
Proj_Type	Text	C 50 Type of project (resurfacing, reconstruction, new construction, add lanes, impact study, other)
Redone	Number	I*8 Flag project as a redo (Number of times redone)
Redo_Reason	Text	C 50 Code and/or text explaining why project was redone
SJN	Text	C 50 State Job Number
Status_Code	Text	C 50 R=Rescinded Request,other codes not yet defined
Origin	Text	C 10 Who did the forecast Consultant, District, ODOT OTS
HotLink	Text	C80 Path and File name Hot Link

Figure A-3: Description of Fields in the Tracker Database.

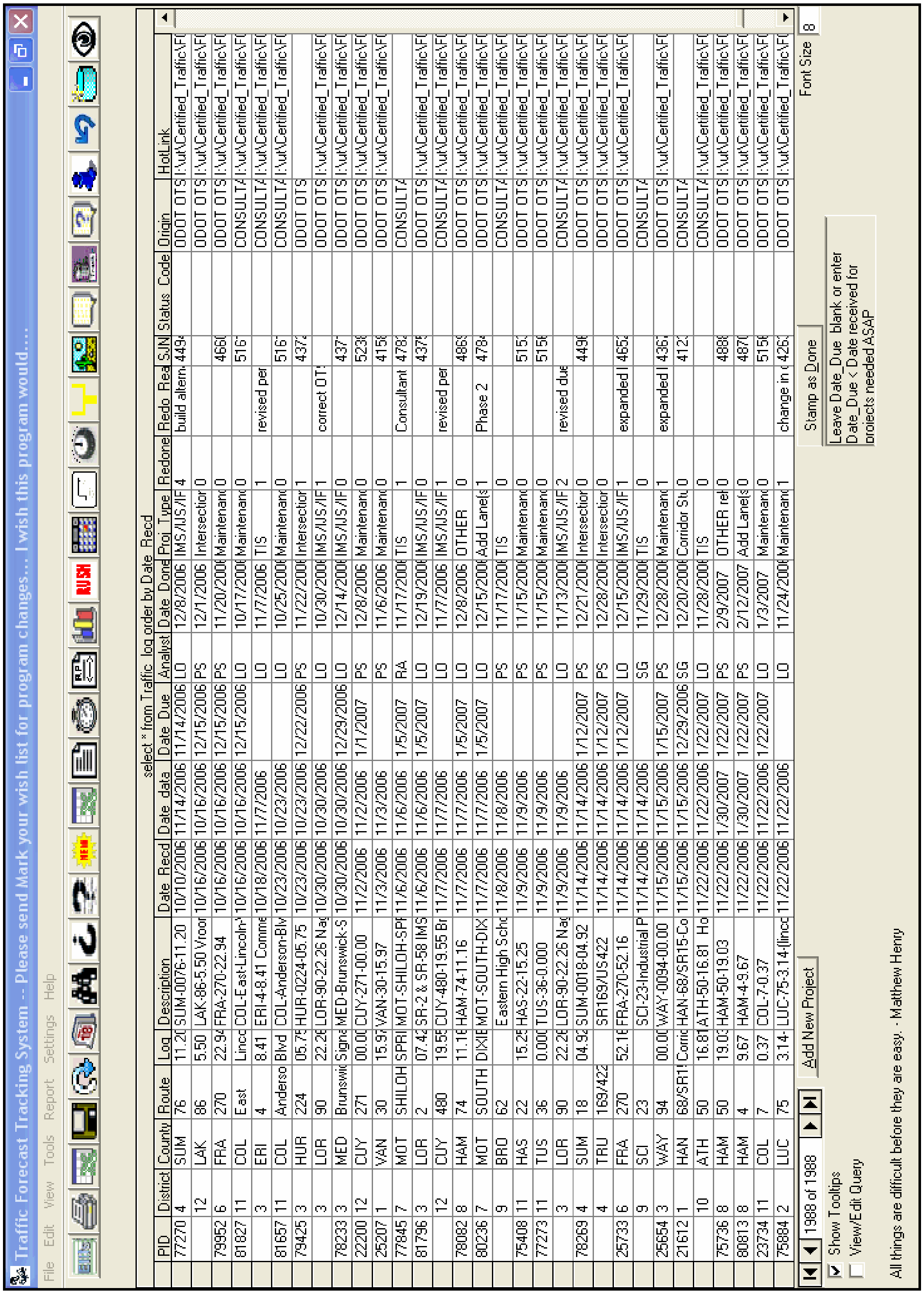


Figure A-4: Screenshot View of the Tracker Database.

Appendix B

Traffic Monitoring Data

Overview:

The most recent and up-to-date traffic data is available at the ODOT-OTS-Traffic Monitoring department website:
http://www.dot.state.oh.us/techservsite/offceorg/traffmonit/TMReports/

Sample Datasets:

1) Hourly Percentage by Vehicle Type
2) K and D Factors
3) Traffic Survey Reports
4) Traffic Survey Flow Maps
5) Manual Count Data
6) Short Term AADT Data
7) Functional Classes
8) Counties in Ohio

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

1) Hourly Percentage by Vehicle Type

Rural Interstate

Sample= 30 Counts

Sample of Permanent ATR's and Portable Counts Taken in 2005

Hour	Hour of Day	FC	P& A (Cars)	% P&A (Cars)	B&C (Trucks)	% B&C (Trucks)	Total	% Total
0	Mid-1A	1	21005	1.1%	26340	2.7%	47345	1.6%
1	1A-2A	1	15505	0.8%	23276	2.4%	38781	1.3%
2	2A-3A	1	14945	0.8%	22636	2.3%	37581	1.3%
3	3A	1	15621	0.8%	23770	2.4%	39391	1.3%
4	4A	1	21090	1.1%	26644	2.7%	47734	1.6%
5	5A	1	43468	2.2%	31327	3.2%	74795	2.5%
6	6A	1	83707	4.2%	35094	3.6%	118801	4.0%
7	7A	1	119555	6.0%	38973	3.9%	158528	5.3%
8	8A	1	112579	5.7%	44068	4.5%	156647	5.3%
9	9A	1	105651	5.7%	49164	5.0%	154815	5.2%
10	10A	1	105555	5.3%	51551	5.2%	157106	5.3%
11	11A-Noon	1	105381	5.3%	53869	5.5%	159250	5.4%
12	Noon	1	107943	5.4%	54562	5.5%	162505	5.5%
13	1P-2P	1	114309	5.8%	55004	5.6%	169313	5.7%
14	2P-3P	1	129476	6.5%	55134	5.6%	184610	6.2%
15	3P	1	147806	7.4%	54784	5.5%	202590	6.8%
16	4P	1	159482	8.0%	52320	5.3%	211802	7.1%
17	5P	1	153028	7.7%	49406	5.0%	202434	6.8%
18	6P	1	112966	5.7%	46978	4.8%	159944	5.4%
19	7P	1	86489	4.4%	43570	4.4%	130059	4.4%
20	8P	1	71408	3.6%	41798	4.2%	113206	3.8%
21	9P	1	61139	3.1%	39259	4.0%	100398	3.4%
22	10P-11P	1	46497	2.3%	36213	3.7%	82710	2.8%
23	11P-Mid	1	33058	1.7%	31845	3.2%	64903	2.2%
			1987663	100%	987585	100%	2975248	100%

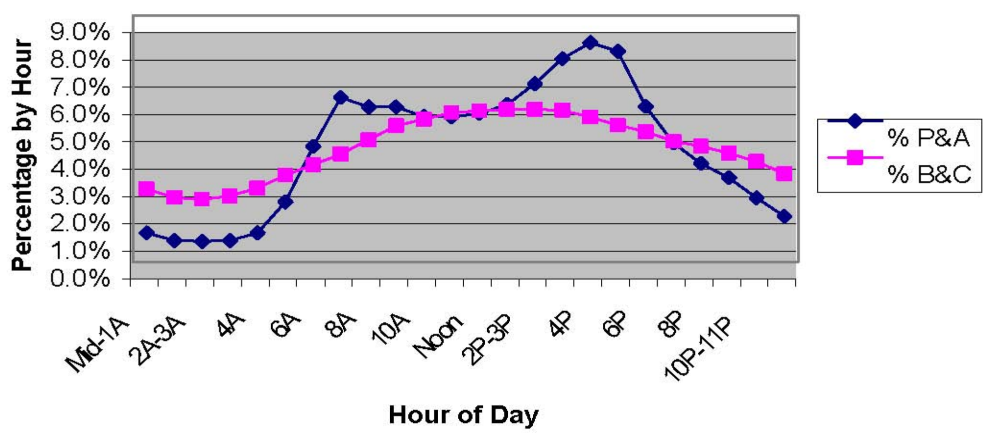


Figure B-1: Example of Hourly Percentages by Vehicle Types Obtained from Permanent ATR's & Manual Counts.

2) K & D Factors Report

K & D Factors Report Page 1 of 1

K & D Factors Report

The ReadMe:

This report is listing of K and D factors derived from all of Ohio's Automatic Traffic Recorders (ATR) sorted by functional classification. These factors play an important role in highway design analysis. A definition for each of the factors is provided below.

K-Factor: expressed as a percent, it is the proportion of daily traffic occurring during the design hour. Values in this report represent the 30th highest hour of the year.

D-Factor: expressed as a percent, it is the proportion of traffic moving in the peak direction during the design hour.

Report Description

Report Item	Description
FN CL	Functional Classification
STA	ATR Station Number
YEAR	Year of Data
ADT	Average Daily Traffic
30 HR VOL	30th Highest Hour Volume
HR	Hour of Day the 30th Highest Hour Volume Occurred
K	K Factor
D	D Factor

2005 K and D Factors Report Report updated 04/01/06 (pdf format)

Questions should be directed to Traffic Monitoring Section Manager, Dave Gardner

http://www.dot.state.oh.us/techservsite/availpro/Traffic_Survey/K&D_Factors/k&d_factors.htm

Figure B-2: Definitions and Description of Data Included in the K & D Factors Report.

K and D Factors by Functional Classification for the 30th Highest Hour

FN CL	STA	CO-RT-LG	YEAR	ADT	30 HR VOL	HR	PEAK DIR (D)	K
14	760	SUM-18R-0.50	2005	24520	2350	18	57.4%	9.584%
14	764	TRU-82R-19.00	2001	35470	3550	17	58.9%	10.008%
14	764	TRU-82R-19.00	2002	37180	3700	16	57.0%	9.952%
14	764	TRU-82R-19.00	2003	38480	3810	17	59.1%	9.901%
14	764	TRU-82R-19.00	2004	37870	3770	16	58.6%	9.955%
14	764	TRU-82R-19.00	2005	36860	3580	16	59.2%	9.712%
14	765	POR-43R-24.39	2001	9430	790	17	57.0%	8.378%
14	765	POR-43R-24.39	2002	10140	1110	11	73.9%	10.947%
14	765	POR-43R-24.39	2003	11740	1190	19	58.8%	10.136%
14	765	POR-43R-24.39	2004	11070	990	17	53.5%	8.943%
14	768	HIG-62R-16.21	2004	10760	1050	17	51.4%	9.758%
14	768	HIG-62R-16.21	2005	10420	1030	16	57.3%	9.885%
16	106	MOT-210C-1.00	1992	22680	2320	13	59.1%	10.229%
16	106	MOT-210C-1.00	1993	22790	2640	17	58.7%	11.584%
16	106	MOT-210C-1.00	1994	22720	2660	18	65.4%	11.708%
16	106	MOT-210C-1.00	1995	21680	2350	18	51.9%	10.839%
16	106	MOT-210C-1.00	1996	20930	2510	18	55.8%	11.992%
16	106	MOT-210C-1.00	1997	20330	2260	17	51.0%	11.117%
16	134	BEL-40R-27.20	1992	16010	1570	13	52.2%	9.806%
16	134	BEL-40R-27.20	1993	15790	1530	12	54.9%	9.690%
16	134	BEL-40R-27.20	1994	15890	1530	16	51.6%	9.629%
16	134	BEL-40R-27.20	1995	15610	1510	16	51.0%	9.673%
16	134	BEL-40R-27.20	1996	15040	1540	17	51.3%	10.239%
16	134	BEL-40R-27.20	1997	14730	1450	16	51.0%	9.844%
16	134	BEL-40R-27.20	1998	18080	1450	12	51.7%	8.020%
16	134	BEL-40R-27.20	1999	18160	1350	14	50.4%	7.434%
16	134	BEL-40R-27.20	2000	13650	1300	17	53.1%	9.524%
16	134	BEL-40R-27.20	2001	13680	1310	14	50.4%	9.576%
16	134	BEL-40R-27.20	2002	13320	1270	17	54.3%	9.535%

Page 50

Figure B-3: Example Data from the K & D Factors Report.

3) Traffic Survey Flow Maps

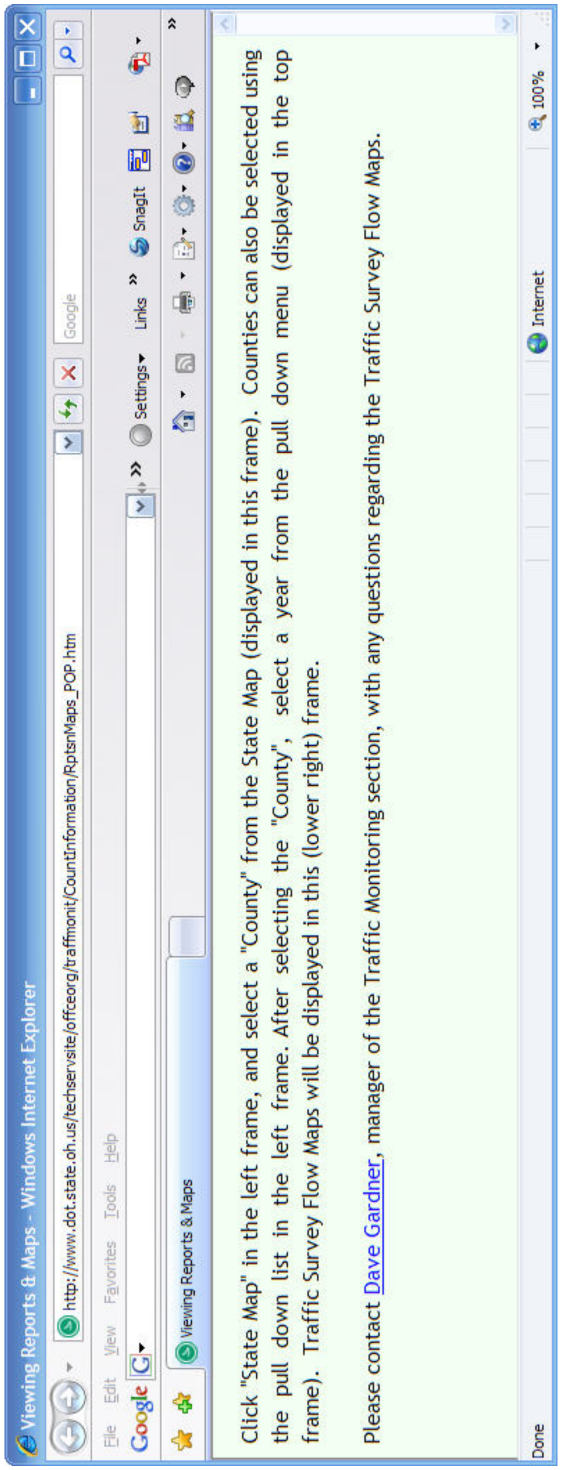


Figure B-4: Instructions for Use of Traffic Survey Flow Maps – from ODOT Traffic Monitoring Website.

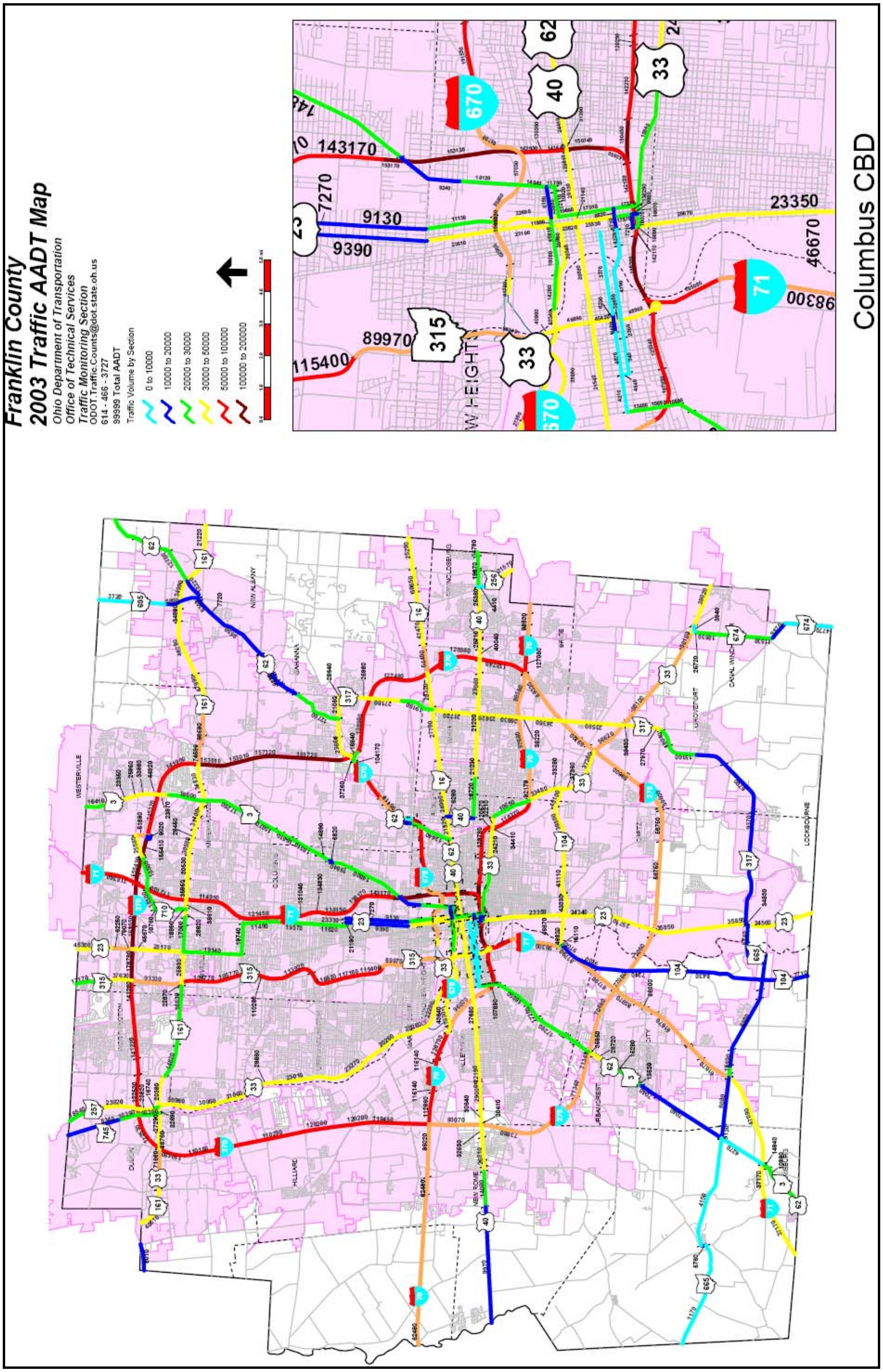
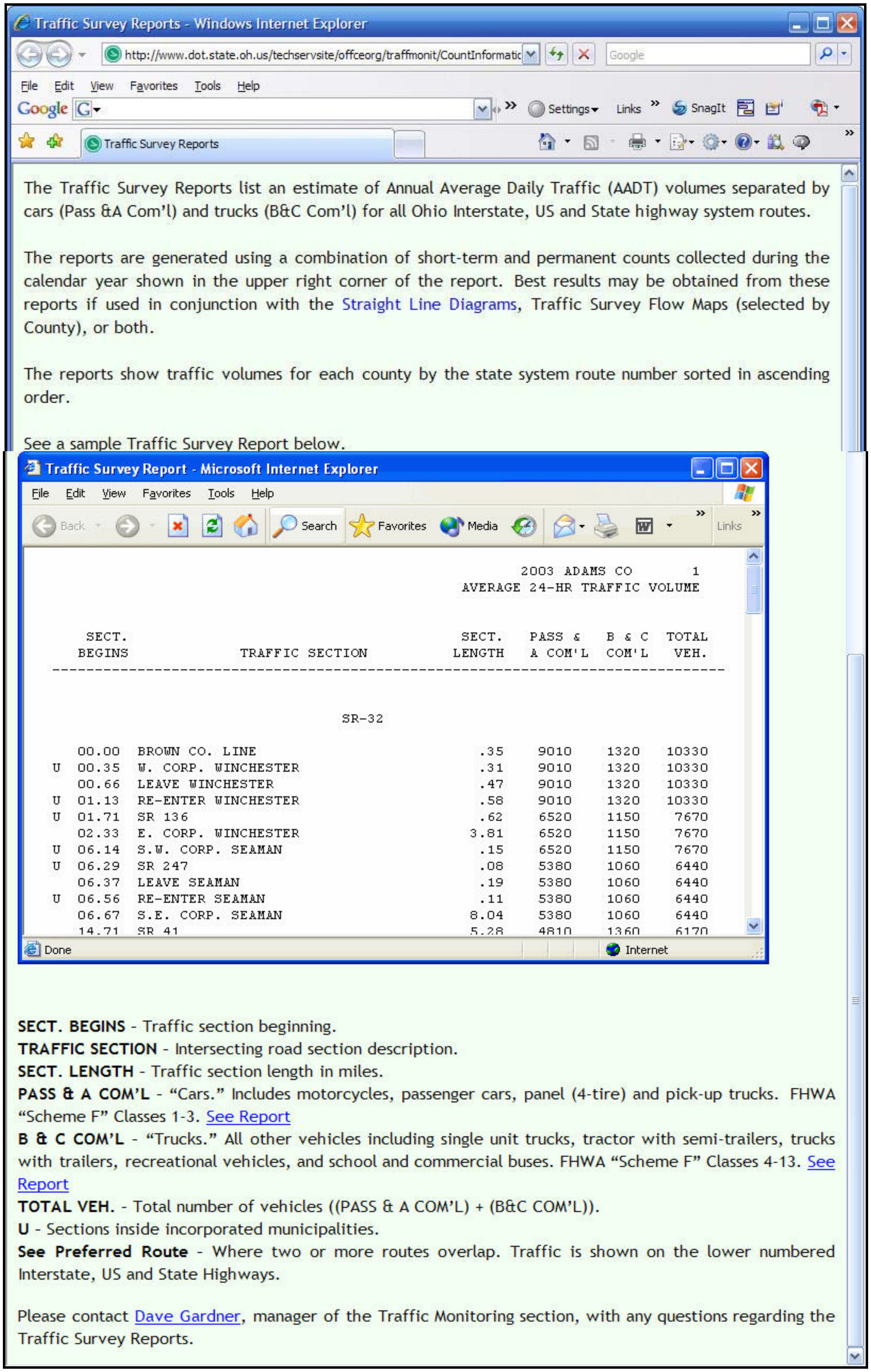


Figure B-5: Example of a Traffic Survey Flow Map.

4) Traffic Survey Reports



Traffic Survey Reports - Windows Internet Explorer

The Traffic Survey Reports list an estimate of Annual Average Daily Traffic (AADT) volumes separated by cars (Pass &A Com'l) and trucks (B&C Com'l) for all Ohio Interstate, US and State highway system routes.

The reports are generated using a combination of short-term and permanent counts collected during the calendar year shown in the upper right corner of the report. Best results may be obtained from these reports if used in conjunction with the Straight Line Diagrams, Traffic Survey Flow Maps (selected by County), or both.

The reports show traffic volumes for each county by the state system route number sorted in ascending order.

See a sample Traffic Survey Report below.

Traffic Survey Report - Microsoft Internet Explorer

2003 ADAMS CO 1
AVERAGE 24-HR TRAFFIC VOLUME

	SECT. BEGINS	TRAFFIC SECTION	SECT. LENGTH	PASS & A COM'L	B & C COM'L	TOTAL VEH.
		SR-32				
	00.00	BROWN CO. LINE	.35	9010	1320	10330
U	00.35	W. CORP. WINCHESTER	.31	9010	1320	10330
	00.66	LEAVE WINCHESTER	.47	9010	1320	10330
U	01.13	RE-ENTER WINCHESTER	.58	9010	1320	10330
U	01.71	SR 136	.62	6520	1150	7670
	02.33	E. CORP. WINCHESTER	3.81	6520	1150	7670
U	06.14	S.W. CORP. SEAMAN	.15	6520	1150	7670
U	06.29	SR 247	.08	5380	1060	6440
	06.37	LEAVE SEAMAN	.19	5380	1060	6440
U	06.56	RE-ENTER SEAMAN	.11	5380	1060	6440
	06.67	S.E. CORP. SEAMAN	8.04	5380	1060	6440
	14.71	SR 41	5.28	4810	1360	6170

SECT. BEGINS - Traffic section beginning.
TRAFFIC SECTION - Intersecting road section description.
SECT. LENGTH - Traffic section length in miles.
PASS & A COM'L - "Cars." Includes motorcycles, passenger cars, panel (4-tire) and pick-up trucks. FHWA "Scheme F" Classes 1-3. See Report
B & C COM'L - "Trucks." All other vehicles including single unit trucks, tractor with semi-trailers, trucks with trailers, recreational vehicles, and school and commercial buses. FHWA "Scheme F" Classes 4-13. See Report
TOTAL VEH. - Total number of vehicles ((PASS & A COM'L) + (B&C COM'L)).
U - Sections inside incorporated municipalities.
See Preferred Route - Where two or more routes overlap. Traffic is shown on the lower numbered Interstate, US and State Highways.

Please contact Dave Gardner, manager of the Traffic Monitoring section, with any questions regarding the Traffic Survey Reports.

Figure B-6: Description of the Traffic Survey Reports – from ODOT Traffic Monitoring Website.

5) Manual Count Data

OHIO DEPARTMENT OF TRANSPORTATION - DIVISION OF MULTI-MODEL PLANNING & PROGRAMS - OFFICE OF TECHNICAL SERVICES

INTERSECTION TRAFFIC COUNT SHOWING TURNING MOVEMENTS

Co.	Station No.	Route	Log	Location	City/Town	FC	Count No.	Year
FRA	26225	161	15.25	SR161 & BUENOS AIRES RD.	IN COLUMBUS	14	A	2005

Recorder	Hour	Period	Day	Date	Weather	Road Condition
T. RENICKER	7:00AM	11:00AM	MON	07/18/05	UNKNOWN	
T. RENICKER	2:00 PM	6:00PM	MON	07/18/05	UNKNOWN	

Leg Names: N-BUENOS AIRES RD______________________ Counter No. __NA__________

S-BUENOS AIRES RD ______________________ Expansion Factor:P&A_1.95______

E-SR161___________________________________ Expansion Factor: B&C_1.71______

W-SR161___________________________________ Seasonal Factor: _0.94_____

Combined P & A/Seasonal Factor: _1.83____

*Note - Expansion factor used - #11725 2003yr

Figure B-7: Example of Intersection Traffic Count Showing Turning Movements.

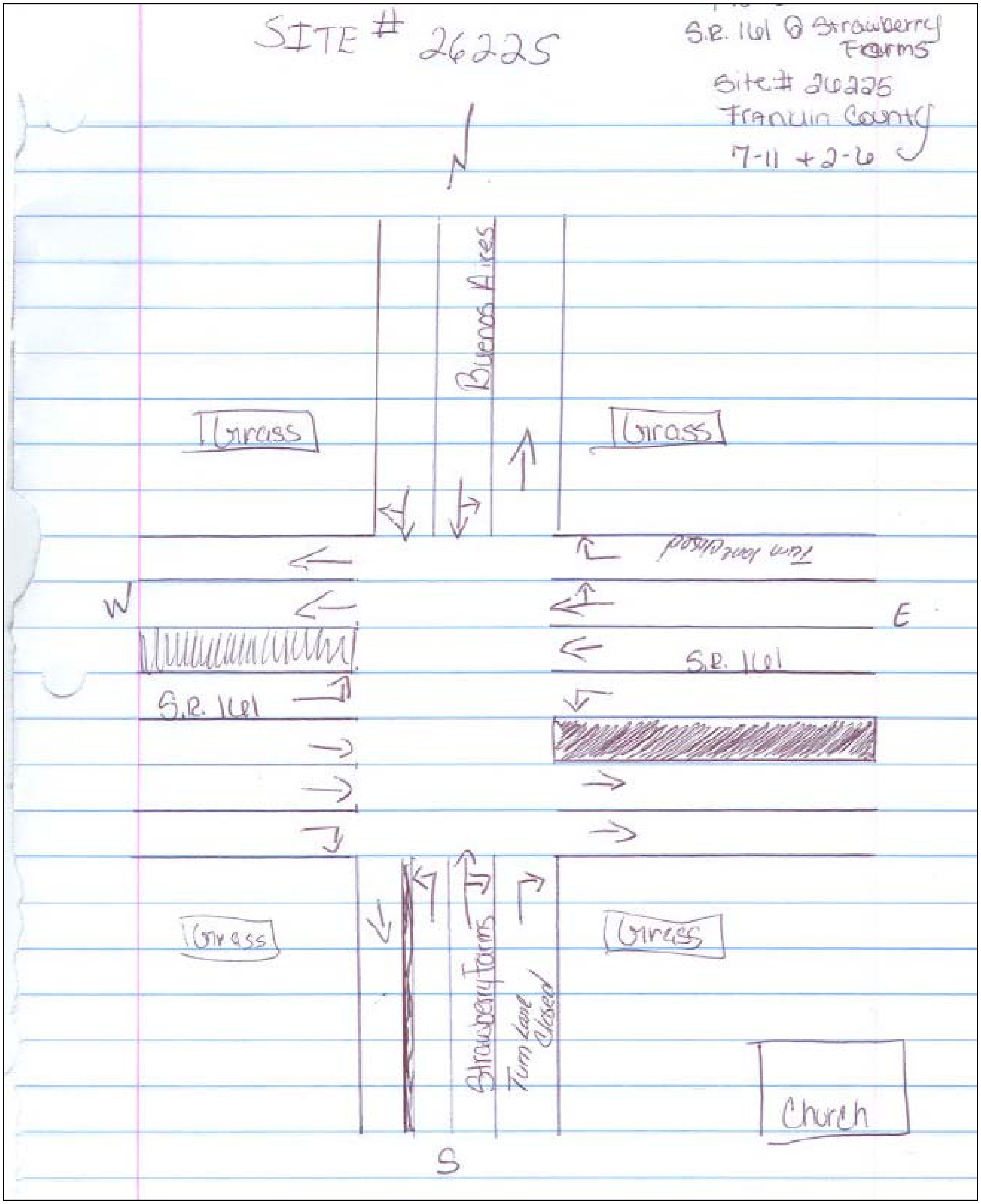


Figure B-8: Intersection Details Noted during a Manual Turning Movement count.

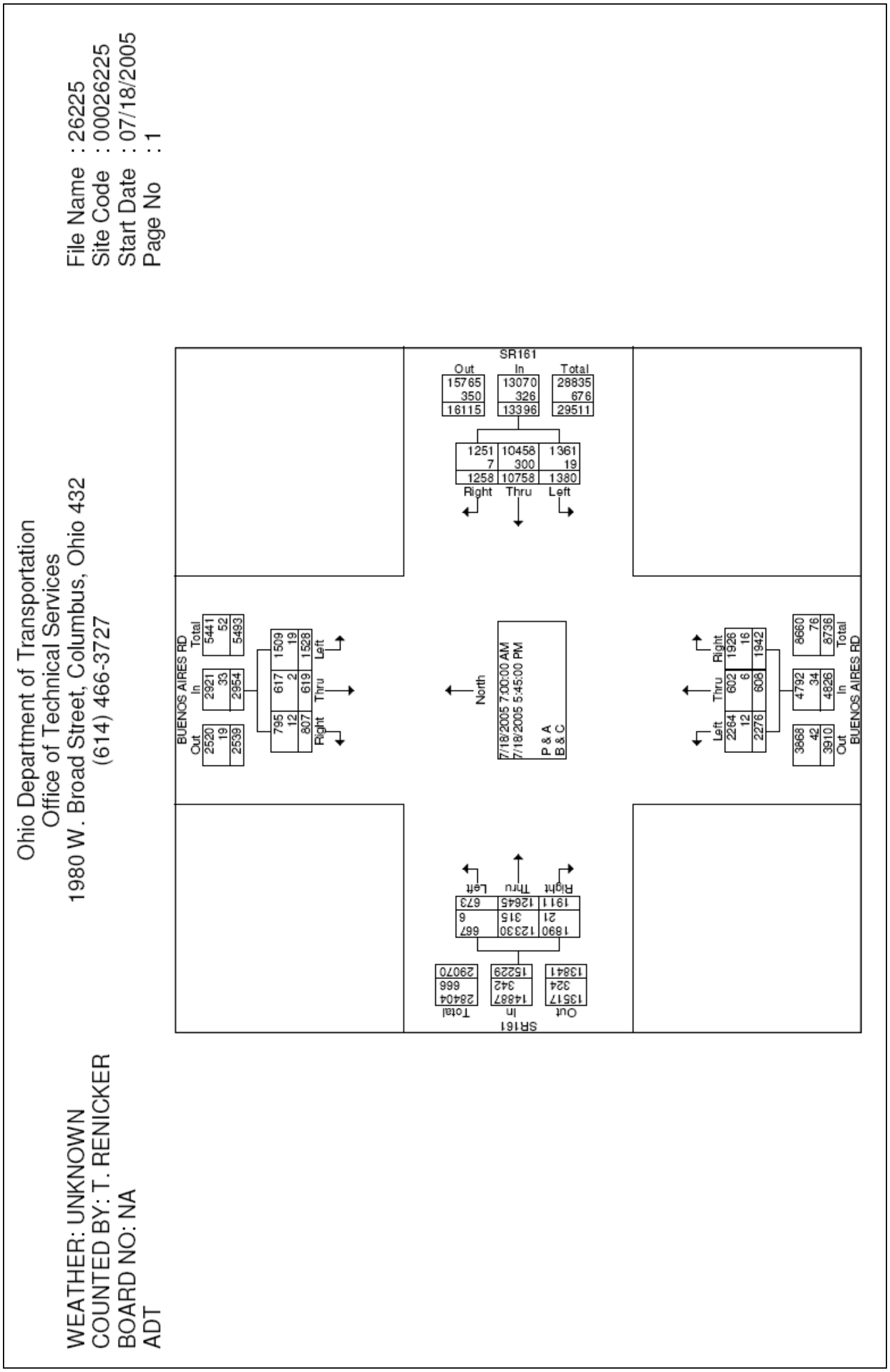


Figure B-9: Example of Summarized Turning Movements Counts.

Ohio Department of Transportation
Office of Technical Services
1980 W. Broad Street, Columbus, Ohio 432
(614) 466-3727

WEATHER: UNKNOWN
COUNTED BY: T. RENICKER
BOARD NO: NA
RAW DATA

File Name : 26225
Site Code : 00026225
Start Date : 07/18/2005
Page No : 1

Groups Printed- P & A

	BUENOS AIRES RD From North				SR161 From East				BUENOS AIRES RD From South				SR161 From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Factor	1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		
07:00 AM	16	2	48	66	12	145	10	167	65	8	40	113	14	165	0	179	525
07:15 AM	14	6	63	83	13	163	8	184	60	5	31	96	21	200	1	222	585
07:30 AM	13	8	54	75	4	221	11	236	65	4	53	122	22	284	5	311	744
07:45 AM	28	8	43	79	7	221	13	241	56	5	43	104	20	241	0	261	685
Total	71	24	208	303	36	750	42	828	246	22	167	435	77	890	6	973	2539
08:00 AM	10	10	40	60	8	189	16	213	54	10	26	90	17	211	6	234	597
08:15 AM	13	2	40	55	11	183	14	208	55	8	34	97	21	206	5	232	592
08:30 AM	16	6	34	56	7	180	12	199	57	4	33	94	14	189	0	203	552
08:45 AM	15	4	28	47	8	195	8	211	37	9	24	70	21	155	11	187	515
Total	54	22	142	218	34	747	50	831	203	31	117	351	73	761	22	856	2256
09:00 AM	12	0	20	32	14	150	14	178	41	8	26	75	12	125	5	142	427
09:15 AM	7	2	15	24	13	130	11	154	34	4	21	59	18	114	6	138	375
09:30 AM	11	10	20	41	14	121	18	153	41	2	33	76	21	137	3	161	431
09:45 AM	5	3	11	19	12	130	17	159	27	4	23	54	21	136	4	161	393
Total	35	15	66	116	53	531	60	644	143	18	103	264	72	512	18	602	1626
10:00 AM	14	7	8	29	8	108	10	126	19	4	34	57	16	144	5	165	377
10:15 AM	10	7	13	30	4	98	16	118	30	6	25	61	23	110	7	140	349
10:30 AM	9	6	6	21	12	136	9	157	18	6	28	52	15	143	14	172	402
10:45 AM	12	5	15	32	9	130	14	153	22	5	26	53	35	151	7	193	431
Total	45	25	42	112	33	472	49	554	89	21	113	223	89	548	33	670	1559
BREAK																	
02:00 PM	13	10	18	41	24	134	17	175	27	11	39	77	40	173	12	225	518
02:15 PM	11	10	21	42	11	139	25	175	22	10	39	71	37	179	16	232	520
02:30 PM	13	11	15	39	22	137	24	183	17	11	30	58	36	178	17	231	511
02:45 PM	10	10	29	49	33	136	24	193	28	12	38	78	30	167	13	210	530
Total	47	41	83	171	90	546	90	726	94	44	146	284	143	697	58	898	2079
03:00 PM	19	7	17	43	16	147	23	186	14	9	40	63	37	220	8	265	557
03:15 PM	16	14	22	52	26	154	23	203	17	18	30	65	35	196	15	246	566
03:30 PM	16	13	15	44	21	196	37	254	25	14	43	82	35	228	13	276	656
03:45 PM	12	13	15	40	28	184	40	252	20	12	45	77	41	221	18	280	649
Total	63	47	69	179	91	681	123	895	76	53	158	287	148	865	54	1067	2428

Ohio Department of Transportation
Office of Technical Services
1980 W. Broad Street, Columbus, Ohio 432
(614) 466-3727

WEATHER: UNKNOWN
COUNTED BY: T. RENICKER
BOARD NO: NA
RAW DATA

File Name : 26225
Site Code : 00026225
Start Date : 07/18/2005
Page No : 2

Groups Printed- P & A

	BUENOS AIRES RD From North				SR161 From East				BUENOS AIRES RD From South				SR161 From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Factor	1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		
04:00 PM	8	15	18	41	23	207	37	267	15	10	56	81	36	264	20	320	709
04:15 PM	13	15	25	53	29	206	48	283	21	17	47	85	39	262	16	317	738
04:30 PM	18	18	27	63	42	243	36	321	23	21	44	88	50	317	25	392	864
04:45 PM	15	18	21	54	61	279	36	376	24	17	49	90	53	317	21	391	911
Total	54	66	91	211	155	935	157	1247	83	65	196	344	178	1160	82	1420	3222
05:00 PM	15	26	29	70	35	273	44	352	35	21	54	110	62	372	24	458	990
05:15 PM	13	32	30	75	52	261	42	355	26	21	54	101	69	318	16	403	934
05:30 PM	18	15	34	67	44	264	45	353	24	20	72	116	59	336	29	424	960
05:45 PM	20	24	32	76	60	254	41	355	34	15	57	106	64	277	23	364	901
Total	66	97	125	288	191	1052	172	1415	119	77	237	433	254	1303	92	1649	3785
Grand Total	435	337	826	1598	683	5714	743	7140	1053	331	1237	2621	1034	6736	365	8135	19494
Apprch %	27.2	21.1	51.7		9.6	80.0	10.4		40.2	12.6	47.2		12.7	82.8	4.5		
Total %	2.2	1.7	4.2	8.2	3.5	29.3	3.8	36.6	5.4	1.7	6.3	13.4	5.3	34.6	1.9	41.7	

Figure B-10: Detailed Turning Movements Counts by 15-Minute Intervals.

6) Short Term AADT Data

The Short Term Count AADT Data includes site specific AADT count data collected by ODOT field staff. It is used to generate the official AADT estimate for the Traffic Survey Report. The data is for each of ODOT's 88 counties and is updated monthly in an Excel spreadsheet. A description of the spreadsheet can be found below.

Please contact Dave Gardner, manager of the Traffic Monitoring section, with any questions regarding Short Term Count AADT data.

Short Term Count AADT File Description	
CO	County
ROUTE	Route
LOG_BEG	Log Point or Mile Point
STA	Count Station Number
LOCATION	Count Location Description
CITY_TOWN	Count Location City/Town
TYPE_CNT	Count Type - C (48 hour vehicle volume), D (48 hour vehicle classification), E (24 hour vehicle volume), F (24 hour vehicle classification)
COMMENTS	Comments
START_YR	Start Year
START_MONTH	Start Month
START_DATA	Start Date
TOT_PA_ADT	Total Car ADT
TOT_BC_ADT	Total Truck ADT
TOT_ADT	Total Combined ADT
PREV_YR1	Previous Count Start Year 1
PREV_PA_ADT1	Previous Count Total Car ADT 1
PREV_BC_ADT1	Previous Count Total Truck ADT 1
PREV_TOT_ADT1	Previous Count Combined Total ADT 1
PREV_YR2	Previous Count Start Year 2
PREV_PA_ADT2	Previous Count Total Car ADT 2
PREV_BC_ADT2	Previous Count Total Truck ADT 2
PREV_TOT_ADT2	Previous Count Combined Total ADT 2
PREV_YR3	Previous Count Start Year 3
PREV_PA_ADT3	Previous Count Total Car ADT 3
PREV_BC_ADT3	Previous Count Total Truck ADT 3
PREV_TOT_ADT3	Previous Count Combined Total ADT 3
DISTRICT	ODOT District Number
NLFID	Used by GIS software to identify GIS strings

Figure B-11: Description of Data Included in a Short Term AADT Report.

7) Functional Classes

Type	Functional Class (FC)	FC Description
Rural	1	Interstate
	2	Principal Arterial
	6	Minor Arterial
	7	Major Collector
	8	Minor Collector
	9	Local
Urban	11	Interstate
	12	Freeway
	14	Principal Arterial
	16	Minor Arterial
	17	Collector
	19	Local

Figure B-12: Functional Classes for the Roadway System in Ohio.

8) Counties in Ohio

	County			County			County
1	Adams		36	Highland		71	Ross
2	Allen		37	Hocking		72	Sandusky
3	Ashland		38	Holmes		73	Scioto
4	Ashtabula		39	Huron		74	Seneca
5	Athens		40	Jackson		75	Shelby
6	Auglaize		41	Jefferson		76	Stark
7	Belmont		42	Knox		77	Summit
8	Brown		43	Lake		78	Trumbull
9	Butler		44	Lawrence		79	Tuscarawas
10	Carroll		45	Licking		80	Union
11	Champaign		46	Logan		81	Van Wert
12	Clark		47	Lorain		82	Vinton
13	Clermont		48	Lucas		83	Warren
14	Clinton		49	Madison		84	Washington
15	Columbiana		50	Mahoning		85	Wayne
16	Coshocton		51	Marion		86	Williams
17	Crawford		52	Medina		87	Wood
18	Cuyahoga		53	Meigs		88	Wyandot
19	Darke		54	Mercer			
20	Defiance		55	Miami			
21	Delaware		56	Monroe			
22	Erie		57	Montgomery			
23	Fairfield		58	Morgan			
24	Fayette		59	Morrow			
25	Franklin		60	Muskingum			
26	Fulton		61	Noble			
27	Gallia		62	Ottawa			
28	Geauga		63	Paulding			
29	Greene		64	Perry			
30	Guernsey		65	Pickaway			
31	Hamilton		66	Pike			
32	Hancock		67	Portage			
33	Hardin		68	Preble			
34	Harrison		69	Putnam			
35	Henry		70	Richland			

Figure B-13: List of Counties in Ohio.

Appendix C

Guidelines for Planning Level Traffic and the Use of Models for Project Traffic Forecasting

Guidelines for Planning Level Traffic and the Use of Models for Project Traffic Forecasting

Ohio Department of Transportation
Division of Planning
Office of Technical Services
Modeling and Forecasting Section

November 2006

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Introduction

Project level traffic forecasts involve volumes on specific roadway segments or for specific turning movements and related parameters such as K, D, T24 etc. These forecasts are often distinguished as either “Planning Level Traffic” or “Design Traffic”. The distinction relates to the level of manual effort used to evaluate and process the forecasts that result from automated procedures and statistical analysis. The implication of this distinction is that each is intended for a different level of project analysis. These guidelines seek to clarify this distinction to ensure users of traffic forecasts use them appropriately.

In addition, models are often used to aid in the production of these forecasts. Note that “aid in the production” implies that the model volumes are not used directly as project level forecasts; rather they are input to a subsequent process for producing final forecast numbers (see the section on volume reporting). Models, as defined here, generally refers to travel demand forecasting (TDF) models, usually using the four step paradigm of Trip Generation, Trip Distribution, Mode Choice and Traffic Assignment. Models can also refer to more modern related techniques such as activity based or tour based models. In addition, more recent techniques that allow TDF model results to tie to operational level models such as VISSIM, CORSIM, Synchro etc. are also addressed. Currently, each of the 17 Metropolitan Planning Organizations (MPO) in Ohio has a TDF model. In addition, ODOT maintains a statewide model.

These TDF models were designed for system-wide planning analysis and are not necessarily accurate enough at any given location for production of segment specific volumes, let alone turn volumes, direction factors etc. When used carefully, these models are an invaluable source of information for creation of project forecasts. When not used carefully they can produce incorrect or illogical results. The following guidelines seek to lay out the proper use of models for creation of project level traffic forecasts in an attempt to avoid potential problems with their use for this purpose. If followed carefully, these guidelines will help ensure that project level forecasts produced throughout the project development process are reasonably consistent with the final certified design traffic.

The following guidelines are divided into two major sections; the first deals with definitions and processes and is intended for both modelers and project managers who need to obtain traffic forecasts for their projects. The second contains detailed project level model usage guidelines for modelers.

I. DEFINITIONS & PROCESSES

A. Project Types

Before delving into specific guidelines on the use of models for project forecasting, the question must be answered: "What projects actually require/benefit from the use of models?" The ODOT Project Development Process (PDP) defines 3 levels of projects, Minimal, Minor and Major. As detailed below, special modeling activity usually only occurs for PDP Major projects which are broken down further for the purposes of determining the level of traffic analysis/modeling necessary.

1. Minimal Projects

Minimal projects require no modeling whatsoever. If a project forecast is even necessary, the analyst will either use past count trends or at their discretion might consult results from an existing model (typically the "model of record" defined in the next section) to aid in the determination of growth rates. The model traffic volume itself is not used since the model results for the subject roadway are passed through no or minimal QA/QC.

2. Minor Projects

Minor projects are typically treated the same way as minimal projects, i.e. they don't require any specific model work though the analyst may consult existing models (typically the "model of record" defined in the next section) to aid in the determination of growth rates. However, occasionally, projects with significant traffic impacts might be classified as minor because they don't involve environmental impacts. In these cases the project should be treated as major for traffic analysis purposes.

3. Major Projects

Section 106.0 of the PDP defines major projects which includes (among other things) any project with a "significant impact to the highway's public access, level of service, traffic flow, mobility patterns, or mode shares." Thus major projects will typically involve modeling activity to aid in the determination of its traffic forecasts since they are often the best method available for assessing changes to traffic flow and mobility patterns. Within this category, there are a wide range of potential projects, so it is helpful to break major projects down further into the following categories:

3a. Normal Major Projects

Normal major projects are those that DON'T involve any of the following:

- Major New Bridge
- New Interchange
- Removal/Addition of Connections for Certain Movements at an Interchange
- Any New Freeway
- One or More Miles of New Non-Freeway Road
- Increase of 50% or More to the Number of Through Lanes

Thus lane widening, addition of short segments of new arterial street, addition of turn lanes or auxiliary lanes and minor realignments are all project activities that fall within the normal major category.

While models are used to derive traffic forecasts for normal major projects, the activities detailed in the sections that follow are somewhat simpler than for more complex projects.

<u>3b. Large Major Projects</u>

Large major projects do meet the criteria listed above. These projects are likely to significantly alter travel patterns and thereby benefit the most from the use of TDF models. Large major projects require more detailed model analysis as documented later.

<u>3c. Mega Projects</u>

There are no specific criteria for defining mega projects. These are simply projects whose construction costs are of such large magnitude that more detailed and refined traffic analysis is justified to aid the decision making process. They often involve large stretches of urban freeway or major new bridges. Different analysis processes are indicated for mega projects versus other types and these will generally be determined on a case by case basis.

B. Types of Traffic Forecasts

The various activities documented in these guidelines can produce increasingly refined traffic estimates. The amount of analysis conducted and at what stage in the PDP depends not only upon the magnitude of the project but also upon the level of the decisions that will be made. The users of traffic forecasts need to be cognizant of this fact and avoid using traffic forecasts produced early in the PDP process to make more refined decisions later without consulting with the analyst who produced the forecast. Conversely, those who provide forecasts must be diligent in specifying the limitations of the forecasts they have provided. Traffic forecasts generally fall within the following four categories:

1. Raw Model Output

Raw model output is just that. Model results that have not been subjected to any of the checking/adjusting/refining documented in these guidelines. Raw model results typically come from the “Model of Record”. The model of record is that model which served as the basis of the current MPO long range transportation plan. It actually consists of at least 3 model runs, the base year validated model run and the long range plan year build and no build (existing + committed) model runs. In most areas intermediate year model runs will also exist which are used for air quality conformity analysis. From the model of record, growth rates are often calculated by comparing the base year and a forecast year volume for use on minimal and minor projects. Even in this case, some reasonableness checking of the model at the project location will be made when making the decision on whether to use the model derived growth rate versus some other growth rate. Unless otherwise directed by Modeling and Forecasting Section (M&F) of the ODOT Office of Technical Services, raw model results should not be used for reporting actual location specific volumes.

2. Planning Level Traffic

Planning level traffic consists of traffic forecasts produced for use in the planning process (PDP Steps 1-4). It is also usually used during the analysis of conceptual alternatives (PDP Step 5) unless either of the subsequent categories is obtained for this purpose. Planning level traffic involves various checks and adjustments as documented in the second part of these guidelines. However, it has not necessarily been refined to produce reasonable values at all locations within the study area. If the checks/refinements/adjustments and volume reporting guidelines in this manual are followed, planning level traffic should be suitable for all decision making in the project planning process and the analysis of conceptual alternatives (unless refined alternative level traffic is deemed necessary or if more detailed design activities are moved forward as discussed in the next section). In addition, following these procedures will make it much more likely that design traffic and planning level traffic are consistent. However, it should always be remembered that planning level traffic is designed to answer questions on the order of magnitude of the addition of a general purpose travel lane in a certain location. If more detailed decisions such as location and length of turn lanes, auxiliary lanes, traffic control devices etc. are being made; refined alternative level or design traffic is required. Generally these types of decisions are deferred until certified design traffic is available in PDP Step 6, if not, the project manager should work with ODOT M&F to identify the appropriate analysis procedures.

3. Refined Alternative Level Traffic

Refined alternative level traffic only occurs in certain rare cases where additional model work beyond the TDF model has occurred for certain types of projects. This model work typically involves using matrix estimation techniques (other techniques are possible as well) to refine travel demand to more precisely match study area traffic counts so that the results are accurate enough for use in operational level models. Since this is extremely labor intensive, this level of traffic is generally only produced for mega projects or certain large major projects that involve highly complex traffic operations such as occurs with major changes in the central business district of a large urban area. Before attempting to produce refined alternative level traffic, all of the appropriate checking/adjusting/refining procedures documented herein should have been applied first. This traffic is suitable for making more detailed decisions on conceptual alternatives in PDP Step 5 (note, most projects will use Planning Level Traffic for the conceptual alternatives analysis).

4. Design Traffic

Design traffic consists of the final traffic forecasts and related information including turn volumes, direction factors, 30^{th} highest hour factors etc. needed to inform the final detailed design of a project. All of the checking/adjusting/refining documented herein (as appropriate for the project type) will have been conducted for the feasible alternatives to produce design traffic. Design traffic is said to be "certified" when the ODOT Office of Technical Services, Modeling & Forecasting Section indicates such. The production of certified design traffic forecasts is its own topic and will not be discussed further here.

C. Process for Obtaining TDF Model Traffic Forecasts

The overall process for obtaining model based traffic forecasts for projects is closely linked to the 14 Step PDP for major projects since generally, only major projects will require substantial model work. However, if the project manager envisions that a minor project will involve the types of traffic impacts normally associated with a major project, M&F staff should be consulted to determine the appropriate level of involvement.

1. PDP Step 2

It is during the development of the existing and future conditions that the model itself should be prepared for use in the project analysis, thus most of the checking/refining/adjusting process documented in these guidelines should occur at this step. A number of specific model related activities will occur at various sub-steps as follows:

1a. PDP sub-Step 201.1

The project manager should include a representative from the Modeling and Forecasting Section (M&F) of the Office of Technical Services (OTS) on the project team.

PRODUCT: M&F staff liaison identified

1b. PDP sub-Step 201.6

The M&F staff person will help coordinate responsibility for conduct of necessary modeling work and related traffic analysis. The general protocol that ODOT M&F will follow for non-Mega projects is:

1. Determine which if any model to use (see below).
2. If the MPO model is used, contact the MPO to conduct the model work unless a memorandum of understanding (MOU) exists between the MPO and ODOT that ODOT conducts all model work, in which case, the MPO will simply be notified that work is commencing and then provided the results of model work when completed.
3. If the MPO cannot conduct the model work within the agreed upon time frame (see below), ODOT M&F will conduct model work.
4. If ODOT is unable to conduct the work within the necessary time frame, either an existing consultant on call agreement will be used or negotiation with the project consultant (via the project manager) will occur to include appropriate scope language in the project contract.

Mega projects will typically be handled differently. Most mega projects will require sufficiently complex analysis that the modeling work will be conducted by the project consultant (or their sub-consultant). ODOT M&F will assist the project manager in scoping model work for these projects. Also, if the MPO model is to be used, their representative will typically be included in this discussion unless the aforementioned MOU exists.

PRODUCT: Memo (email) identifying responsibilities, data needs and time lines or scope language for consultant contract

1c. PDP sub-Steps 202.1 through 202.4

This is the appropriate place for most travel demand forecasting model activities detailed in these guidelines to occur. Forecasts produced at this stage are generally referred to as “Planning Level Traffic”.

PRODUCT: Project model technical documentation detailing results of model checks and a precise listing of model changes and their effects
PRODUCT: Revised model input and output files

1d. PDP sub-Step 202.5

The definition of study area is extremely important to various aspects of the modeling procedure documented here. Conversely, the model itself is an extremely useful tool for delineating potential project impact areas and thereby defining the study area. See section II-B for more information on defining study areas.

2. PDP Steps 3 – 5

It is the use of traffic forecasts during this stage of project development that causes the most confusion and thus deserves more elaboration. So long as the Major Project PDP process is being followed closely, planning level traffic can be used to satisfy the need for traffic projections up to and including Step 5 of the PDP. Traffic dependent activities that occur in Step 5, according to Section 1403.3 of the Location and Design (L&D) Manual, include the designation of 1000'-2000' corridors, interchange locations and development of typical sections. All of these activities easily fall within the scope of planning level traffic as defined in the previous section. A problem arises, however, when project managers take advantage of the provisions of L&D Section 1403.3.4 to move elements of PDP Step 6 into Step 5. In these instances, it may be necessary to obtain certified design traffic earlier. However, the following quote from this section of the L&D Manual should be remembered:

"For projects that involve ***a constrained study area or limited number of alternatives****, it is sometimes advantageous to complete detailed design work on the entire study area rather than phasing in these tasks over various review submissions."*

Generally only one or a very small number of alternatives will receive certified design traffic (PDP Step 5 indicates that only 2-3 alternatives should pass to Step 6). Multiple alternatives that vary in only minor ways from a base case can also sometimes be accommodated.

For some projects additional work to link TDF model results to operational models will occur. When such occurs, a "Conceptual Alternatives Model" is said to exist and the traffic resulting from such is termed "Refined Alternative Level Traffic" as defined in the previous section. Refined alternative level traffic can help bridge the gap between planning level traffic and design traffic for very large or complex projects. Due to its expense, however, the usual process is either to use planning level traffic or to obtain design traffic earlier than normal.

PRODUCT: Alternatives analysis reports showing volumes and/or measures of effectiveness (such as LOS or V/C ratio) by alternative.
PRODUCT: Alternative specific model inputs and outputs

3. PDP Step 6

It is at this stage that certified design traffic is obtained for the feasible alternatives.

PRODUCT: Certified design traffic

D. Selection of Model

As previously mentioned, Ohio has 17 MPO's, each with a TDF model and ODOT maintains a statewide TDF model. ODOT M&F in consultation with the relevant MPO will determine the proper model to use for a given project based on the following criteria:

- If the project and its impacts lie entirely within an MPO model area, the MPO model will be used, unless specific information that can only be obtained from the statewide model related to freight or land use/economic impacts is required.

- Otherwise the statewide model will be used; however, if any of the project lies within an MPO area, ODOT M&F will still consult with the relevant MPO on this decision and will provide model results as requested.

This protocol is followed for 2 reasons. First, the MPO model produces a more refined estimate of passenger car traffic in their areas due to their more refined network and zone structures. Second, the MPO has the primary responsibility for transportation planning in their area and thus is deferred to by ODOT in the area of traffic modeling.

E. Time Frames for Model Work

Turn around time for model work depends upon the following factors:

- Data availability
- Staff work flow management
- Magnitude of project and required analyses

Typically, ODOT M&F can turn around any model request in 1 or 2 weeks (less for normal projects) IF all necessary data is available and IF ODOT Central Office management wishes to reset section priorities to work on the project immediately at the expense of others.

One turn around time for all modeling work cannot be given since this work often occurs at various times throughout the PDP. For project planning purposes, project managers should count upon the following turn around times for most cases:

Prepare Model for Normal Major Project	3 weeks
Prepare Model for Large Major Project	2 months
Model Alternatives on a Normal Major Project	2 weeks plus 1 wd. per Alt.
Model Alternatives on a Large Major Project	2 weeks plus 2 wd. per Alt.
Mega Project	Negotiated case by case

Note that these turn around times are from the date ODOT M&F receives all the data necessary to make model checks/refinements and adjustments. Typically for large major projects some additional count information or land use data will be needed which might take 2 months or more to obtain. The project manager must anticipate the time necessary to collect, assemble and provide this data and understand that it is the project sponsor's responsibility to obtain. The implication of these times when M&F is contacted later in the project development process should be noted. If, for example, ODOT M&F is first contacted by the project manager during PDP Step 5 with a series of 8 alternatives for analysis on a larger project and no counts or other data have been assembled, the turn around time might be about 5 months (2 months + 2 months + 2 weeks + 8*2 wd.). On the other hand, if ODOT M&F is involved early so that data collection and model preparation are already complete, a request to analyze some alternatives can be turned around in a week or two.

For minimal and minor projects, there is typically no project specific model work so there is no turn around time.

Since these turn around times are based largely upon work flow management, not the actual amount of time it takes to conduct the analysis for a given project, ODOT M&F will work with the project sponsor to provide expedited turn around time if necessary. As alluded to earlier, this may involve ODOT Central Office Management if staff are to reprioritize their time from other projects.

II. PROJECT LEVEL MODEL USAGE

The sections to follow will assume the reader has knowledge of travel demand forecasting models. It should also be remembered that "running the travel demand forecasting model" for project level analysis can imply various things besides running the **entire** TDF model. For example, most normal major highway projects can be analyzed by only running the traffic assignment portion of the model (possible in conjunction with a Fratar step to project the trip table) in which case checks on socio-economic (SE) data, trip distribution etc. would be irrelevant. Also, most large major highway projects can be run without the mode choice model (barring specific projection analysis requirements such as might pertain to an MIS) thus making any transit checking irrelevant.

A. Definition of Model Checking/Refining/Adjusting

All project level modeling will begin with the validated model of record as defined in Section I-B. However, the raw results from this model, while useful for system level analysis are not necessarily suitable for producing the location specific forecasts needed for planning level traffic or above. A process of checking, refining and adjusting is used to overcome this limitation. **It is important to note, that it is not enough to simply conduct the processes described below, these must be documented!** All checks, refinements and adjustments made to models for use in project forecasting must be documented. If model work for ODOT projects is not conducted by ODOT M&F, then the documentation should be provided to ODOT M&F (which will provide them to any relevant MPO) along with the refined/adjusted model and its inputs and outputs.

1. Model Checking

Model checking is defined as the process of comparing model results to base conditions and model trends to independently estimated trends to determine their suitability for use.

2. Model Refining

Model refining includes, both correcting errors in the network and zonal data discovered during model checking and adding additional detail to the model, either by subdividing traffic analysis zones, creating special generator zones, adding network links or adding additional detail to network links.

3. Model Adjusting

Model adjusting is the process of changing the model to produce better results. The key difference between model refinements and model adjustments is that adjustments are made without regard to an actual base condition data source. The model's operation, parameters or inputs are simply changed to make the model work better (note, in the modeling world this would typically be called "calibration"). The most common type of model adjustment is the changing of network speeds to produce better assignments. Typically, model checks lead to refinements; adjustments are only made as a last resort and their use for project analysis is strictly controlled.

The following sections will detail these three components and are given in the general order that they are conducted. Many of the guidelines will be given in terms of those conducted within the study area versus those conducted on the entire model. As such, definition of the study area is of primary importance and will be discussed next.

B. Defining Traffic Analysis Study Areas

Care should be taken to distinguish the project study area defined by the project manager from the traffic analysis study area defined by the traffic forecasting analyst. The project study area will most likely have been based on other factors such as environmental impacts while the traffic analysis study area should encompass all areas whose traffic will be significantly impacted by any of the project alternatives (consider, for example, remediation of a short bottleneck such as a narrow bridge within existing right of way whose project study area might be quite small while its traffic impacts could be regional). When the two study areas are different, coordination should occur to determine if the project study area should be revised. If the project study area ends up larger than the traffic analysis study area, the project study area should be used for traffic analysis, otherwise the traffic analysis study area (henceforth simply called the study area) is used.

A study area should at a minimum include the following parts of the network:

- The next parallel facility to either side of the project facility
- Two intersections or interchanges before and after the last one impacted by the project and one beyond the parallel facilities on cross routes
- All of the remaining network facilities connected to and bounded by these

For large major projects and above, a preliminary traffic assignment using the alternative likely to produce the greatest impact can be compared to the base case to determine links with "significant impact". In this case, the study area could be defined to include the links with more than a 10% change in traffic volumes between the base case and the alternative scenario, but at a minimum would still include the area defined by the three bullet points above.

C. Model-wide Checks

All model work should begin with the validated model of record and thus system-wide statistics should initially fall within the required bounds. However, the base year for a project analysis may be different from the validation year, necessitating system checks with respect to available base year counts. In addition, model checking/refining/adjusting is an iterative process, when adjustments are made for the project, the overall model should be rechecked to ensure that it still performs well overall. This is not to say that a complete revalidation of the TDF model occurs, rather that some of the key validation criteria, as mentioned below, should be checked and reported upon. Typically, refinements do not require the overall model to be rechecked unless they are significant. Significant refinements are those that involve the same types of changes to the model network as those that define a "Large Major" project as defined in Section I-A.

ODOT's "Traffic Assignment Procedures" [1] manual requires the following checks on the overall model assignments:

- %RMSE Check
- VMT Check
- Screen-line Check
- V/G Ratio Check

1. %RMSE Check

%RMSE check is reported either graphically or in tabular format showing achieved versus desired level by volume group. This check is typically ignored altogether for directional volumes under 500 per day (i.e. volume group 1). Because it is crucial to both this check and several others discussed in this document, the desired %RMSE for daily directional volumes is shown below:

Table 1. Allowable %RMSE by Directional Link Volume Group

Volume Group	1	2	3	4	5	6	7	8	9
Group Midpoint	250	1000	2000	3000	4000	5000	6250	7750	9250
Desired Max. %RMSE	NA	100%	62%	54%	48%	45%	42%	39%	36%
Volume Group	10	11	12	13	14	15	16	17	18
Group Midpoint	11250	13750	16250	18750	22500	30000	45000	65000	97500
Desired Max. %RMSE	34%	31%	30%	28%	26%	24%	21%	18%	12%

2. VMT Check

VMT check is reported by at least the following categories (showing the acceptance criteria in parenthesis): Freeway (7%), Arterial Streets (10%), Other Streets (15%) and Total (3%) for links with counts showing the counted VMT, model VMT and percent difference versus the desired levels.

[1] Travel Demand Forecasting Manual 1, Traffic Assignment Procedures, ODOT, Division of Planning, Office of Technical Services, August 2001 (http://www.dot.state.oh.us/urban/data/assmtdoc/assign2000.zip)

3. Screen-line Check

The screen-line check reports the counted and model volumes and percent difference and maximum allowed percent difference for all screen-lines defined for the model validation.

4. V/G Ratio Check

The V/G ratio check (volume divided by ground count) is shown as a link map colored as follows:

V/G<0.5, Dark Blue
V/G<0.75, Medium Blue
V/G<1.0, Light Blue
V/G<1.33, Pink
V/G<2.0, Medium Red
V/G>=2.0, Dark Red

Furthermore it should be annotated with the directional assigned volume and count.

5. Other Checks

Besides the overall model assignment checks, if model adjustments were performed, additional checks should be conducted identical to the relevant checks reported in the subject models validation report. For example, if the model's trip distribution is altered through the use of K factors or screen-line penalties, then, trip length frequency distributions, average trips lengths, percent intra-zonal and coincidence ratios should be reported for the entire model.

D. Study Area Checks for All Projects

Model checking has 2 main components, checking model base year results with respect to actual conditions and checking the reasonableness of forecast growth rates. The checking within the study area actually begins with data collection as additional and potentially more detailed counts will be needed. Counts from this data collection are coded to the network in the study area before beginning study area checks.

For all projects, the study area should be subjected the following checks:

Base Year Checks
Network Coding Check
Land Use Checking
Percent Difference Check
VMT Check
Screen-line Check
Forecast Checks
Forecast Land Use Checking
Growth Rate Check

1. Network Coding Check

Several key network attributes should be checked within the study area including: posted speed (POSTSPD), functional class (FUNCLASS), area type (AREATYPE) and number of lanes (LANES). Additional attributes such as roadway width (TWIDTH), intersection type (IXTYPE), turn lanes (TURNLANE), on street parking (PARKING) and two way left turn lanes (MEDTURN) might be indicated for some projects. Network checking is simply a comparison of the coded attributes with known conditions, obtained either from field inspection, ODOT roadway information database, video log, aerial photos or other sources.

2. Land Use Checking

The zonal socio-economic (SE) data should be checked for accuracy within the study area. It is not unusual for the model of record SE data to exclude new developments that have occurred or been announced since the last long range plan update. The level of checking for normal projects will typically be very cursory but will be much more extensive for large and mega projects. Comparisons with Census data, ES202, field studies, Traffic Impact Studies and other sources should be used to verify the accuracy of the SE data. GIS maps and tabular comparisons of these checks and changes should be provided. Ratio checks with respect to households such as population, workers, vehicles etc. are a useful means of pointing out gross errors in SE data. Trip rates from the model versus ITE Trip Generation[2] or driveway counts should be compared to determine the need for special generator rates for important land uses in the study area.

[2] Trip Generation, 7th Edition, Institute of Transportation Engineers, 2003

3 Percent Difference Check

The percent difference check is analogous to the %RMSE check conducted for the entire model. This check is simply check 4 of Chapter 4 in NCHRP 255[3]. An examination of Figure A-3 in this document shows that "Maximum Desirable Deviation" in individual link volumes is exactly the same curve as the maximum desirable %RMSE curve used for the entire model. Thus, the percent error of the daily directional volume of individual links in the study area is simply compared to the allowable %RMSE curve to determine their acceptability. This is done for 2 reasons: 1. Location specific accuracy is desired for project forecasting rather than the broader volume group based accuracy of the overall model, 2. There aren't necessarily enough links in any given volume group within the study area to calculate volume group based %RMSE. Note that this check, as with %RMSE is always done by direction.

There is no particular requirement that all or even any link in the study area meet these criteria. Rather, such discrepancies should be reported and probably lead to additional refining and adjusting. Volumes for links not meeting these criteria should not be reported via simple application of the NCHRP 255 volume adjustment procedure when they are significantly impacted by the project alternatives but should be subjected to additional scrutiny to identify the cause and corrective action. This is generally reported in tabular format. For larger projects, the percent difference check should also be reported using a map coloring links that don't meet the criteria (red for over assigned, blue for under assigned similar to the V/G ratio check map) and annotating the model volume, count and percent difference. This check can also be applied to sub-daily and truck volumes if the modifications to the allowable percent error curve discussed in Section II-F are made.

4 VMT Check

The VMT check is exactly analogous to that conducted on the entire model area.

5 Screen-line Check

The Screen-line check uses the same criteria and reporting requirements as that for the entire model area. The main difference is that additional screen-lines will most likely need to be defined within the study area for larger projects, while for normal projects; the screen-line check need not be formalized but can simply be evidenced by the percent difference check.

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[3] Appendix A (Users Guide), NCHRP 255, Highway Traffic Data for Urbanized Area Project Planning and Design, Transportation Research Board, December 1982

6. Forecast Land Use Checking

Forecast year SE data should be checked versus the base year data to ensure the assumed land use changes are reasonable. Ratio and difference checks comparing the various SE variables between base year and forecast year conditions are used to check this data.

7 Growth Rate Check

The growth rate check simply involves listing the resultant growth rate produced by the model against growth rates computed by independent methods such as from count trends, population growth, employment growth, HPMS VMT growth, ODOT congestion management system growth or ODOT annual adjustment factors. Not all of these sources need to be used for every project, the analyst has some flexibility in choosing comparison data to match the needs of the project; the key issue is simply to conduct some kind of checking of the reasonableness of model growth rates. Growth rate checking for planning level traffic only needs to be conducted on the key routes in the study area.

E. Additional Study Area Checks for Large Major and Mega Projects

Larger, more important projects require more detailed model checking. In addition, if the model will be used to produce “Refined Alternative Level Traffic” for operational level analysis, the checks in this section should be conducted. Not every check listed here need be conducted for every project; those selected depend on the nature of the project and the analysis needed. These additional checks include:

Travel Time Check
Path Check
Select Link Check
Distribution Checks

1. Travel Time Check

Travel times from the model should be compared to known travel times from field studies for important routes in the study area or at least reported for reasonableness. Both the coded free-flow and final “congested” model speeds should be reported versus independent time/speed values and the model volume that produced the “congested” speed. The SPEEDMOD field should also be analyzed in conjunction with this check to ensure the modeler understands where the model has been adjusted in the past.

2. Path Check

Network routing problems can sometimes be ascertained through V/G ratio plots or percent difference checks. In some cases, however, more detailed analysis of paths is needed. Checking specific paths between origins and destinations is sometimes necessary for this purpose. The paths between certain important OD pairs in the study area can be checked (and plotted) to demonstrate that these OD movements utilize the expected routes. Two useful applications of this check are to make sure a freeway to freeway movement through the study area doesn't illogically exit the freeway onto surface streets and to make sure a surface street through movement follows a logical path (such as the signed state route) through the study area. Path maps showing the routes used between OD pairs are the best way to report this information.

3. Select Link Check

Select link checking is a further check that may be indicated on certain links that are diagnosed with problems in one of the other checks or that are extremely important to the study. This check helps clarify where the traffic using a link is coming from and is best shown through a band width based select link map. Select link analysis will often be conducted for its own sake to provide useful information to the project team for the evaluation of conceptual alternatives. Select zone checks might also be used in conjunction with select link checks.

4. Distribution Checks

Trip distribution is usually checked for most projects by simply analyzing screen lines. However, for some larger projects, a more in depth review of trip distribution patterns is in order. Origin-destination surveys or CTPP Journey to Work data are the most likely data sources for checking the distribution patterns of the model. Desire line maps, trip length frequency distributions (TLFD) and average trip length comparisons are the best way to show these comparisons. The criteria used to judge trip distribution models is that average trip lengths should be within 3% of the validation data, TLFD coincidence ratio at least 70% and the percent difference of individual OD pairs should follow the same criteria used for link flows in the previous section (note: most OD pairs have extremely low volume and thus aren't much constrained by this curve). Note that as with assignment percent differences, there is no particular requirement that these criteria be met, however, they provide a base line for how well the model is performing and should be reported and possibly lead to additional refining or adjusting.

F. Special Requirements for Use of Model Data Other Than 24 Hour Link AADT

TDF models are capable or producing various other traffic data besides 24 hour link volumes. The most common of these are:

Turn Movement Volumes
Model Period (sub-daily) Volume
Directional Volumes
Truck Volumes

The use of these more detailed data require additional consideration and checking. If any of these checks result in refinements/adjustments to the model, then the 24 hour link volume checks must be repeated.

1. Turn Movement Checks

Model turn movements are typically not used for project level traffic forecasts unless the turn movement does not exist in the existing conditions. Rather, the NCHRP 255 methodology for producing turn volumes is employed. This is mainly because TDF model turn movements are not validated (nor will they in the foreseeable future due to the expense that would be involved to do so). If model turn volumes are to be used for project traffic (either at new or existing locations), volume checks at the turn movement level should be conducted. While the “add a lane/drop a lane” philosophy behind the allowable percent error curve used for link volumes does not really apply to individual turn movements, this curve still serves as a useful bench mark of the relative accuracy of turn movement volumes and should be used as such. As with link checking, turn volumes not meeting this criteria help point the analyst to locations needing refinement or adjustment and also serve a cautionary function when determining the final forecast volume to report for turning movements. Turn volume checks are typically shown in tabular format or on turning movement diagrams. A potential map format is to color intersection nodes based on the number of turn movements not meeting the turn percent difference criteria.

2. Model Period Volume Checks

Today’s TDF models include several independent sub-daily model period assignments, which when summed together produce the total daily traffic. This formulation allows peak demand periods and the resultant route selection and directionality to be segregated from other times of day. There is a natural desire to take advantage of such information in the development of project specific design hour volumes. Before doing so, however, it is important that the period level volumes be subjected to the same validation tests as the daily volumes. If the entire model has been validated with respect to a given time period (say the

PM peak period) then this assignment may be used with appropriate study area enhancement as documented for daily link volumes. If not, then a new period level validation must be conducted within the study area at a minimum. The model periods typically cover from 3 to 12 hours, thus hourly count data would need to be obtained, aggregated and coded to the period level network. All the cautions and requirements discussed with respect to daily volume checking/refining/adjusting apply to sub-daily volumes when they are used.

The maximum allowable percent error curve (Table 1) must then be adjusted to reflect the hours contained in the model period. The following table showing the 2005 percent traffic by time of day may be used to adjust these targets. The “Period” column shows the model periods used in the Ohio Standard MPO model. Thus for example, since 16.6% of daily traffic occurs during the AM peak period of the standard model, the target volumes would be multiplied by 0.166 to determine the maximum allowable percent error for a given volume, so a maximum allowable percent error of 100% would apply to an AM period volume of 166 instead of a daily volume of 1000.

Table 2.

2005 Urban Daily Traffic Distribution

Period	Hour	AADT	Truck
NT	0	0.9%	1.9%
NT	1	0.6%	1.7%
NT	2	0.5%	1.6%
NT	3	0.5%	1.8%
NT	4	0.8%	2.1%
NT	5	2.0%	2.7%
AM	6	4.4%	3.9%
AM	7	6.5%	5.2%
AM	8	5.8%	5.7%
MD	9	4.9%	5.9%
MD	10	5.0%	6.2%
MD	11	5.5%	6.4%
MD	12	5.8%	6.4%
MD	13	5.8%	6.4%
PM	14	6.5%	6.5%
PM	15	7.5%	6.3%
PM	16	8.0%	5.7%
PM	17	7.8%	5.1%
NT	18	5.9%	4.1%
NT	19	4.5%	3.6%
NT	20	3.8%	3.2%
NT	21	3.2%	2.9%
NT	22	2.3%	2.6%
NT	23	1.6%	2.3%

Thus, when model period volumes are to be used to aid in the forecasting of design hour volumes; the same study area checks as for 24 hour volumes are used, namely:

- Model period percent difference by link
- Model period VMT
- Model period screen-line

Typically, the growth rate check would still only be conducted for 24 hour volumes (since most independent trend data will only be available at that level). However, the following additional check should be made when using model period volumes:

- Model periods proportion check comparing the proportion of traffic occurring in the model period for the forecast to its base year value. Changes of more than 3 percentage points should be flagged on a link map (thus for example, if 26% of daily traffic occurs on a given link in the PM peak in the validated base network and 30% in the forecast scenario, the link should be flagged and investigated to ensure the change is logical).

If these procedures are not followed, development of project level K (30^{th} highest hour factors) should follow the traditional method based on permanent automatic traffic recorder (ATR) station counts. Even in cases where these procedures are used, a conversion from model period volumes to K are necessary (even if the model period is a single hour, recall that a conversion from peak hour to design hour is necessary since they are not the same). Use of the model period data in essence simply provides information that allows the analyst to select a forecast K that is different from the base condition.

3. Directional Split Check

Link checking, whether at daily or period level is always done directionally. Thus a properly validated model can be used to provide directional split information. This would typically only apply to the use of a period level model since directional split information from the daily model is less useful. If directional split information will be used, 2 additional checks should be reported:

- Map of model vs. count directional split in base year coloring links off by over 3 percentage points (for example 60% split versus 56%).
- Map of base year vs. forecast year directional split coloring links where the directional split changes by more than 3 percentage points

These checks should be used to ensure the directional splits are reasonable and to make model refinements or adjustments if necessary.

4. Truck Volume Check

Most of the current TDF models have truck components. Some of these have been validated on a daily basis and thus can be used to provide daily percent truck information so long as all cautions and requirements related to AADT volumes presented in these guidelines are also followed for trucks. If the model has not been validated with respect to trucks, then it must be so within the study area at a minimum to be used in this manner. Note that since the maximum allowable percent error curve has its basis in capacity considerations, the curve (Table 1) must be adjusted using truck passenger car equivalents (PCE) prior to use. Thus for example, if a PCE of 2 were used, then the maximum allowable percent error of 100% would apply to a daily truck volume of 500 instead of an AADT volume of 1000. Truck directional splits, turn volumes and period level volumes can all be used from the model if the applicable procedures from this section are successfully applied to trucks as well (note that applying percent difference checks to period level trucks would require 2 adjustments to the maximum allowable percent error curve).

G. Model Refinements for All Projects

Model refinements are changes to the model to either fix incorrect data or add additional detail to the model in the area of the project. Refinements should normally be made to the base year data and then carried forward to forecast years (either by recoding forecast year projects and land use to the refined base year or by modifying the original forecast data by using log files or database tools). Refinements are typically only carried out within the study area based on the results of the study area checking. For normal projects, model refining will mainly involve correcting the current model coding as listed here. Occasionally, normal projects will also require some minor additions of roadway links or special generators (but not zone splits which are more complicated), these are documented in the next section.

1. Correct Network Coding

Correct network coding of fields: Posted speed (POSTSPD), functional class (FUNCLASS), area type (AREATYPE), number of through (LANES), roadway width (TWIDTH), intersection type (IXTYPE), turn lanes (TURNLANE), on street parking (PARKING) and two way left turn lanes (MEDTURN)

When network coding is updated, it is important that the ODOT network calculators[4] (capacity, speed, turn penalty) be rerun on the corrected network.

[4] ODOT Capacity Calculator Documentation, http://www.dot.state.oh.us/urban/data/odotdoc2.zip

2. Correct Centroid Connectors

Centroid connector locations should be checked versus actual zonal access points and reconnected appropriately.

3. Correct Zonal SE Data

There are a couple things to keep in mind with regard to SE data corrections. First, while the state (ODOT and ODOD) require that the model of record respect county wide control totals for population, there is no particular requirement that the SE data used for project analysis respect such control totals. Second, maintenance and updating of SE data is primarily an MPO task, so they should be coordinated with closely in the updating of such data.

Any such corrections should be documented in detail and transmitted to ODOT M&F via both the updated network or SE file and a list of each specific change that was made.

H. Additional Model Refinements for Large Major and Mega Projects

Larger projects or those requiring very detailed results may require additional refinements to the model of record. These include:

1. Adding additional network detail in the study area

Additional roads, ramps etc. not included in the model might be added in the study area to give more refined results. When using intersection based delay modeling (as in the Ohio Standard model) additional network coding may be necessary to properly represent some signalized intersections at driveways or other low type facilities, this coding may point to the need for zone splits (and vice versa). Any added network must contain all of the fields specified in the previous section and the ODOT network calculators should be rerun on the refined network.

2. Splitting zones

Zones should be subdivided, when necessary, so that all land uses within the same zone access the public street system the same way. Each individual access point does not have to be unique; rather the centroid connectors for the zone should connect to the roadway links that all or most of the development in the zone can access directly.

3. Adding special generators

Important developments in the study may need to be made special generators if indicated by the trip end or link volume checks. This might also be done for a smaller project if the focus of the project is the development in question.

4. Coding more detailed intersection operating characteristics

When intersection level delay modeling is used, the network data related to this (besides those data maintained on the links) can be updated. Currently, Cube's Junction modeling capability is used for the standard models. However, while the intersection type and physical turn lanes are maintained on the link coding, details regarding the signal phasing and timing are assumed. This information can be entered using Cube's Junction editor if it is known. Since hard coded signal operations are not flexible and therefore cannot respond to future changes, another method is to adjust the FUNCLASS and IXTYPE coding of the links entering each intersection so that the default characteristics are more reflective of the actual operations (this requires more knowledge of the ODOT capacity/junction calculators[4]).

I. Model Adjustments

Model adjustments are changes to the model to make it produce better results. These adjustments are not based on incorrect/better data but rather are changes to model operation and thus should be viewed as a last resort. While a whole range of model adjustments are possible, parameter changes within the model itself are generally not recommended. If such changes are necessary, say for example for a major transit project, consultation with ODOT M&F would be necessary and the Mega project process would probably be followed. Adjustments that might commonly be used where necessary include:

1. Adjustment of network link speeds via the SPEEDMOD field

Small adjustments (say within 2 or 3 MPH) are not a major cause for concern because network speeds are coded from a speed table of averages and the expected variances in speed on individual links are well within this range. More severe changes should be made with care. Speed adjustments should be made using the SPEEDMOD field and then rerunning the ODOT speed calculator. If other speed fields are modified directly instead, the next time the calculators are run, any adjustments will be lost. This method also helps to keep speed adjustments well documented on the network.

2. Addition of screen line penalties or K factors

Problems with screen-line volumes or otherwise noted in distribution checking can sometimes be solved with screen line penalties or K factors. The Ohio Standard model has provision for the addition of screen-line penalties where needed.

Any adjustments of this nature should be documented with a map showing the links changed and a listing of all changes with justification for the change.

J. Feedback of Refinements/Adjustments to the Regional Model

Model adjustments should usually be made to the overall model and their impact checked on overall model validation. As documented previously, large refinements resulting from major errors/omissions in the model, should also be reflected and checked in the overall model. Small refinements do not need to be checked in this way. If ODOT M&F does not conduct the model work, then when the adjusted/refined model meets the validation criteria mentioned previously, the adjusted/refined model, documentation of the changes, and documentation of the revised validation results should be transmitted to ODOT M&F who will send them along to the relevant MPO if necessary.

K. Development of Refined Alternative Level Traffic

Refined alternative level traffic is only needed for some very rare cases as defined in Section I-B. Since such projects tend to be unique, only some very general guidelines are offered here.

Matrix estimation (ME) techniques are a common way to further refine the TDF model results to better match traffic counts in the study area. This technique should only be applied after the previously described checking/refining/adjusting process has been carried out with the travel demand forecasting model itself. There are two important reasons for this; 1. the ME process is rather static, i.e. the adjustments that result cannot respond to changes in the transportation system or the land use the way the TDF model can, 2. ME is meant to produce changes to the input demand model (trip table), however, if applied to a model with network problems, it will adjust the demand data in strange ways to compensate for this.

Some software can apply ME at the turn volume level (as opposed to link level). If turn volumes are to be the final product of refined alternative level traffic then this should be done rather than link level ME.

Some software allows confidence levels to be attached to various input data to the ME process. If this is the case, the confidence levels for those data should have approximately the following relationship (these are given as relative values, note the order of magnitude relationships):

Trip table cell values: 1
Zonal trip ends for most zones: 10
Older or not so good counts: 50-75
External zone trip ends based on counts (50-100 depending on how new/good the count)
Zonal trip ends for a special generator zone based on driveway counts: 100
Newer or better counts: 100

These values represent a starting point only, a good understanding of the particular ME process being used and how each data element and the amount of data impacts the final results is necessary for proper application of an ME process.

Count consistency is extremely important to ME processes (particularly those based on turning counts). Before an ME process is applied, all counts in the study area must be checked for consistency with one another. For example, counts on adjacent links with no centroid connectors between shouldn't be different, one link entering an intersection, shouldn't have a higher count than all the other links combined etc.

When an ME process is used, a method for translating those adjustments to the forecast year is needed. There are two methods that have been used successfully:

- Calculate the cell by cell differences between the TDF model trip table and the ME trip table and apply this delta matrix to the TDF forecast trip table (note, ratios are generally not used for this because of their instability at the relatively low volumes of individual trip table cells)

- Fratar the ME trip table to the forecast year trip ends of the TDF model

The advantage of the first method is that changes in the underlying trip distribution of the TDF model will be reflected in the forecast, however its disadvantage is that the static "delta" adjustments reflect neither these changes nor changes in zonal land use that may impact trip generation. The second method's advantage is that the lack of a delta adjustment allows the adjusted matrix to be fit to future land use patterns more precisely; its disadvantage is that it does not allow the TDF model itself to say anything about changes in distribution patterns. The Fratar method is preferred.

Often times, a sub-area model will be created for use in the development of refined alternative level traffic. There are a couple of important points related to this. First, before extracting a sub-area, at least some review of the study area assumptions should have been made to ensure the sub-area is large enough (extracting a sub-area somewhat larger than the study area isn't a bad idea either). Second, count data (which could include truck counts and period level counts depending on what model information will be used as documented in the previous section) must exist on every link crossing the sub-area. Third, it is a good idea to Fratar the sub-area trip table to match external volumes before conducting the study area checks/refinements/adjustments. This is because the creation of the sub-area model implies an a priori assumption that the known conditions at the sub-area boundary are fixed and the subsequent refinements and adjustments should not be compensating for problems at this boundary.

L. Volume Reporting

Project level traffic forecasts are almost never reported as model volumes. An exception might occur in the case of refined alternative model results from a conceptual alternatives model. Generally, regardless of whether planning level or design traffic is being provided, the adjusting process in NCHRP 255 (Chapter 4) would be used to report project volumes. These can be applied in bulk on a link by link basis for planning level traffic. However, it is important to keep in mind the capacity constraint of links when bulk applying these adjustments as there is no inherent restraint to the volumes that can result from the NCHRP process as there is within the TDF model itself.

As mentioned previously, turn volumes from the model are usually not used except for new locations or if turning movement level matrix estimation was used to produce refined alternative traffic. In other cases the process documented in NCHRP 255 (Chapter 8) is employed.

Traffic forecast volumes should be rounded to the nearest 10. Even greater rounding of larger volumes to emphasize the degree of confidence in the numbers is prudent but not required.

Appendix D

Traffic Forecasting Tools Information

Reports:

1) MPO Modeling Contacts
2) Trend Line Analysis Example
3) Turning Movement Example
4) Modeling Spreadsheet Example
5) Non-Interstate Bridge Projects Design Designation Worksheet.

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

1) MPO Modeling Contacts

City		MPO	Handling Agent	Addresses
Akron	AMATS	Policy Committee of the Akron Metropolitan Area Transportation Study	City of Akron	146 South High Street, Citicenter Bldg. Rm. 806 Akron, Ohio 44308-1423 Phone: (330) 375-2436 FAX : (330) 375-2275 http://ci.akron.oh.us/amats/
Canton	SCATS	Policy Committee of Stark County Area Transportation Study	Stark County Regional Planning Commission	201 3rd. Street N.E., Suite 201 Canton, Ohio 44702-1231 Phone: (330) 451-7389 FAX: (330) 451-7990 http://www.rpc.co.stark.oh.us/
Cincinnati	OKI	Executive Committee of the Ohio-Kentucky-Indiana Regional Council of Governments	Ohio-Kentucky-Indiana Regional Council of Governments	720 East Pete Rose Way Suite 420 Cincinnati, Ohio 45202 Phone: (513) 621-7060 FAX: (513) 621-9325 http://www.oki.org/
Cleveland	NOACA	Northeast Ohio Areawide Coordinating Agency Policy Board	Northeast Ohio Areawide Coordinating Agency	1299 Superior Ave. Cleveland, Ohio 44114-3204 Phone: (216) 241-2414 FAX: (216) 621-3024 http://www.noaca.org/
Columbus	MORPC	Policy Committee of the Columbus Area Transportation Study	Mid Ohio Regional Planning Commission	285 E. Main St. Columbus, Ohio 43215 Phone: (614) 228-2663 FAX: (614) 621-2401 http://www.morpc.org/
Dayton	MVRPC	Miami Valley Regional Planning Commission Board of Directors	Miami Valley Regional Planning Commission	One Dayton Centre One South Main St. Suite 260, Dayton, Ohio 45402 Phone: (937) 223-6323 FAX: (937) 223-9750 http://www.mvrpc.org/
Huntington (WV)	HIATS	Huntington-Ironton-Area Transportation Study Coordinating Committee	KYOVA Interstate Planning Commission	1221 6th Ave., P.O. Box 939 Huntington, West Virginia 25712 Phone: (304) 523-7434 FAX: (304) 529-7229 http://www.wvs.state.wv.us/kyova
Lima	LACRPC	Coordinating Committee of the Lima Area Transportation Study	Lima-Allen County Regional Planning Commission	130 W. North St. Lima, Ohio 45801 Phone: (419)228-1836 FAX: (419)228-3891 http://lacrpc.com/
Mansfield	RCRPC	Coordinating Committee of the Mansfield Area Transportation Study	Richland County Regional Planning Commission	35 North Park Street Mansfield, Ohio 44902 Phone: (419) 774-5684 FAX: (419) 774-5685 http://www.rcrpc.org/main.htm

City	MPO		Handling Agent	Address
Newark-Heath	LCATS	Policy Committee of the Licking County Area Transportation Study	Licking County Planning Commission	20 South 2nd Street Newark, Ohio 43055 Phone: (740) 349-6930 FAX: (740) 349-6567 http://www.lcats.org/main.asp
Parkersburg-Belpre	WWW	Wood-Washington-Wirt Interstate Planning Commission	Mid-Ohio Valley Regional Planning And Development Council	531 Market Street, P.O. Box 247 Parkersburg, West Virginia 26101 Phone: (304) 422-4993 FAX: (304) 422-4998 http://www.movrc.org/wwwipc.htm
Sandusky	ERPC	Policy Board of the Erie Regional Planning Commission	Erie Regional Planning Commission	2900 Columbus Ave. Sandusky, Ohio 44870 Phone: (419) 627-7792 FAX: (419) 627-6670 http://www.erie-county-ohio.net/planning/Planning.htm
Springfield	CCSTS	Coordinating Committee of the Clark County-Springfield Transportation Study	Clark County	76 East High Street Springfield, Ohio 45502 Phone: (937) 324-7751 FAX: (937) 328-3940 http://www.donet.com/~clarktcc/
Steubenville-Weirton	BHJTS	Brooke-Hancock-Jefferson Transportation Study Policy Committee	Brooke-Hancock-Jefferson Metropolitan Planning Commission	124 North Fourth Street - 2nd Floor Steubenville, Ohio 43952 Phone: (740) 282-3685 FAX: (740) 282-1821 http://www.bhjmpc.org/
Toledo	TMACOG	Executive Committee of the Toledo Metropolitan Area Council of Governments (responsibilities delegated to the Transportation and Land Use Committee)		Toledo Metropolitan Area Council of Governments	300 Central Union Terminal, P.O. Box 9508 Toledo, Ohio 43697-9508 Phone: (419) 241-9155 FAX: (419) 241-9116 http://www.tmacog.org/
Wheeling-Bridgeport	BOMTS	Bel-O-Mar Regional Council and Interstate Planning Commission	Bel-O-Mar Regional Council and Interstate Planning Commission	105 Bridge Street Plaza, P.O. Box 2086 Wheeling, West Virginia 26003 Phone: (304) 242-1800 FAX: (304) 242-2437 http://www.belomar.org/
Youngstown	ECOG	General Policy Board of the Eastgate Regional Council of Governments	Eastgate Regional Council of Governments	Austin Square Building 5121 Mahoning Avenue Youngstown, OH 44515 Phone: (330) 779-3800 FAX: (330) 779-3838 http://www.eastgatecog.org/

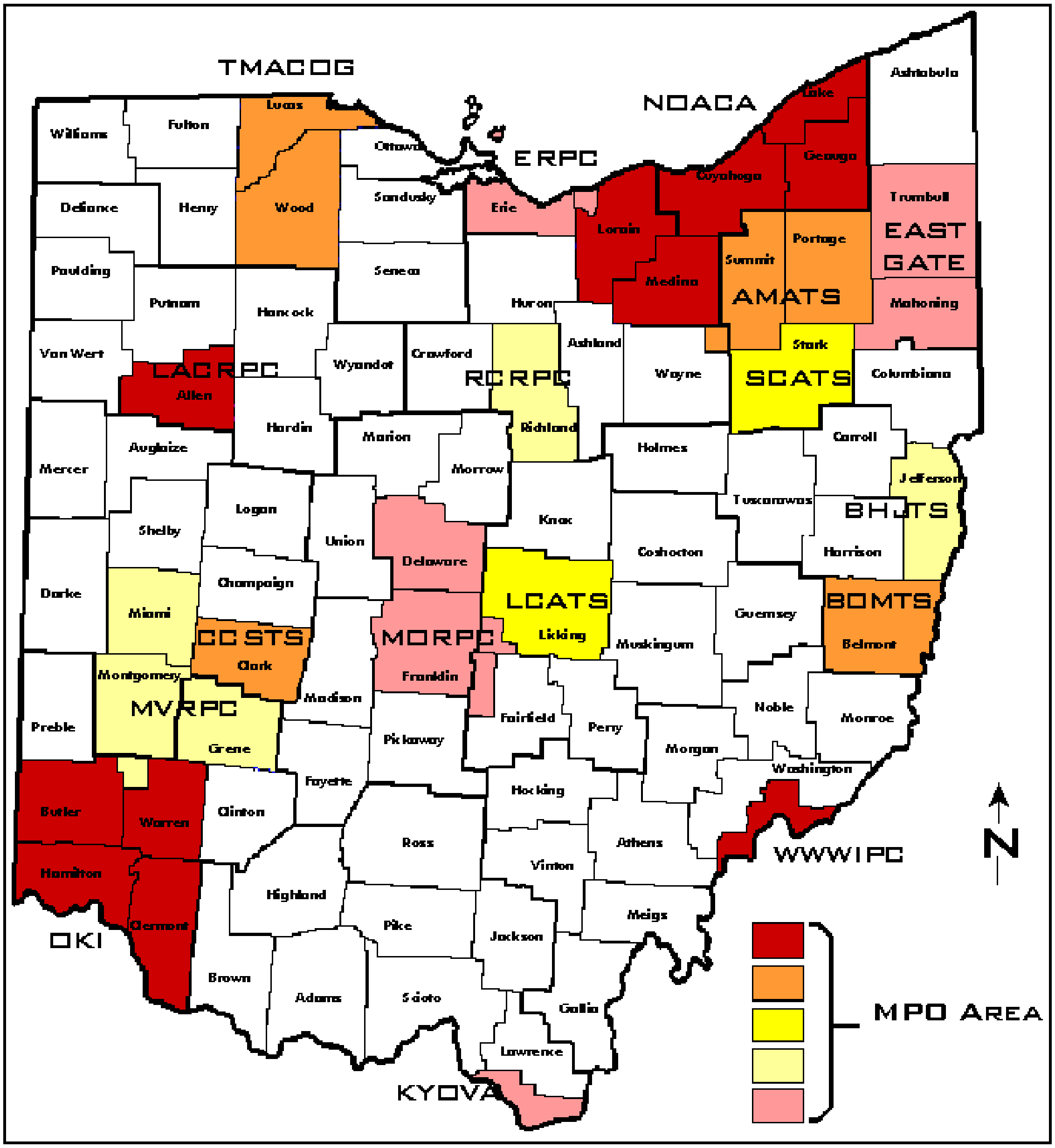


Figure D-1: Ohio MPO Area Map.

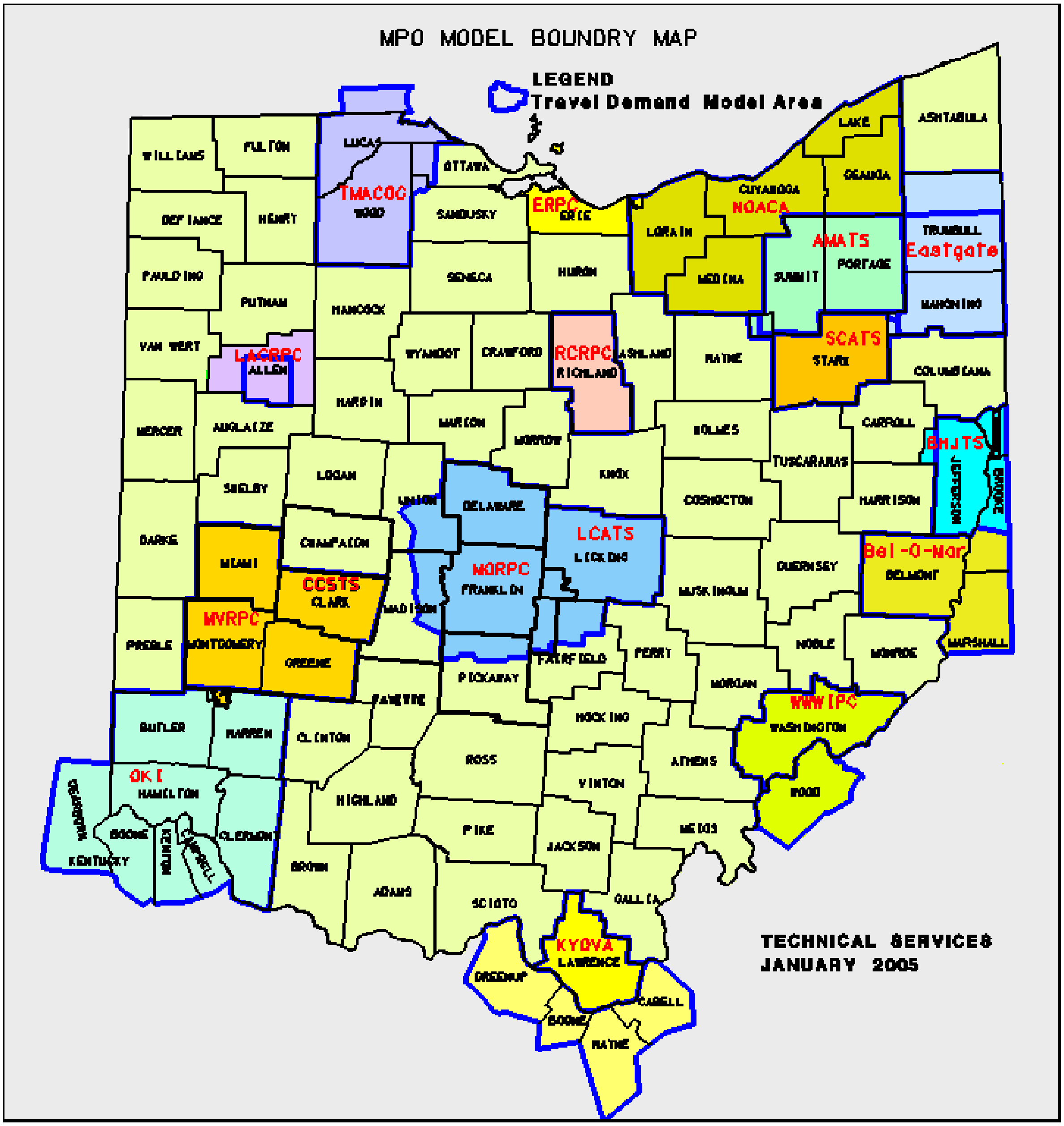


Figure D-2: Ohio MPO Travel Demand Model Boundary Map.

2) Trend Line Analysis Example

For simple projects or projects where a travel demand model is not available, future ADTs are established using trend line analyses. This analysis can be performed in any spreadsheet application such as Microsoft Excel.

The following steps are involved in estimating future traffic volumes using trend line analysis:

1. Gather historical data for the subject locations from Traffic Survey Reports (TSR) or other sources.

ASD 60	1.22	N. CORP. LOUDONVILLE	
TSR	ADT	B&C	T24
2006	3170	270	0.09
2003	3100	190	0.06
2000	3060	240	0.08
1992	1860	120	0.06
1988	1970	120	0.06
1984	1270	130	0.10
1980	2080	200	0.10

Figure D-3: Sample Data Set for Trend Line Analysis Example.

2. Plot a chart with volumes on the y-axis and the year on the x-axis.

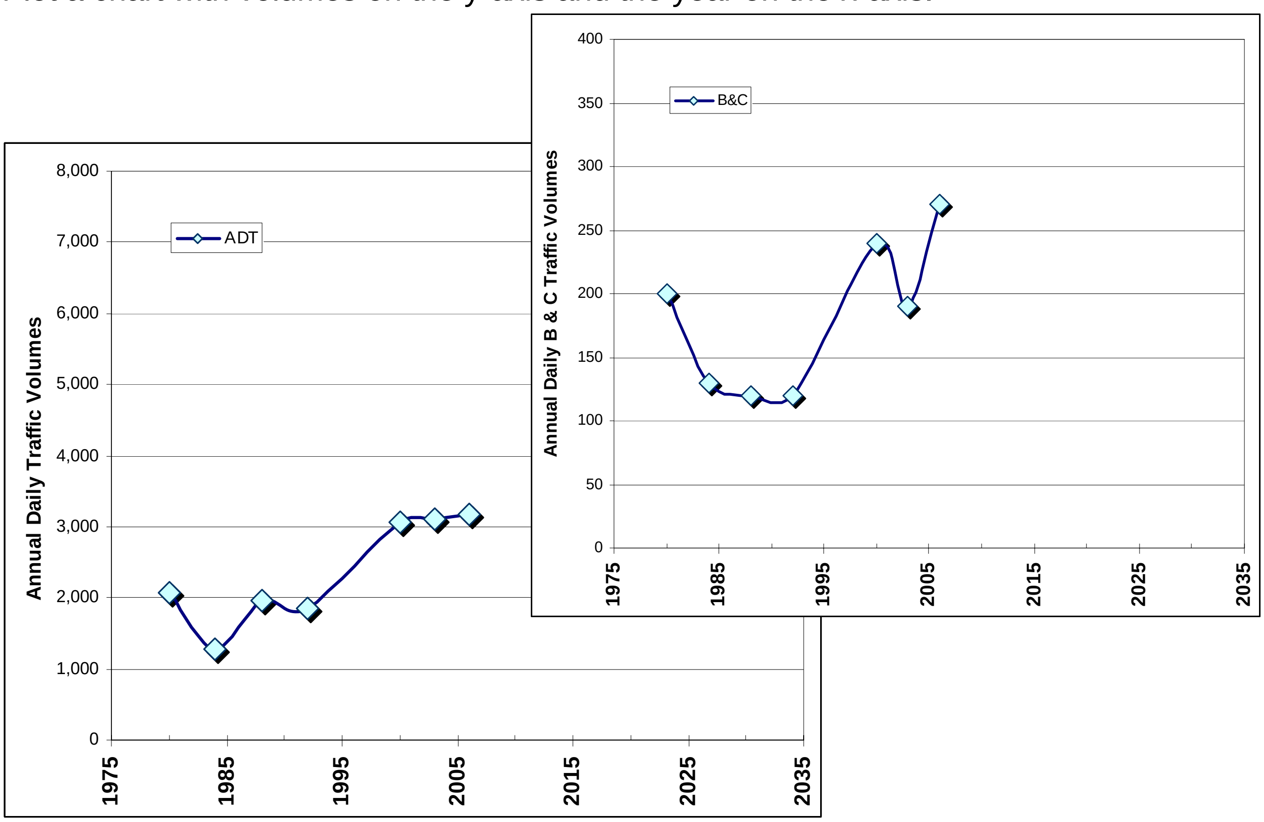


Figure D-4: Chart Depicting the Sample Data Set from Figure D-3.

Extend the x-axis to include the future years for which volume projections is needed.

3. Use regression analyses to estimate a line with coefficients (slope and y-intercept for the most commonly used **linear** regression analyses) that best fits the set of historical traffic volumes. This generally results in an equation that can be applied to future years to compute estimated volumes.

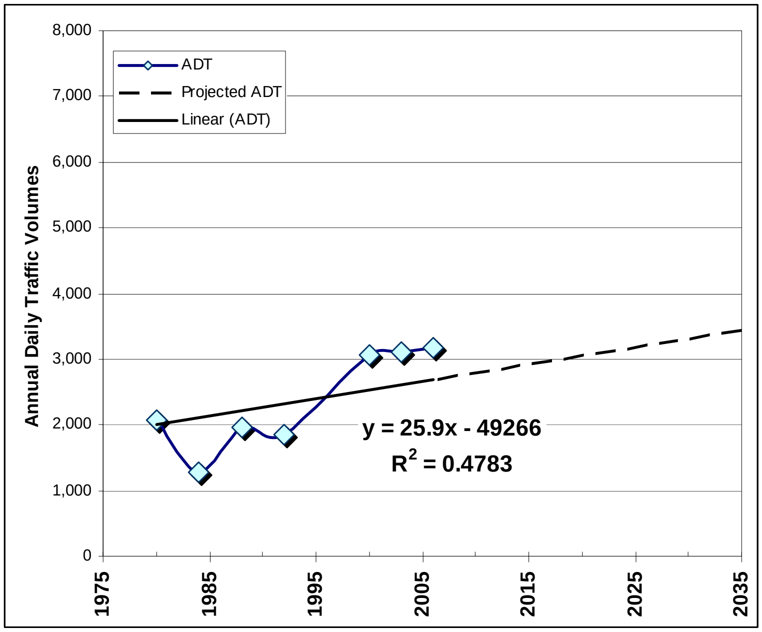


Figure D-5: Linear Regression Applied to Historic ADT Data.

Using linear regression analyses for the example data set future ADT can be estimated by the following equation:

$$y = bx \pm a$$

where,

y = Future ADT
x = Future Year
a = the y-intercept
b = slope of the line

From the graph above, the future year ADT can be calculated as:

Future ADT = (25.9 x 2035) – 49,266 = 3,441.

Based on this formula the ADT for the year 2035 is 3,441.

4. Repeat regression analyses to estimate future B&C volumes.

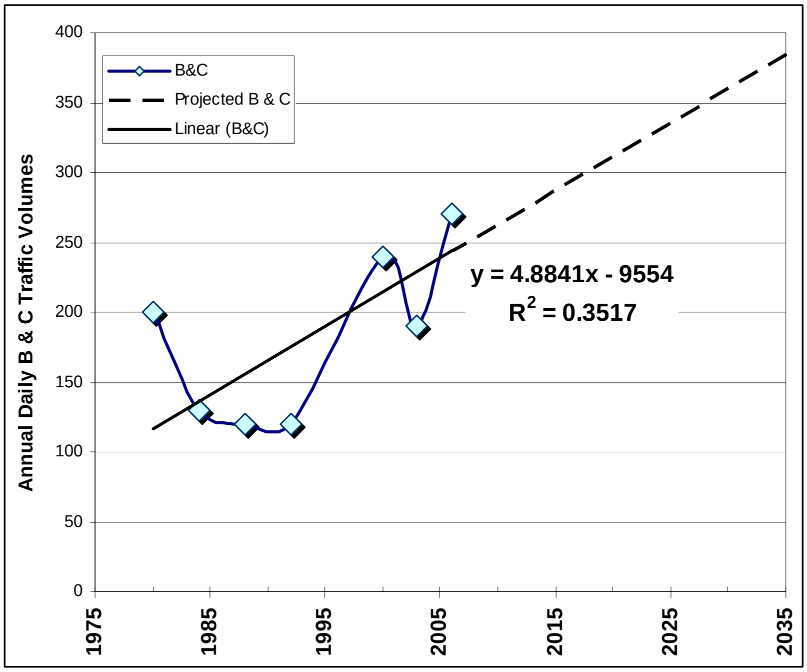


Figure D-6: Linear Regression Applied to Historic B&C Volumes Data.

Using linear regression analyses for the example data set future B&C volumes can be estimated by the following equation: Future B&C = (4.88 x 2035) – 9,554 = 385.

Based on this formula, estimated B&C volume for the year 2035 is 385.

5. Thus a preliminary estimate of future volumes can be computed using trend line analyses.

ASD 60	1.22	N. CORP. LOUDONVILLE		
TSR	**ADT**	**B&C**	**T24**	
2006	3170	270	0.09	
2003	3100	190	0.06	
2000	3060	240	0.08	
1992	1860	120	0.06	
1988	1970	120	0.06	
1984	1270	130	0.10	
1980	2080	200	0.10	
2035	**3441**	**385**	**0.11**	

Figure D-7: Future Year Volume Estimate Computed using Linear Regression.

6. Using the above estimates of future volumes, determine the volume growth rate for ADT and B&C vehicles. For example, the per year growth rate between 2006 (current year) and 2035 (design year) can be computed as follows:

ADT Growth Rate = {(2035 ADT – 2006 ADT)/2006 ADT)}/{no. of years}

= {(3441 – 3170)/3170}/{2035-2016}

= 0.0029 or **0.3%** per year

B&C Growth Rate = {(2035 B&C – 2006 B&C)/2006 B&C)}/{no. of years}

= {(385 – 270)/270}/{2035-2016}

= 0.015 or **1.5%** per year

Caution: Growth rates should be used as a check to determine reasonableness of future volume estimates obtained by a trend line analyses. If growth rates seem too high or too low, they need to be adjusted and future volume estimates should be obtained directly by using the appropriate growth rate.

Caution: The R^2 (r-squared) value is a measure of how well the data fits the trend line. The closer the R^2 value is to 1.00 the better the fit. Data which result in an R^2 less than 0.75 should be evaluated for "outliers," which may be discarded to achieve a better "fit." In the above example, there is a large variation in volumes between 1980 and 1992. It may be appropriate to determine a trend beginning in the year 1988, i.e., by discarding volume data from 1980 to 1984 as 'outliers'. Judgment must be used to insure that (even with the removal of "outliers") an appropriate number of data points (usually no less than 5) are included in the trend line analyses.

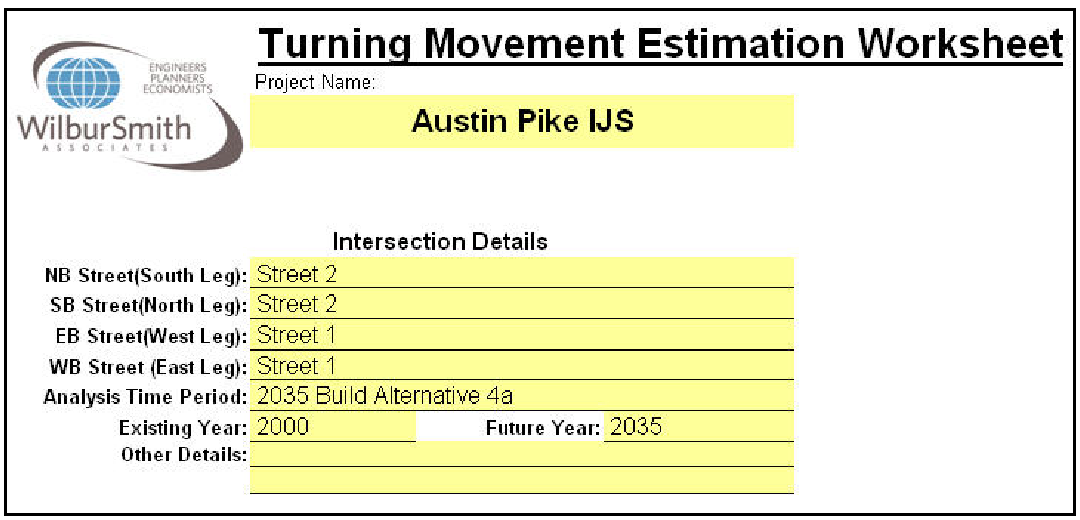
Caution: Blind use of future volume estimates using trend line analysis is not recommended. There also needs to be a check for reasonableness of projections based on external factors related to the project. For example, the above projections do not fully reflect potential changes to future roadway capacity and geometry. Nor do they account for land use changes in the vicinity. Adjustments for such changes should be accounted for along with the reasonableness check of the growth rates. All trend line projections need to be adjusted appropriately before being used for further analyses and design purposes.

3) Turning Movement Example

For several projects where future certified traffic volumes are needed, there is also a need for turning movement volumes at intersections for future years. Turning movement volumes are generally needed for the design hour rather than the ADT (24-hour) turning volumes. This section presents a methodology for deriving design hour turning volumes using an example data set. The process described below is based on a spreadsheet tool created with a user-friendly interface and it can be used for a regular 4-approach intersection. The Excel spreadsheet is called "NCHRP255 Turning Mvmt - 4-Leg Example (w User Interface).xls" and is available on the accompanying CD-ROM or can be obtained by contacting the Project Analysis Administrator at ODOT-OTS.

The spreadsheet tool has instructions for use with color-coded/shaded cells where users input data. The following steps discuss the application of this spreadsheet, using the NCHRP Report 255 estimation methods, in computing turning movement volumes. Each step below discusses different portion(s) of the spreadsheet.

1. Before using, save the spreadsheet with a different name so as not to accidentally modify the original file. Enter details of the project and the intersection in the top left corner of the spreadsheet, as shown in the example below.


Turning Movement Estimation Worksheet

Project Name:

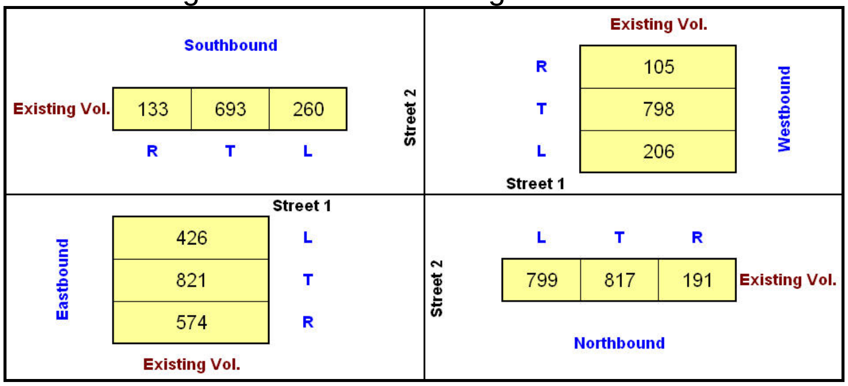
Austin Pike IJS

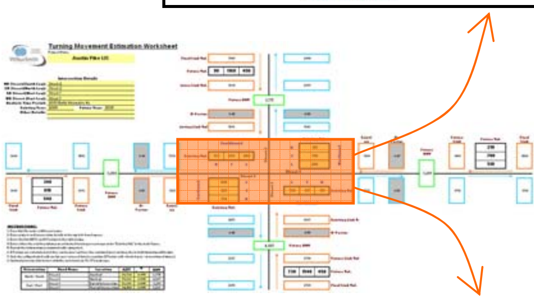
Intersection Details

NB Street(South Leg): Street 2
SB Street(North Leg): Street 2
EB Street(West Leg): Street 1
WB Street (East Leg): Street 1
Analysis Time Period: 2035 Build Alternative 4a
Existing Year: 2000 Future Year: 2035
Other Details:

Figure D-8: Project Details Entered in to the Turning Movement Estimation Worksheet.

2. Gather existing/base year turning movement volumes and enter them in the cells labeled ‘Existing Vol.” as shown in Figure D-9.





If turning volumes are required for a future new intersection, use estimates of turning percentages based on similar intersections and/or landuse in the vicinity or turning percentages can be obtained from a travel demand model.

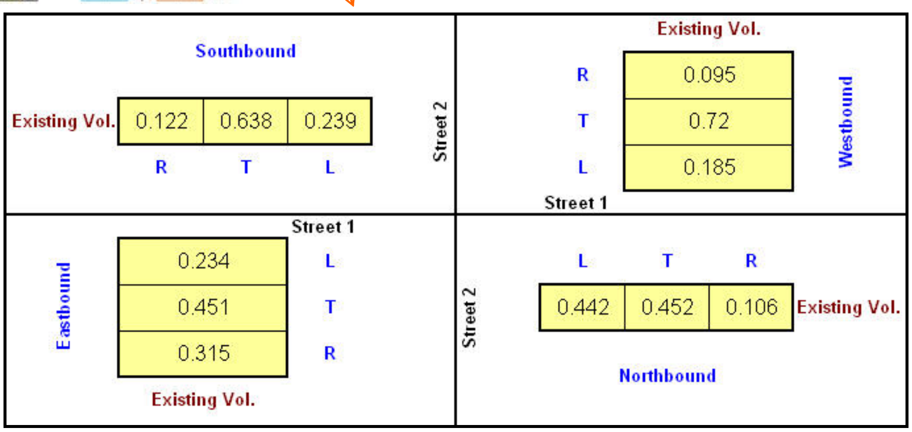
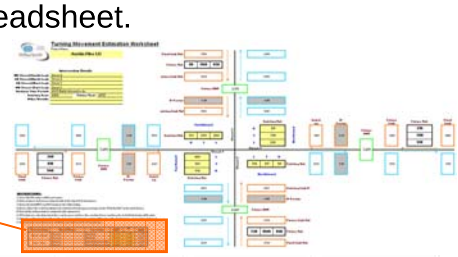


Figure D-9: Sample Data Set for the Turning Movement Example.

3. Obtain future year ADT and K-factors. Then enter the data into the table (shaded cells) on the lower left-hand side of the spreadsheet.



Orientation	Road Name	Location	ADT	K factor	DHV
North - South	Street 2	South of Intersection	39,734	0.095	3,775
	Street 2	North of Intersection	51,860	0.095	4,927
East - West	Street 1	East of Intersection	33,697	0.095	3,201
	Street 1	West of Intersection	34,404	0.095	3,268

Figure D-10: Sample ADT and K factor Data for the Turning Movement Example.

More details on obtaining future year ADTs and k-factors are included in Chapter 3. For each leg of the intersection, the Design Hour Volume (DHV) is automatically computed by multiplying the ADT and corresponding k factor:

Design Hour Volume (DHV) = ADT x k factor

4. From the existing turning volumes, the spreadsheet tool automatically computes existing directional link volumes (volumes approaching and departing each leg) by adding turning volumes of all appropriate movements. Then it calculates the directional distribution factor (d factor) for each leg.

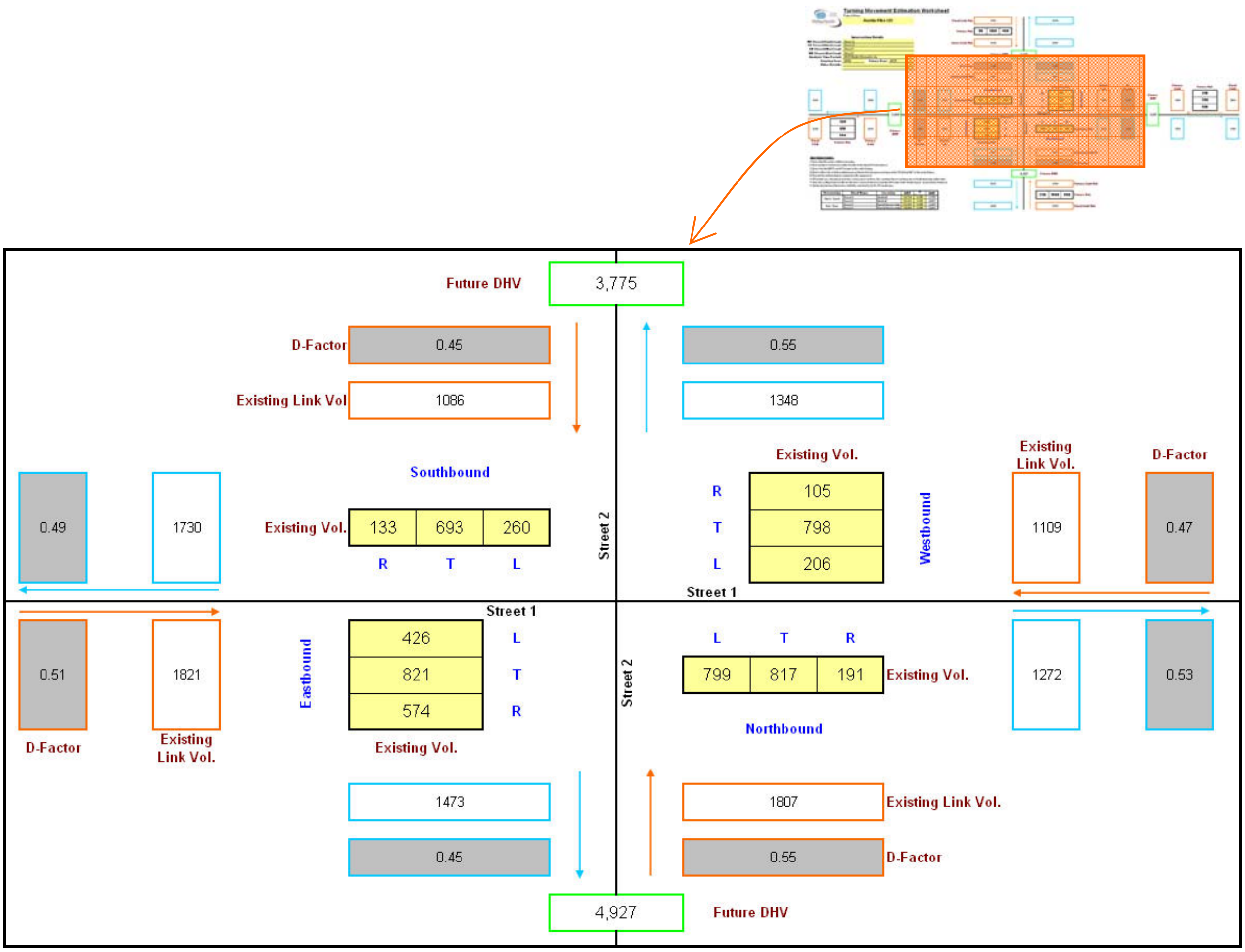


Figure D-11: Directional Distribution Factors Computed by the Turning Movement Worksheet.

5. The existing D-Factors, along with the future DHV (from step 3) are used to compute future year directional link volumes.

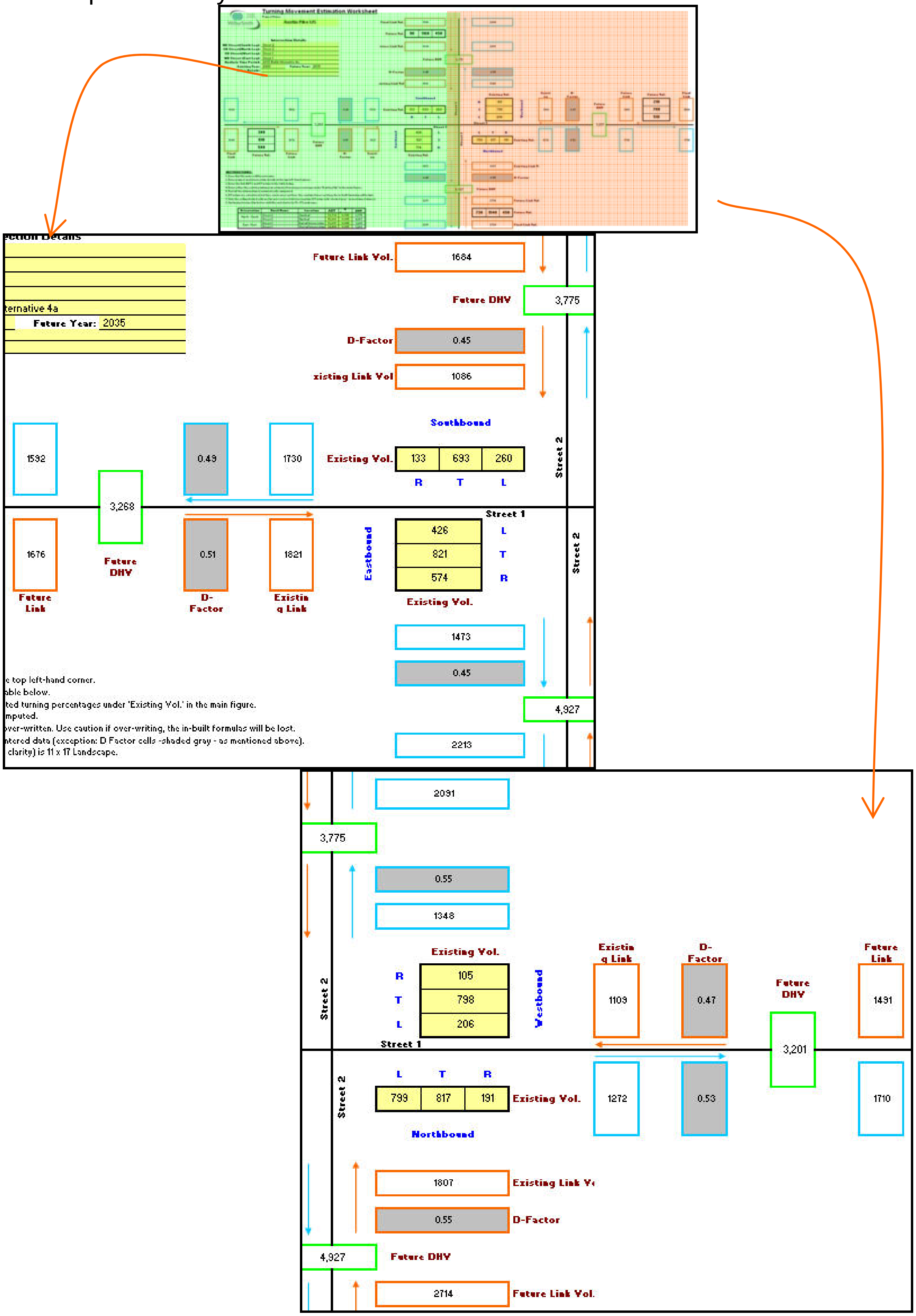


Figure D-12: Future Directional Link Volumes Computed Using Future DHV and Existing D-factors.

6. The future year directional link volumes and existing/base year directional link volumes (or turning percentage estimates) are automatically taken as inputs into a new tab labeled 'NCHRP Spreadsheet'. As the name suggests, this spreadsheet uses the iterative procedure detailed in NCHRP Report 255 (Chapter 8 Turning Movement Procedures).

   The data input structure for this spreadsheet is shown below in Figure D-13:

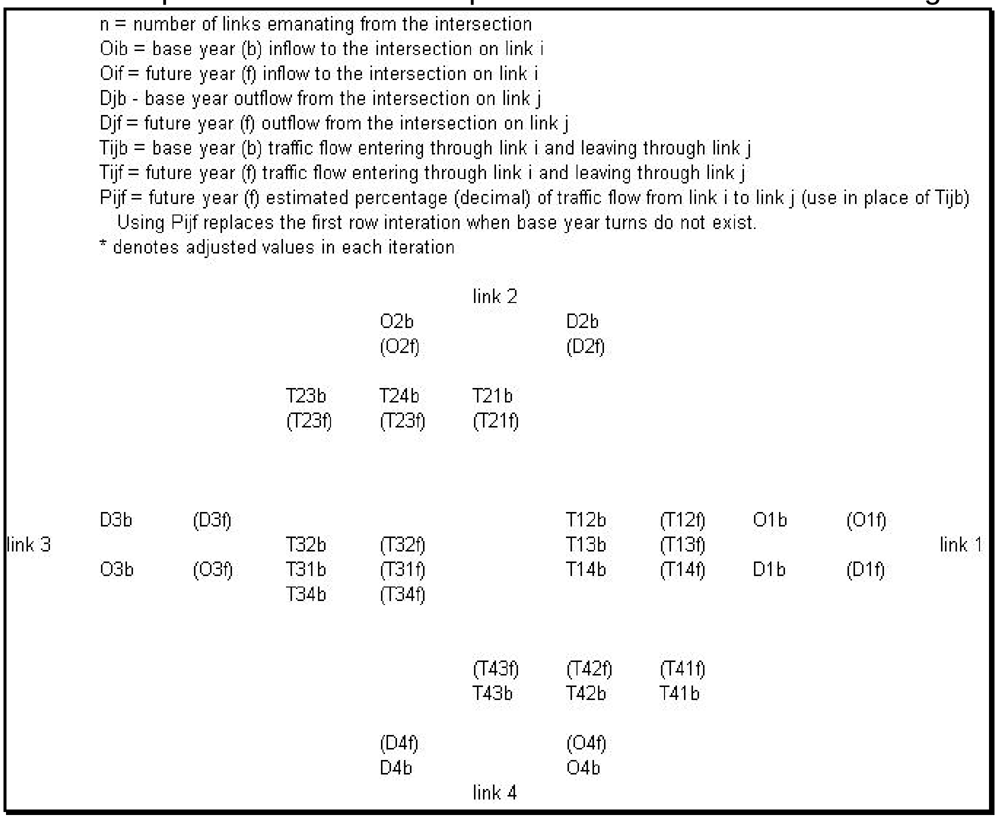


Figure D-13: Data Input Format for the Iterative Turning Movement Procedure of NCHRP Report 255.

   The example being followed in the previous steps, when input in the above format is shown in Figure D-14.

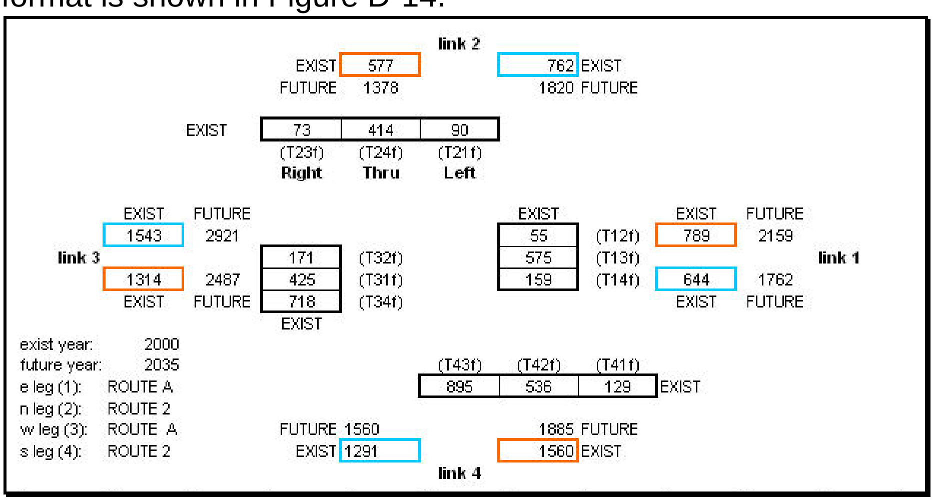


Figure D-14: Sample Data Set taken as Input for the NCHRP Report 255's Turning Movement Example.

7. The NCHRP Report 255 procedure involves balancing the traffic entering and leaving the intersection in alternative row/column iterations until a preset convergence (+/-10%) is reached. Typically 10 iterations are sufficient, but if convergence (within +/-10%) is not obtained after 10 iterations, the original turning percentages (or turning volumes) and/or future link volumes need to be reassessed.

   For the above example, the fifth row and column iteration results (i.e., the 9^{th} and 10^{th} iteration) are shown in Figure D-15.

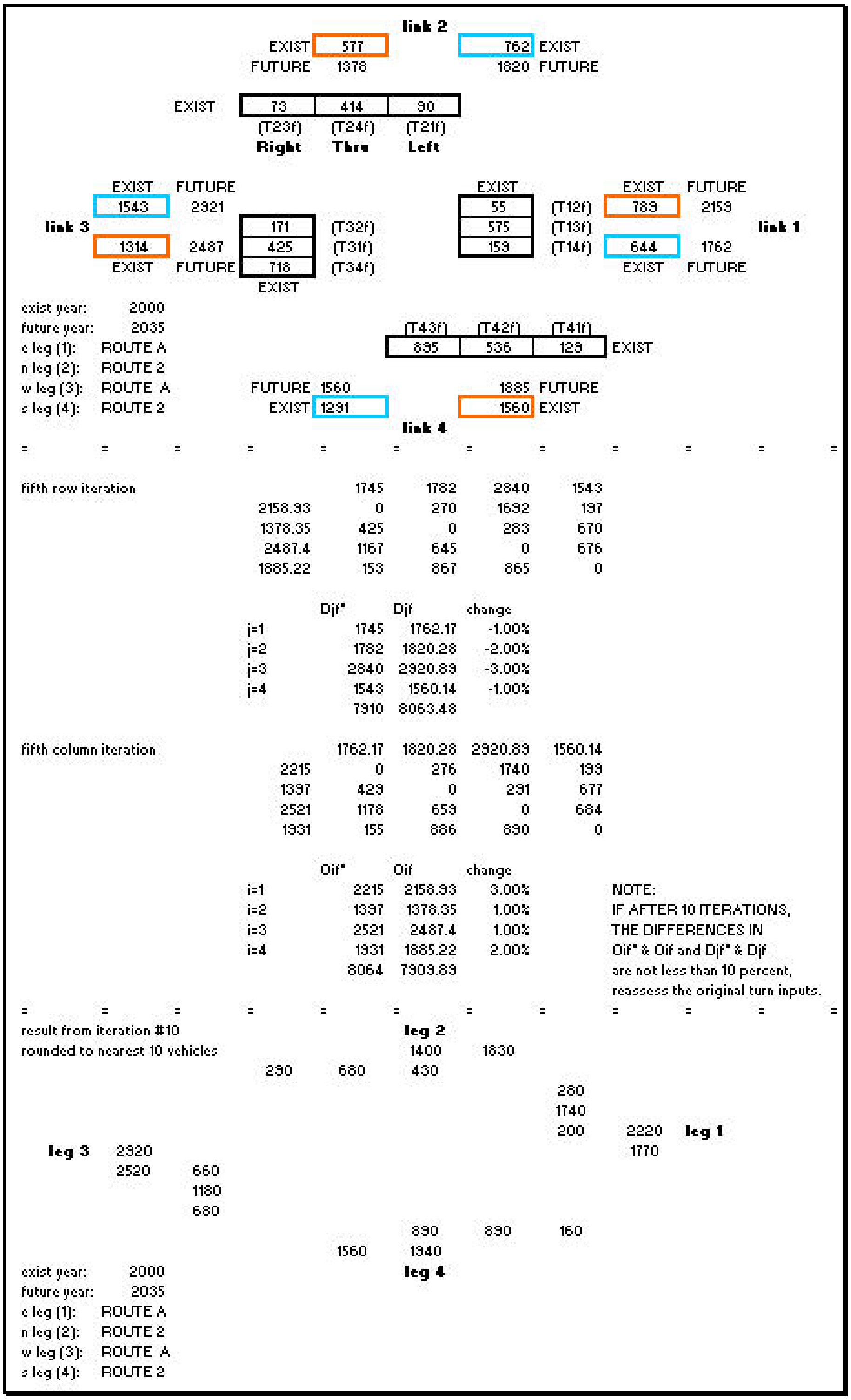


Figure D-15: Results of the Fifth Row and Fifth Column Iteration for the Sample Data Set.

8. The final result is automatically transferred back to the 'Volumes' tab and the final result is as shown in the Figure D-16. An 11 x 17 version of this figure is included at the end of this Appendix.

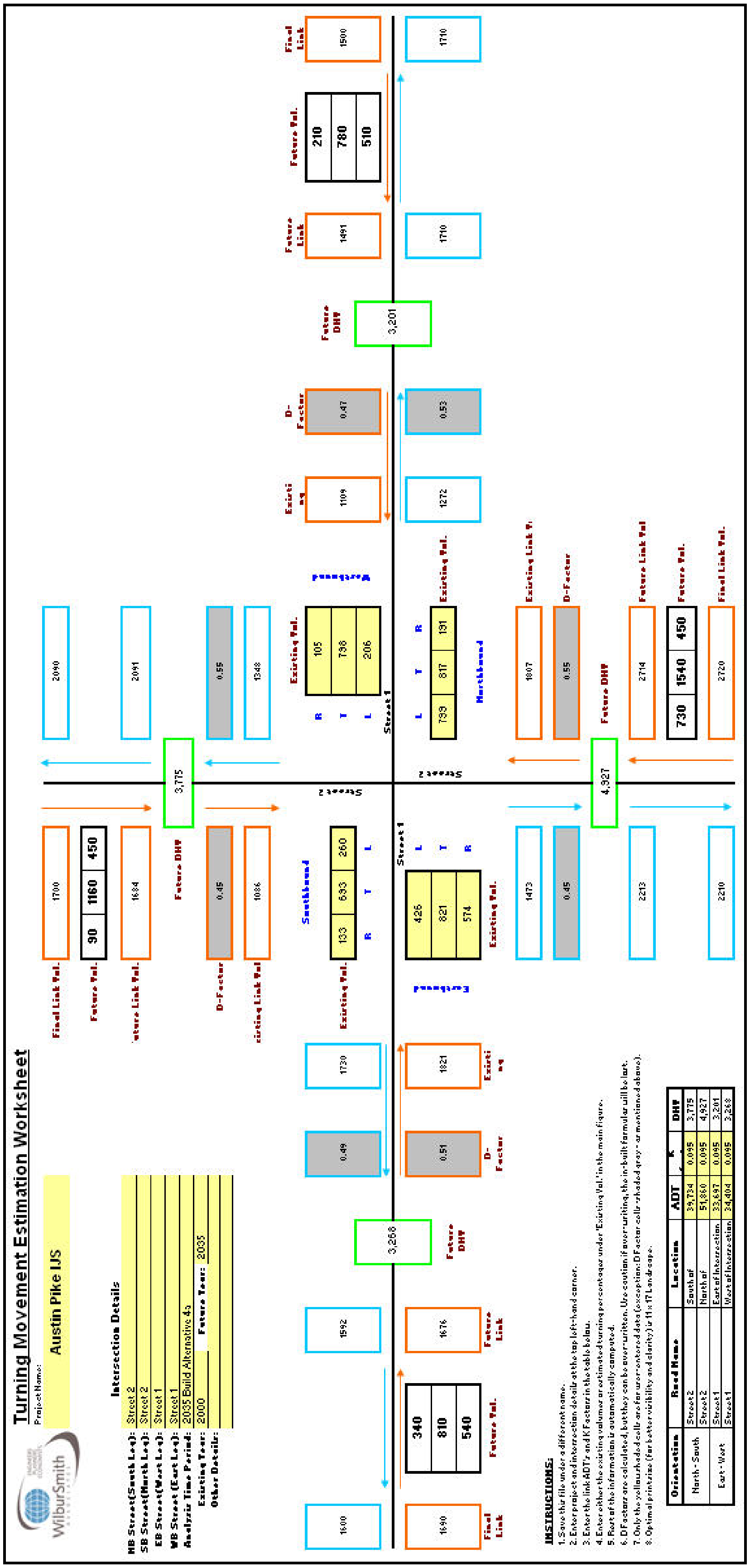


Figure D-16: Final Estimate of Future Year Turning Movement Volumes for the Sample Data Set.

Though the above example is for a four legged intersection, the process works for an intersection with less or more than four legs or approaches. Sample screenshots of the modified spreadsheet for a 5-leg and 6-leg intersection are shown in Figures D-17 and D-18.

					link 2					
				O2b		D2b				
				(O2f)		(D2f)				
		T23b	**T25b**	T24b	T21b					
		(T23f)	**(T25f)**	(T23f)	(T21f)					
	D3b	(D3f)				T12b	(T12f)	O1b	(O1f)	
link 3			T32b	(T32f)		T13b	(T13f)			link 1
	O3b	(O3f)	T31b	(T31f)		**T15b**	**(T15f)**	D1b	(D1f)	
			T34b	(T34f)		T14b	(T14f)			
			T35b	**(T35f)**						
EXIST	**FUTURE**			**(T45f)**	(T43f)	(T42f)	(T41f)			
D5b	**(D5f)**			**T45b**	T43b	T42b	T41b			
link 5				(D4f)		(O4f)				
		T53b	**(T53f)**	D4b		O4b				
O3b	**(O3f)**	**T52b**	**(T52f)**		link 4					
		T51b	**(T51f)**							
		T54b	**(T54f)**							
=	=	=	=	=	=	=	=	=	=	=
BEGIN HERE										
volume input					link 2					
			EXIST	12500		12500	EXIST			
			FUTURE	25000		25000	FUTURE			
	EXIST	1200	300	10000	1000					
		(T23f)	(T25f)	(T24f)	(T21f)					
	EXIST	FUTURE				EXIST		EXIST	FUTURE	
	6800	13600				1000	(T12f)	9250	18500	
link 3			1200	(T32f)		5000	(T13f)			link 1
	6800	13600	5000	(T31f)		250	(T15f)	9250	18500	
	EXIST	FUTURE	500	(T34f)		3000	(T14f)			
			100	(T35f)						
EXIST	FUTURE		EXIST							
850	1700			(T45f)	(T43f)	(T42f)	(T41f)			
				200	500	10000	3000	EXIST		
link 5		100								
850	1700	300		27400		27400	FUTURE			
		250		13700		13700	EXIST			
		200			link 4					
input:	2001									
output:	2005									
e leg (1):	East Ave									
n leg (2):	North Ave									
w leg (3):	West Ave									
s leg (4):	South Ave									
sw leg (5):	SW Blvd									

Figure D-17: NCHRP Report 255 - Turning Movement Volume Computation Spreadsheet Modified for a 5-leg Intersection.

					link 2								
				O2b		D2b		T62b	(T62f)				
				(O2f)		(D2f)		T63b	(T63f)	O6b	(O6f)		
								T65b	(T65f)				
		T23b	T25b	T24b	T21b	T26b		T64b	(T64f)	link 6			
		(T23f)	(T25f)	(T23f)	(T21f)	(T26f)		T61b	(T61f)				
										D6b	(D6f)		
						T16b	(T16f)						
	D3b	(D3f)	T32b	(T32f)		T12b	(T12f)	O1b	(O1f)				
link 3			T36b	(T36f)		T13b	(T13f)			link 1			
	O3b	(O3f)	T31b	(T31f)		T15b	(T15f)	D1b	(D1f)				
			T34b	(T34f)		T14b	(T14f)						
			T35b	(T35f)									
EXIST	FUTURE			(T45f)	(T43f)	(T42f)	(T46f)	(T41f)					
D5b	(D5f)			T45b	T43b	T42b	T46b	T41b					
link 5		T53b	(T53f)	(D4f)		(O4f)							
		T56b	(T56f)	D4b		O4b							
O5b	(O5f)	T52b	(T52f)		link 4								
		T51b	(T51f)										
		T54b	(T54f)										
=	=	=	=	=	=	=	=	=	=	=	=	=	=
BEGIN HERE													
volume input					link 2				20	(T62f)	Exist	Future	
			EXIST	12520		12520	EXIST		30	(T63f)	150	300	
			FUTURE	25040		25040	FUTURE		50	(T65f)			
									40	(T64f)	link 6		
	EXIST	1200	300	10000	1000	20			10	(T61f)			
		(T23f)	(T25f)	(T24f)	(T21f)	(T26f)					150	300	
						EXIST							
	EXIST	FUTURE				10	(T16f)	EXIST	FUTURE				
	6830	13660	1200	(T32f)		1000	(T12f)	9260	18520				
link 3			30	(T56f)		5000	(T13f)			link 1			
	6830	13660	5000	(T31f)		250	(T15f)	9260	18520				
	EXIST	FUTURE	500	(T34f)		3000	(T14f)						
			100	(T35f)									
EXIST	FUTURE		EXIST										
900	1800			(T45f)	(T43f)	(T42f)	(T46f)	(T41f)					
		100	(T53f)	200	500	10000	40	3000	EXIST				
link 5		50	(T56f)										
900	1800	300	(T52f)	27480		27480	FUTURE						
		250	(T51f)	13740		13740	EXIST						
		200	(T54f)		link 4								
input:	2001												
output:	2005												
e leg (1):	CENTRAL												
n leg (2):	MONROE												
w leg (3):	CENTRAL												
s leg (4):	NORTHWOOD												
sw leg (5):	MONROE												
ne leg (6)	NORTHWOOD												

Figure D-18: NCHRP Report 255 - Turning Movement Volume Computation Spreadsheet Modified for a 6-leg Intersection.

Turning Movement Estimation Worksheet

Project Name:

Austin Pike IJS

Intersection Details

NB Street(South Leg):	Street 2
SB Street(North Leg):	Street 2
EB Street(West Leg):	Street 1
WB Street (East Leg):	Street 1
Analysis Time Period:	2035 Build Alternative 4a
Existing Year:	2000
Future Year:	2035
Other Details:	

North Leg (Street 2)

	Southbound	Northbound
Final Link Vol.	1700	2090
Future Vol.	90 / 1160 / 450	
Future Link Vol.	1684	2091
D-Factor	0.45	0.55
Existing Link Vol	1086	1348

Future DHV: 3,775

Southbound Existing Vol.

R	T	L
133	693	260

Westbound Existing Vol.

R	105
T	798
L	206

East Leg (Street 1)

	Westbound	Eastbound
Existing Link Vol.	1109	1272
D-Factor	0.47	0.53
Future Link Vol.	1491	1710
Future Vol.	210 / 780 / 510	
Final Link Vol.	1500	1710

Future DHV: 3,201

West Leg (Street 1)

	Westbound	Eastbound
Final Link Vol.	1600	1690
Future Vol.		340 / 810 / 540
Future Link Vol.	1592	1676
D-Factor	0.49	0.51
Existing Link Vol.	1730	1821

Future DHV: 3,268

Eastbound Existing Vol.

L	426
T	821
R	574

Northbound Existing Vol.

L	T	R
799	817	191

South Leg (Street 2)

	Southbound	Northbound
Existing Link Vol.	1473	1807
D-Factor	0.45	0.55
Future Link Vol.	2213	2714
Future Vol.		730 / 1540 / 450
Final Link Vol.	2210	2720

Future DHV: 4,927

INSTRUCTIONS:
1. Save this file under a different name.
2. Enter project and intersection details at the top left-hand corner.
3. Enter the link ADT's and K Factors in the table below.
4. Enter either the existing volumes or estimated turning percentages under 'Existing Vol.' in the main figure.
5. Rest of the information is automatically computed.
6. D Factors are calculated, but they can be over-written. Use caution if over-writing, the in-built formulas will be lost.
7. Only the yellow shaded cells are for user-entered data (exception: D Factor cells -shaded gray - as mentioned above).
8. Optimal print size (for better visibility and clarity) is 11 x 17 Landscape.

Orientation	Road Name	Location	ADT	K factor	DHV
North - South	Street 2	South of Intersection	39,734	0.095	3,775
	Street 2	North of Intersection	51,860	0.095	4,927
East - West	Street 1	East of Intersection	33,697	0.095	3,201
	Street 1	West of Intersection	34,404	0.095	3,268

4) Modeling Spreadsheet Example

Future year traffic volumes obtained from a Travel Demand Model (TDM) need to be refined before being used as certified traffic.

There are several types of TDMs in use in Ohio, as explained further in Section 4.4. A screen-capture of Ohio's Interim statewide TDM is shown in Figure D-19 below.

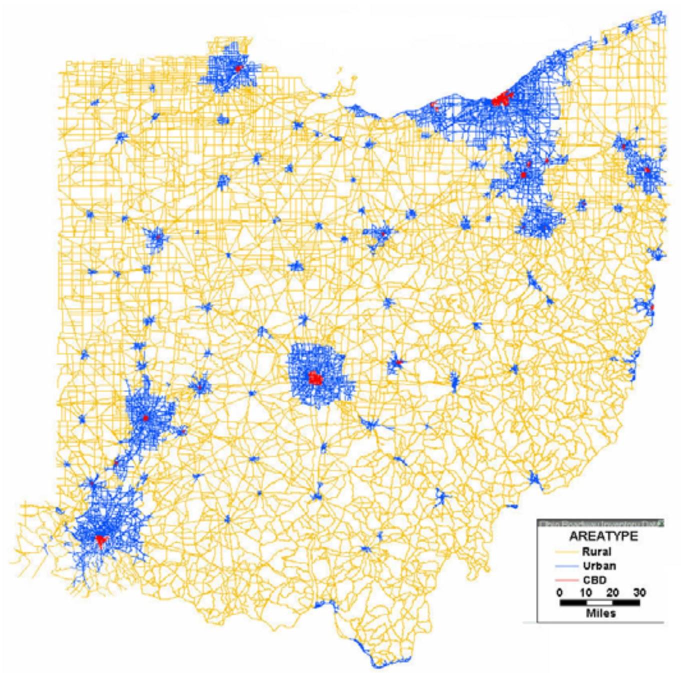


Figure D-19: Ohio's Statewide Travel Demand Model.

A portion of the Cincinnati MPO (OKI) model is shown in Figure D-20.

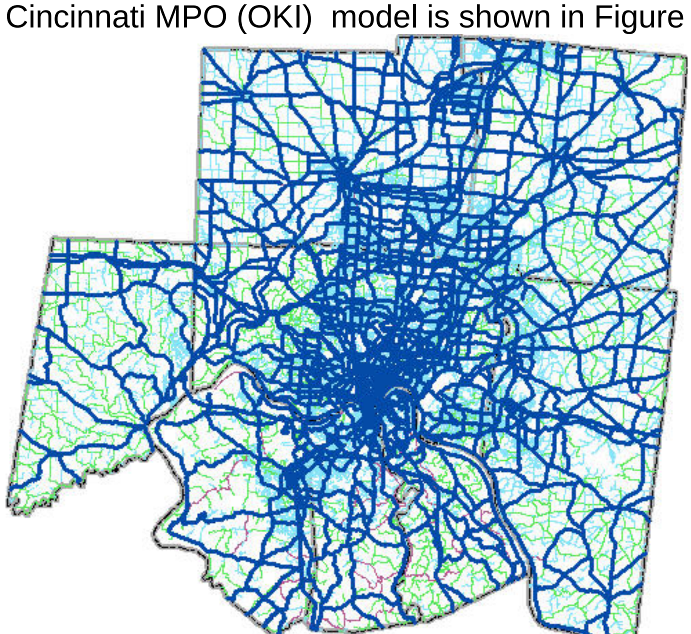


Figure D-20: Screen capture of a portion of OKI's Travel Demand Model.

An example of future year volumes obtained from a travel demand model run is shown below. Figure D-21 shows model assigned link volumes by direction for a future year.

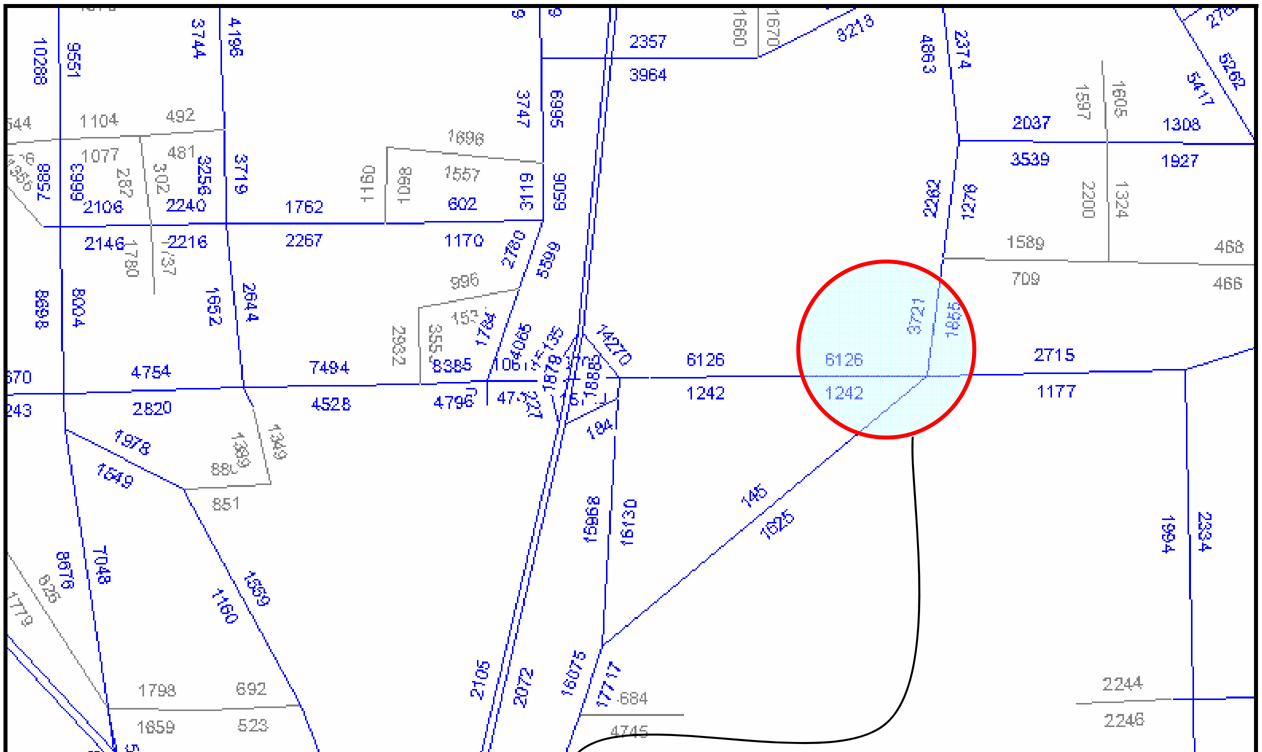


Figure D-21: Example of Link Volume Assignments Obtained from a Model Run.

	COL 1	COL 2	COL 3	COL 4	COL 5	COL 6	COL 7	COL 8	COL 9	COL 10		COL 12	COL 13	COL 14	COL 15	COL 16	COL 17
	USER INPUT	FINAL REFINED FORECAST										interpolate opening & design year from most recent count and adjusted future year forecast					
		COUNT		2000		2030				Selected		most recent	most recent	2009	2029	growth factors	
	Road/Link	year	COUNT	Ab	Ab interpolate	Af	RATIO	DIFF	RAf	Adjustment		count data	count year	opening year	design yr	opening yr	design year
(east leg)	Road A	2000	40000	42390	42390	45560	42991	43170	43081	RAf		40000	2005	40493	42957	1.0123	1.0739
(north leg)	Road B	1995	16300	13060	10791.667	26670	40283	32178.333	36231	RAf		16300	2005	19489	35433	1.1956	2.1738
(south leg)	Road C	2000	3300	6640	6640	14060	6988	10720	8854	RATIO		3650	2005	4184	6854	1.1463	1.8778
(west leg)	Road D	2001	4000	4590	4921.3333	14530	11810	13608.667	12709	RAf		4000	2005	5393	12361	1.3483	3.0903

Figure D-22: Example of a Volume Adjustment Spreadsheet.

The volume assignments obtained from a TDM need to be refined by comparing actual base year traffic counts to model generated base year volumes and applying any differences to the model generated future year volumes.

A detailed description and methodology for conducting such a refinement can be found in the NCHRP Report 255. A spreadsheet (Figure D-22) has been created to automate the NCHRP Report 255 methodology. (A copy of this spreadsheet is included in the CD-ROM).

Figure D-23 below shows the definition for each column in the NCHRP Report 255 spreadsheet. The yellow shaded variables indicate user inputs. The non-shaded variables are automatically calculated.

COLUMN	VARIABLE	DEFINITION
1	**Road/Link**	The name/route number of each facility bisected by the screenline and/or the link (node) numbers from the network.
2	**COUNT year**	year of the actual base year traffic count
3	**COUNT**	actual base year traffic count
4	**Ab**	base year traffic assignment - user to input year
5	$Ab^{interpolate}$	interpolation between base and future year assignment -- used when year of count data differs from base year assignment
6	**Af**	future year traffic assignment - user to input year
7	**RATIO**	adjusted future year traffic forecast (**COUNT/Ab**) * **Af**
8	**DIFF**	adjusted future year traffic forecast (**COUNT** - **Ab**) + **Af**
9	**RAf**	adjusted future year traffic forecast (AVERAGE(**RATIO**, **DIFF**))
10	**Selected Adjustment**	Selects the type of future year adjustment based on the ratio of actual base year traffic count to interpolated base year traffic assignment
12	**most recent count data**	most recently available actual count data for the facility
13	**most recent count year**	year of the most recently available actual count data
14	**opening year**	final refined forecast for the opening year - user to input year
15	**design year**	final refined forecast for the design year - user to input year
16	**growth factor opening year**	growth factor to apply to most recent count to obtain opening year
17	**growth factor design year**	growth factor to apply to most recent count to obtain design year

Figure D-23: Definition for each Column of the NCHRP Report 255 Adjustment Spreadsheet.

5) Non-Interstate Bridge Projects Design Designation Worksheet

NON-INTERSTATE BRIDGE PROJECT DESIGN DESIGNATION WORKSHEET			
1A	Enter the PID:		1A
1B	Enter the County-Route-Log or other identifier:		1B
2A	Enter the Existing ADT (Total Vehicles):		2A
2B	Enter 24-hour B&C (commercial) volume if available:		2B
2C	Enter the Existing Year:		2C
3	Enter the Opening Year:		3
4	Enter the Design Year:		4
5A	Enter the number of years from the Existing Year to the Opening Year: **(3) - (2C) =**		5A
5B	Enter the number of years from the Existing Year to the Design Year: **(4) - (2C) =**		5B
6	Select a growth rate from the following range of rates: Stable .0025-.0050 Moderate .0100-.0200 Low .0050-.0100 High .0200-.0300		6
7	Enter the Opening Year Factor: **[(6) x (5A)]+1 =**		7
8	Enter the Design Year Factor: **[(6) x (5B)]+1 =**		8
9	Enter the Opening Year ADT: **(2A) x (7) =** Round to nearest 100 vehicles (nearest 10 vehicles if < 1000)		9
10	Enter the Design Year ADT: **(2A) x (8) =** Round to nearest 100 vehicles (nearest 10 vehicles if < 1000)		10
11A	Enter K, selected from the following table of Design Year ADT : < 1000 .12 5001 - 15000 .10 1001 - 5000 .11 15001 < .09		11A
11B	Enter the DHV: **(10) x (11A)**		11B
12	Enter the D factor (for DDHV): within an MPO area: .60 outside an MPO area: .55 any one-way bridge: 1.00		12
13	Enter the T24 factor (the proportion of B&C vehicles in ADT): **[(2B)/(2A)]** or **.03** if (2B) is blank		13
14	Enter the TD factor (the proportion of B&C vehicles in the design hour): **(13) x 0.6**		14

Figure D-24: Page 1 of the Non-Interstate Bridge Project Design Designation Worksheet.

NON-INTERSTATE BRIDGE PROJECT DESIGN DESIGN DESIGNATION WORKSHEET		
15 COMMENTS		15
DESIGN DESIGNATION (summarized from above) PID		1A
County-Route-Log		1B
Opening Year ADT =		9
Design Year ADT =		10
DHV =		11B
D =		12
T24 =		13
TD =		14

Figure D-25: Page 2 of the Non-Interstate Bridge Project Design Designation Worksheet.

Appendix E

Example Traffic Forecasts

Reports:

1) Certified Simple Traffic Forecast Example
2) Certified Complex Traffic Forecast Example

1) Certified Simple Traffic Forecast Example

SIMPLE PROJECT – CERTIFIED TRAFFIC COMPUTATION STEPS (SUMMARY)

STEP 1 — Review project details in ELLIS, using PID code. Figure E-1 shows an example of an ELLIS project description.

Ohio Department of Transportation:
ELLIS Reporting

User: loesterl
Date: 09/21/2006

Basic Project Information

Project Name:	ASD SR 0060 00.68	**PID:**	80173
Project Status:	Active	**Responsible District:**	D3
Project Type:	Let	**Locale:**	ASD
Project Description:	Resurface SR60 from SR3 (0.68) to Hayesville South Corp (10.56)		

Detailed Project Information

Letting Type:	ODOT Let	**Project Manager:**	STOVER, DAVID E
Work Categories:	**Preservation** • Minor Rehabilitation - Pavement Gnrl Sys	**Contract Features:**	
Primary Work Category:	Minor Rehabilitation - Pavement Gnrl Sys	**Environmental Document Type:**	
Project Purpose:	Preservation	**Trac Tier:**	
Designers:	• DISTRICT 3 PRODUCTION	**Program Family:**	
Responsible Design Agency:	DISTRICT 3 PRODUCTION	**Federal Congressional District:**	16
Sponsoring Agency:	ODOT SPONSORING AGENCY	**Demo ID:**	
Plans Measurement Type:	English Units	**Reservoir Year:**	
FHWA Oversite:		**FHWA Project Type:**	
Reporting Group Codes:	• TMS 16 Minor Rehab - General & Urban Sys • CO PDP Class - "Minor"	**Primary MPO:**	
Project Termini:	SR3 (0.68) to Hayesville South Corp (10.56)		

Figure E-1: Example of ELLIS Project Description.

STEP 2 — Gather historic and current traffic counts from ODOT-OTS, Traffic Sections' Traffic Survey Reports, or from other relevant sources. Figure E-2 shows an example of a short term hourly count data file.

04/12/06 Ohio Department of Transportation Page: 1
14:26:19 Office of Technical Services
Traffic Section - 2nd Floor North
Columbus, Ohio 43223
(614) 466-3727

*** Volume By Type By Lane Report (#207) ***

Site ID : 000000004003 Data Starts : 08:00 on 04/04/06
Info 1 : Data Ends : 09:00 on 04/07/06
Info 2 : Adj. Factor : 1.000%

Lane #1 Info : 11
Modes : AXLE
Sensors : Axle-Axle Sensor Spacing: 4.0'

Lane #2 Info : 15
Modes : AXLE
Sensors : Axle-Axle Sensor Spacing: 4.0'

Date	Time	Lane	#1 Cycle	#2 Cars	#3 2A-4T	#4 Buses	#5 2A-SU	#6 3A-SU	#7 4A-SU	#8 4A-ST	#9 5A-ST	#10 6A-ST	#11 5A-MT	#12 6A-MT	#13 Other	Total
04/04/06	08:00	#1	0	69	34	0	1	4	0	2	4	0	1	0	1	116
Tue		#2	0	53	16	0	2	1	0	1	6	0	0	0	0	79
		ALL	0	122	50	0	3	5	0	3	10	0	1	0	1	195
	09:00	#1	0	53	14	0	2	2	0	0	3	1	0	0	0	75
		#2	0	48	21	1	1	0	0	0	3	1	0	0	0	75
		ALL	0	101	35	1	3	2	0	0	6	2	0	0	0	150
	10:00	#1	0	53	17	0	1	2	0	1	4	0	1	0	1	80
		#2	0	40	16	1	3	3	0	1	10	0	0	0	0	74
		ALL	0	93	33	1	4	5	0	2	14	0	1	0	1	154
	11:00	#1	0	55	32	2	2	0	0	1	1	0	0	0	1	94
		#2	0	43	14	0	1	1	0	1	1	0	1	0	0	62
		ALL	0	98	46	2	3	1	0	2	2	0	1	0	1	156

**** AM Peak Hours ****

Date	Time	Lane	#1 Cycle	#2 Cars	#3 2A-4T	#4 Buses	#5 2A-SU	#6 3A-SU	#7 4A-SU	#8 4A-ST	#9 5A-ST	#10 6A-ST	#11 5A-MT	#12 6A-MT	#13 Other	Total
03/12/03	07:00	#1	0	100	30	0	1	0	0	1	3	0	0	0	0	135
	Percent		0.00	74.07	22.22	0.00	0.74	0.00	0.00	0.74	2.22	0.00	0.00	0.00	0.00	
03/12/03	07:00	#2	0	70	34	1	4	1	0	0	3	1	0	0	0	114
	Percent		0.00	61.40	29.82	0.87	3.50	0.87	0.00	0.00	2.63	0.87	0.00	0.00	0.00	
03/12/03	07:00	ALL	0	170	64	1	5	1	0	1	6	1	0	0	0	249
	Percent		0.00	68.27	25.70	0.40	2.00	0.40	0.00	0.40	2.40	0.40	0.00	0.00	0.00	

**** PM Peak Hours ****

Date	Time	Lane	#1 Cycle	#2 Cars	#3 2A-4T	#4 Buses	#5 2A-SU	#6 3A-SU	#7 4A-SU	#8 4A-ST	#9 5A-ST	#10 6A-ST	#11 5A-MT	#12 6A-MT	#13 Other	Total
03/10/03	16:00	#1	0	92	28	0	2	0	0	0	0	0	0	0	0	122
	Percent		0.00	75.40	22.95	0.00	1.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
03/10/03	17:00	#2	0	99	31	0	0	1	0	0	1	0	0	0	0	132
	Percent		0.00	75.00	23.48	0.00	0.00	0.75	0.00	0.00	0.75	0.00	0.00	0.00	0.00	
03/10/03	16:00	ALL	0	183	56	0	5	0	0	0	1	2	0	0	0	247
	Percent		0.00	74.08	22.67	0.00	2.02	0.00	0.00	0.00	0.40	0.80	0.00	0.00	0.00	

Figure E-2: Short Term Hourly Count Data File.

STEP 3 — Determine K & D factors for the appropriate functional classification of the roadway for which traffic forecasts are needed. The K & D factors report, available from the Traffic Monitoring section of ODOT-OTS, is derived from all of Ohio's Automatic Traffic Recorders (ATR) and sorted by function classification. (See Chapter 3 for a detailed discussion on how to estimate K & D factors.)

K-factor, expressed as a percent, is the proportion of daily traffic occurring during the design hours. D-factor, expressed as a percent, is the proportion of traffic moving in the peak direction during the design hour. Values represent the 30th highest hour of the year in which the ATR data is obtained. Figure E-3 is an example of the data in a K & D factors report.

K and D Factors by Functional Classification for the 30th Highest Hour

FN CL	STA	CO-RT-LG	YEAR	ADT	30 HR VOL	HR	PEAK DIR (D)	K
6	46	WAY-83R-6.64	1997	4310	450	16	57.8%	10.441%
6	46	WAY-83R-6.64	1998	4660	470	18	51.1%	10.086%
6	46	WAY-83R-6.64	1999	4810	690	19	50.7%	14.345%
6	46	WAY-83R-6.64	2000	4790	480	17	56.3%	10.021%
6	46	WAY-83R-6.64	2001	4680	470	12	59.6%	10.043%
6	46	WAY-83R-6.64	2002	4610	480	17	55.3%	10.412%
6	46	WAY-83R-6.64	2003	4590	460	18	54.3%	10.022%
6	46	WAY-83R-6.64	2004	4380	440	18	56.8%	10.046%
6	53	UNI--31R-13.86	1997	3390	350	18	54.3%	10.324%
6	53	UNI--31R-13.86	1998	3400	350	17	57.1%	10.294%
6	53	UNI--31R-13.86	1999	3500	360	18	50.0%	10.286%
6	53	UNI--31R-13.86	2000	3350	350	18	51.4%	10.448%
6	53	UNI--31R-13.86	2001	3510	360	17	61.1%	10.256%
6	53	UNI--31R-13.86	2002	3840	390	17	51.3%	10.156%
6	53	UNI--31R-13.86	2003	3570	390	18	56.4%	10.924%
6	53	UNI--31R-13.86	2004	3850	400	17	52.5%	10.390%
6	53	UNI--31R-13.86	2005	3950	400	18	57.5%	10.127%

Report Item	Description
FN CL	Functional Classification
STA	ATR Station Number
YEAR	Year of Data
ADT	Average Daily Traffic
30 HR VOL	30th Highest Hour Volume
HR	Hour of Day the 30th Highest Hour Volume Occurred
K	K Factor
D	D Factor

Figure E-3: Example of a K & D Factors Report.

STEP 4 — Calculate opening and design year traffic using linear regression analyses and/or NCHRP Report 255 methods (for Interim Statewide Model assignments, when available, see Figure E-4 for example).

NCHRP	**if count/Ab <= 0.5 then; use RATIO**				**if count/Ab >= 2 then; use DIFF**							
COL	COL	COL	COL	COL	COL	**COL**	*interpolate opening & design year from most recent count and future refined volume*					
1	2	4	5	6	7	**8**	2006					
	2000	2000	2018	adjust	adjust	**2018**	LATEST		**use avg**	**use avg**	yrly grwth	
	COUNT	Ab	Af	Ratio	Diff	**RAf**	ESTIMATE	yr	**2009**	**2021**	06 to 20	
SR 60 n of SR 3	3060	2531	3505	4237.574	4034	**4135.8**	3170	2006	***3410***	***4380***	2.73%	1.381703
SR 60 n of SR 95	2710	7137	8689	3299.312	4262	**3780.7**	2750	2006	***3010***	***4040***	3.35%	1.469091
COUNT	ACTUAL BASE YEAR TRAFFIC COUNT											
Ab	BASE YEAR ASSIGNMENT			I:\ut\Statewide Model\interimmod\proj\Acc_Ohio_jobsprogress\JP_NETVOLS_30.MAP (Base year)								
Af	FUTURE YEAR ASSIGNMENT			I:\ut\Statewide Model\interimmod\proj\Acc_Ohio_jobsprogress\JP_NETVOLS_30.MAP (J&P 2018)								
RAf	***ADJUSTED FUTURE YEAR FORECAST***											

Figure E-4: Example for Computing Design Traffic Using NCHRP Report 255 Methods from Interim Statewide Model assignments.

For regression analyses use data gathered in Steps 2 and 3 and use any software that enables statistical analyses. Use the coefficients obtained from linear regression analyses of historical data to compute the projected traffic volumes for the future years.

Figure E-5 shows an example of a regression analyses in the Excel spreadsheet software. Regression analyses should be run separately to obtain different set of coefficients for projecting total traffic (ADT) and heavy vehicle (B & C commercial vehicles).

ASD 60	**1.22**	**N. CORP. LOUDONVILLE**	
TSR	**ADT**	**B&C**	**T24**
2006	3170	270	0.09
2003	3100	190	0.06
2000	3060	240	0.08
1992	1860	120	0.06
1988	1970	120	0.06
1984	1270	130	0.10
1980	2080	200	0.10
2009	**3550**	279	0.08
2021	**4533**	376	0.08
09 to 21	2.31%	2.90%	
06 to 21	2.87%	2.62%	

ADT

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.943657262
R Square	0.890489028
Adjusted R Square	0.85398537
Standard Error	250.9998653
Observations	5

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1536877.203	1536877.203	24.3945152	0.015917907
Residual	3	189002.7972	63000.9324		
Total	4	1725880			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-161103.7762	33151.25521	-4.859658411	0.016638608	-266605.9649	-55601.58758	-266605.9649	-55601.58758
X Variable 1	81.95804196	16.59378575	4.9390804	0.015917907	29.14916027	134.7669236	29.14916027	134.7669236

B&C

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.898730051
R Square	0.807715705
Adjusted R Square	0.74362094
Standard Error	34.60188159
Observations	5

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	15088.12937	15088.12937	12.60189823	0.038093
Residual	3	3591.870629	1197.29021		
Total	4	18680			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-16035.39336	4570.105271	-3.508757984	0.039232889	-30579.52163	-1491.265079	-30579.52163	-1491.265079
X Variable 1	8.120629371	2.287555848	3.549915242	0.038093	0.840598886	15.40065986	0.840598886	15.40065986

Figure E-5: Example of an Excel Spreadsheet Used for Linear Regression Analyses.

STEP 5 — Report the calculated certified traffic data, including figures showing turning volumes (if requested) to the requestor in an Inter Office Communication memo. A sample memo with certified traffic data is shown in Figure E-6.

INTER-OFFICE COMMUNICATION

TO: Mike Schafrath, P.E., Roadway Team Leader, Production-District 3

FROM: Leigh A. Oesterling, Transportation Planner, Office of Technical Services

SUBJECT: ASD-60-0.68, PID 80173

DATE: August 22, 2006

In reply to an e-mailed request dated August 2, 2006, please use the following design designations:

PID 80173
ASD-SR 60

log pt.	*0.68 -1.22*	*1.22 - 5.61*	*5.61 - 10.56*
2009 ADT =	3280	3550	2900
2021 ADT =	3590	4530	3450
DHV =	360	450	350
(K =	*0.10*	*0.10*	*0.10)*
D =	0.55	0.55	0.60
T24 =	0.09	0.09	0.09
TD =	0.05	0.05	0.05

If you have any questions, please contact me at (614) 752-5747.

LAO:lo

c: J. McQuirt, OTS - P. Siddle, OTS - File

Figure E-6: Example of a Certified Traffic reported via an IOC memo.

2) Certified Complex Traffic Forecast Example

COMPLEX PROJECT – CERTIFIED TRAFFIC COMPUTATION STEPS (SUMMARY)

All except STEP 4 are same as in “Simple Project” listed above. STEP 4 for a complex project is a bit more extensive and involves the following.

STEP 4 — Using an appropriate travel demand model, run assignments for ‘no-build’ and ‘build’ scenarios for existing, opening and design years.

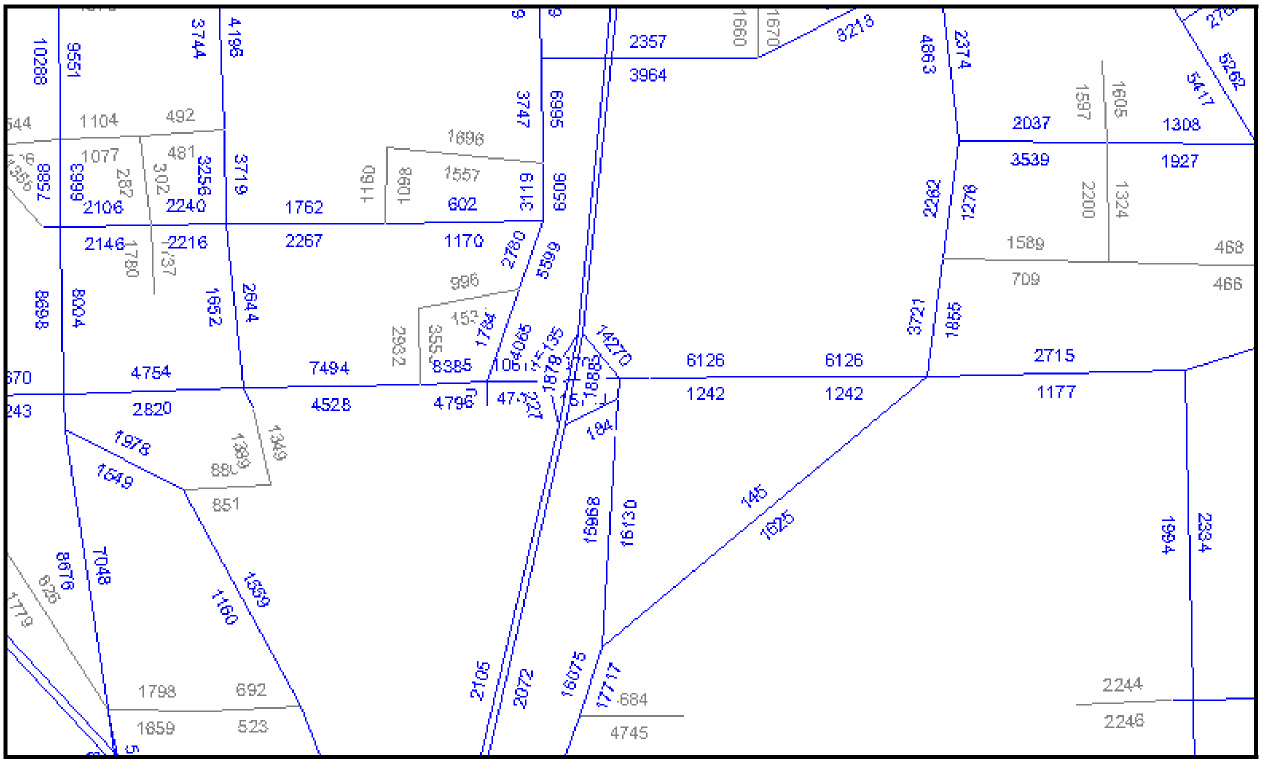


Figure E-7: Example of a Traffic Assignment Map from a Travel Demand Model Run.

STEP 4a – Adjust link volume assignments using screenline analyses. Screenline analyses is a refinement process that adjusts traffic volumes crossing a screenline by looking at the relationships between base and future year traffic counts, traffic assignments and link capacities. The initial part of this analysis involves selecting screenlines that cross all the links that need refinement. The NCHRP Report 255 has detailed discussion on the refinement process (Chapter 4 Refinement of Computerized Traffic Volume Forecasts).

Figures E-8 and E-9 show an example of selecting screenlines as well as a spreadsheet showing the screenline adjustment methodology.

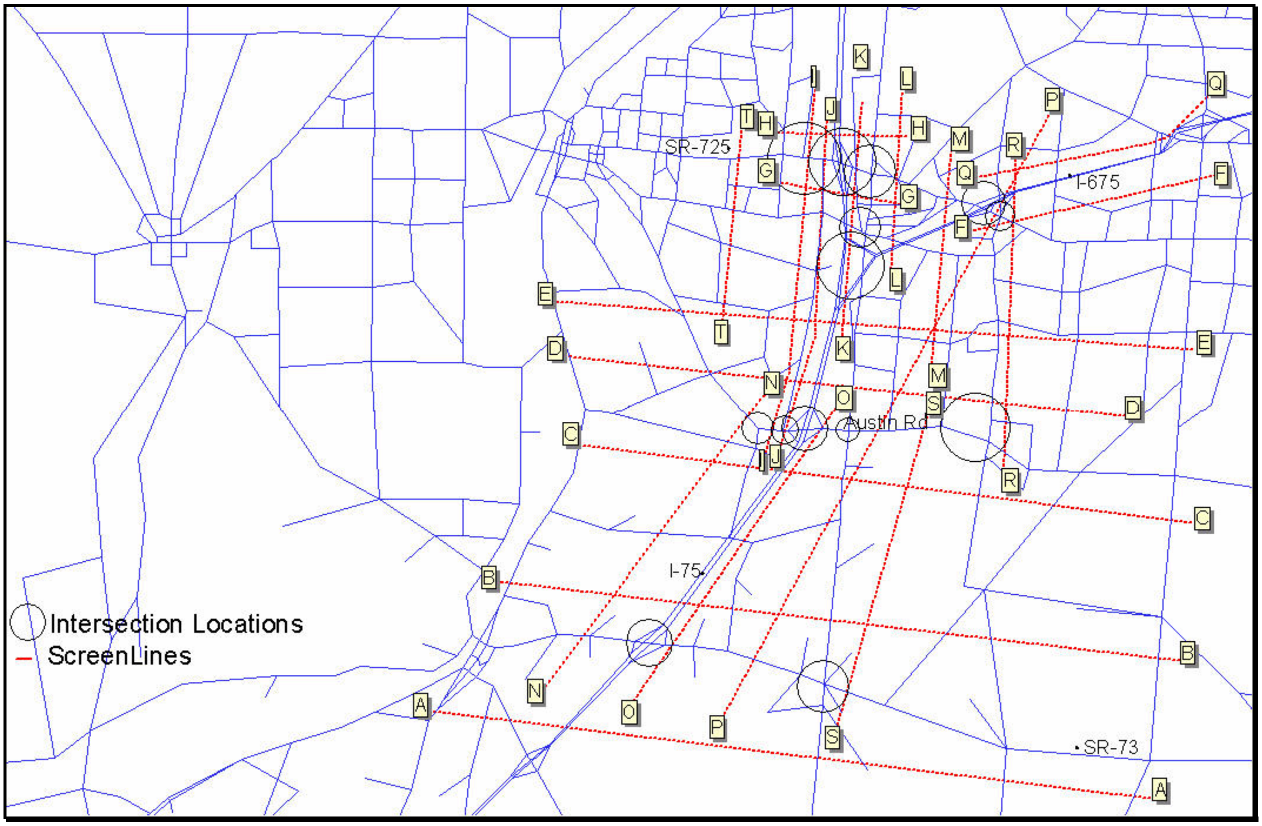


Figure E-8: Example of Screenlines Selected for Refining Link Assignments.

COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL	COL
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
ScreenLine G (South of I-725)					adjust	adjust						Adjustment				
	COUNT	TCOUNT	Ab	Af	Ratio	Diff	RAf	Cb	Cf	%TCf	RAf/Cf	Capacity	BaseCount	FAf	FAf/Cf	Count/Cb
SR-741 S of I-725	25710	0.247	22140	24083	27966	27653	27810	37334	37334	0.158	0.745	12273	21739	34012	0.911	0.689
I-75 S of I-725	71900	0.692	52357	100494	138005	120037	129021	125000	125000	0.527	1.032	41093	60794	101887	0.815	0.575
Byers Rd S of I-725	1900	0.018	10317	12203	2247	3786	3017	37334	37334	0.158	0.081	12273	1607	13880	0.372	0.051
Alexanderville S of I-725	4400	0.042	10502	12652	5301	6550	5925	37334	37334	0.158	0.159	12273	3720	15994	0.428	0.118
Sum	103910	1.000	95316	149432	173519.2	158026	165773	237002	237002	1.000	0.699	0.47	0.53	165773	0.699	0.438
	TCOUNT		TAb	TAf			TRAf	TCb	TCf		TRAf/TCf	FCAP	FCOUNT	TFAf	TFAf/TCf	COUNT/TCb
COUNT	ACTUAL BASE YEAR TRAFFIC COUNT															
TCOUNT	SCREENLINE COUNT SUM															
Ab	BASE YEAR ASSIGNMENT															
TAb	BASE YEAR ASSIGNMENT SCREENLINE SUM															
Af	FUTURE YEAR ASSIGNMENT															
TAf	FUTURE YEAR ASSIGNMENT SCREENLINE SUM															
RAf	ADJUSTED FUTURE YEAR FORECAST															
	EQUALS AVERAGE OF RATIO AND DIFFERENCE ADJUSTMENTS (AV OF RATIO AND DIFFERENCE ADJUSTMENTS)															
Cb	CAPACITY IN BASE YEAR															
TCb	SCREENLINE CAPACITY IN BASE YEAR															
Cf	FUTURE YEAR CAPACITY															
TCf	FUTURE YEAR SCREENLINE CAPACITY															
ADJUST RATIO = (COL 2/COL 4) X COL 5																
ADJUST DIFF = (COL 2-COL 4)+COL 5																
FAF =	FINAL ADJUSTED FUTURE ASSIGNMENT															
capacity adjustment for new facilities																
	%TCf X TRAf		THIS EQUALS FAf													
capacity adjustment for existing facilities																
	%TCf X TRAf X FCAP															
count adjustment for existing facilities																
	%TCOUNT X FCOUNT X (TRAf-SUM(FAfNEW))															
count adjustments for new facilities [obviously?] aren't possible																

Figure E-9: Example of a Spreadsheet Used in Analyzing Screenline Adjustments.

STEP 4b – After refinements to the link assignment are complete, the adjusted future year ADT volumes are computed in to turning movement volumes, if desired, at intersections. Procedures for computing turning movement volumes are explained in NCHRP Report 255 (Chapter 8 Turning Movement Procedures).

The inputs necessary in this step include turning movement volumes (or estimated turning percentages) for the base year and, future year design hour volumes (DHV) for each leg of the intersection. The NCHRP Report 255 procedure involves balancing the traffic entering and leaving the intersection in alternative iterations until a preset convergence is reached. If future year turning volumes are not expected to reflect base year turning patterns they can be substituted with turning movement volumes from a travel demand model or estimated turning percentages based on future land use and trip distribution estimates.

Figure E-10 is an example of a spreadsheet that uses this iterative procedure to compute turning movement volumes for a four-leg intersection.

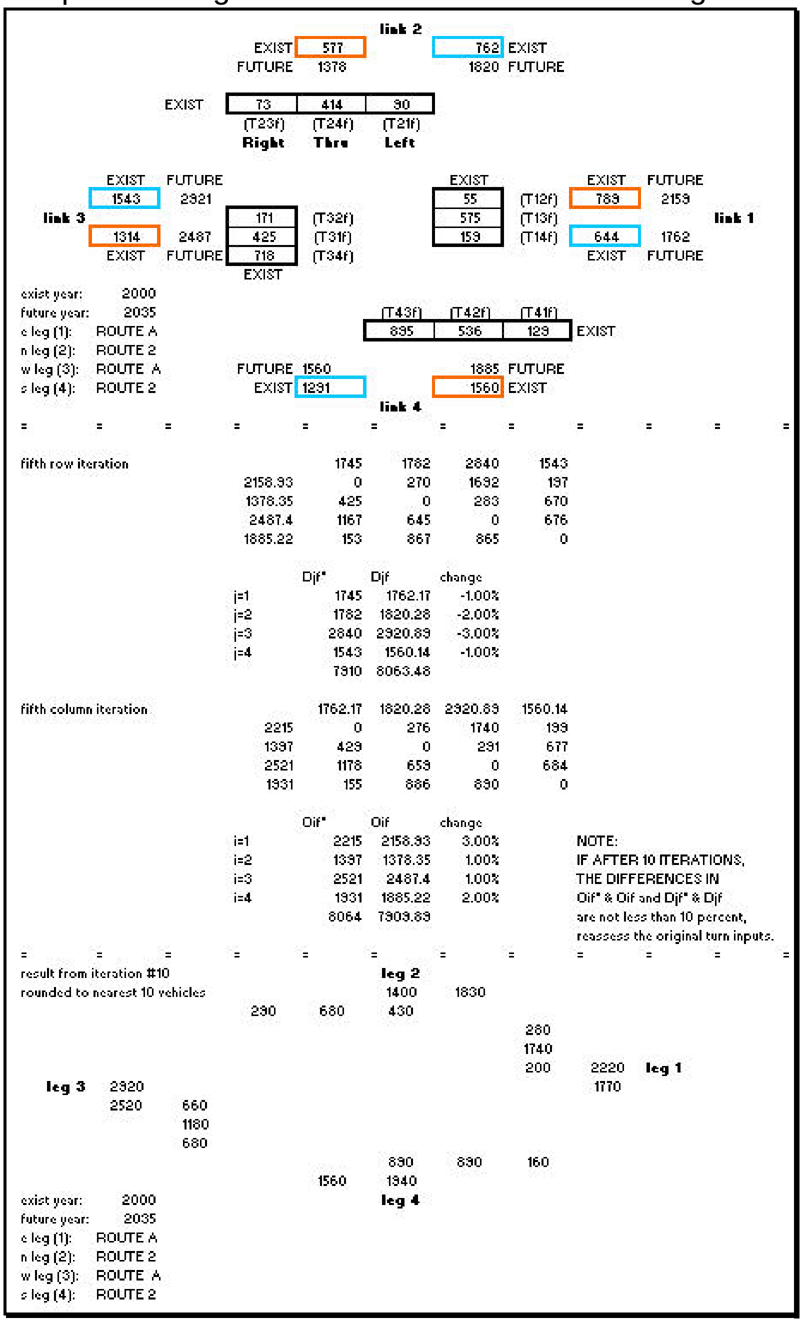


Figure E-10: Example of the use of NCHRP Report 255 iterative procedure to compute Turning Movement Volumes at an intersection.

Appendix F

Glossary/Acronyms

Reports:

1) Glossary
    a. Forecasting
    b. Model Refinement
        i. NCHRP 255 without Screenlines
        ii. NCHRP 255 with Screenlines
        iii. NCHRP 255 Turning Movement Volumes
2) Acronyms
3) Formulas

1) Glossary

The following is a list of the terms used throughout this handbook

A. Forecasting:

ADT – Average Daily Traffic – the number of vehicles that traverse a segment of roadway over a 24 hour period, factored to an annual average.

DADT – Directional Average Daily Traffic - the number of vehicles that traverse a segment of roadway over a 24 hour period, factored to an annual average, by direction.

P&A – Passenger & type "A" Commercial vehicles – “Cars” Includes motorcycles, passenger cars, panel (4-tire) and pick-up trucks. *FHWA “Scheme F” Classes 1-3*

B&C – B & C Commercial vehicles – “Trucks” All other vehicles, that are not P&A, including single unit trucks, tractor with semi-trailers, trucks with trailers, recreational vehicles, and school and commercial buses. *FHWA “Scheme F” Classes 4-13.*

D – Directional Factor - Expressed as a percent, it is the proportion of traffic moving in the peak direction during the design hour

T24 - Expressed as a percent, it is the proportion of B&C commercial vehicles in the ADT

TD – Expressed as a percent, it is the proportion of B&C commercial vehicles in the design hour

K – Expressed as a percent, it is the proportion of daily traffic occurring during the design hour

DHV – Design Hour Volumes - the number of vehicles that traverse a segment of roadway during the design hour, which is representative of the 30th highest hour of traffic volumes for the year.

8th Highest Hour – The 8th highest hour of the day factor, expressed as a percentage, is used for traffic signal warrants. The default value for 8th highest hour is 0.056. More specific values can be determined by reviewing the hourly distribution of traffic reports by functional class.

Simple forecast – A traffic forecast relying on trend line analysis for future year volume calculation and/or without intersection turning movements.

Complex forecast – A traffic forecast that uses a travel demand model for calculating future year volumes and/or one with intersection turning movements.

Build – The future scenario involving a change to existing geometric conditions (e.g. a new bypass or lane widening).

No Build – The future year scenario with the geometric conditions unchanged from today.

Opening Year – The opening year is the year when the Build scenario opens. This is usually a few years later than the current year.

Design Year – This is the year in which the forecasts are targeted. Normally the design year is 20 years after the opening year.

PID – Project Identification number

Peak Hour Volumes – The peak hour volumes are the highest hourly traffic volumes in a 24-hour period. They can provide the basis for directional factors and turning movement percentages for design hour volumes forecasts.

Model Output – Data generated from a travel demand model, such as traffic assignments, that can be used in the certified traffic forecasting process.

TDF model – A travel demand forecasting model.

Screenline – An imaginary line which intercepts major traffic flows through a region, usually along a physical barrier such as a river or railroad tracks, splitting the study area into parts. Traffic counts and possibly interviews are conducted along this line as a means to compare simulated model results to field results as part of the calibration/validation of a model.

B. Model Refinement:

i) NCHRP 255 Adjustments without Screenlines:

Road/Link – The name/route number of each facility bisected by the Screenline and/or the link (node) numbers from the network.

COUNT year – Year of the actual base year traffic count

COUNT – Actual base year traffic count

Ab – Base year traffic assignment - user to input year

Ab interpolate – Interpolation between base and future year assignment -- used when year of count data differs from base year assignment

Af – Future year traffic assignment - user to input year

RATIO – Adjusted future year traffic forecast (COUNT/Ab) * Af

DIFF – Adjusted future year traffic forecast (COUNT - Ab) + Af

RAf – Adjusted future year traffic forecast (AVERAGE(RATIO, DIFF))

Selected Adjustments – Selects the type of future year adjustment based on the ratio of actual base year traffic count to interpolated base year traffic assignment. General rule: if COUNT/Ab <= 0.5 then use RATIO, OR if COUNT/Ab >= 2 then use DIFF instead of RAf

most recent count data – Most recently available actual count data for the facility

most recent count year – Year of the most recently available actual count data

opening year – Final refined forecast for the opening year - user to input year

design year – Final refined forecast for the design year - user to input year

growth factor opening year – Growth factor to apply to most recent count to obtain opening year

growth factor design year – Growth factor to apply to most recent count to obtain design year

ii) <u>NCHRP 255 Adjustments with Screenlines:</u>

Road/Link – The name/route number of each facility bisected by the Screenline and/or the link (node) numbers from the network.

COUNT – Actual base year traffic count

TCOUNT – Screenline total base year traffic counts

%TCOUNT – Proportion of TCOUNT occurring on a particular link (COUNT/TCOUNT)

Ab – Base year traffic assignment

Tab – Screenline total base year traffic assignment

Af – Future year traffic assignment

TAf – Screenline total future year traffic assignment

RATIO – Adjusted future year traffic forecast (COUNT/Ab) * Af

DIFF – Adjusted future year traffic forecast (COUNT - Ab) + Af

RAf – Adjusted future year traffic forecast (AVERAGE(RATIO, DIFF))

TRAf – Screenline total adjusted future year traffic forecast

Cb – Base year capacity

TCb – Screenline total base year capacity

Cf – Future year capacity

TCf – Screenline total future year capacity

%TCf – Proportion of TCf occurring on a particular link (Cf/TCf)

RAf/Cf – Ratio of adjusted future year traffic forecast to the future year capacity

Adjust Capacity – Portion of a link's final refined future year traffic forecast resulting from its proportional future year capacity (%TCf * FCAP * TRAf)

FCAP – Weight given to the future year distribution of roadway capacity

Adjust Base Count – Portion of a link's final refined future year traffic forecast resulting from its proportional base year traffic count (%TCOUNT * FCOUNT * TRAf)

FCOUNT – Weight given to the base year traffic count distribution

FAf – Final refined future year traffic forecast

TFAf – Screenline total final refined future year traffic forecast (TFAf = TRAf)

FAf/Cf – Ratio of the final refined future year traffic forecast to future year capacity

TFAf/TCf – Ratio of the total Screenline final refined future year traffic forecast to total Screenline future year capacity

COUNT/Cb – Ratio of the actual base year traffic count to base year capacity

TCOUNT/TCb – Ratio of the total Screenline actual base year traffic count to total Screenline base year capacity

iii) NCHRP 255 Turning Movement Volumes:

n – Number of links emanating from the intersection

Oib – Base year (b) inflow to the intersection on link i

Oif – Future year (f) inflow to the intersection on link i

Djb – Base year outflow from the intersection on link j

Djf – Future year (f) outflow from the intersection on link j

Tijb – Base year (b) traffic flow entering through link i and leaving through link j

Tijf – Future year (f) traffic flow entering through link i and leaving through link j

Pijf – Future year (f) estimated percentage (decimal) of traffic flow from link i to link j (use in place of Tijb when base year turns do no exist)

2) Acronyms

Acronyms:

The following is a list of the acronyms used throughout this handbook:

ADT – Average Daily Traffic

AADT – Annual Average Daily Traffic

DADT – Directional Average Daily Traffic

DHV – Design Hour Volume

DDHV – Directional Design Hour Volume

K – Ratio of DHV to ADT

D – Proportion of traffic in the peak direction for the 30th highest hour

T24 – Daily Truck Factor

TD – Design Hour Truck Percentage

FHWA – Federal Highway Administration

HCM – Highway Capacity Manual

LOS – Level of Service

MPO – Metropolitan Planning Organization

ATR – Automatic Traffic Recorder

V/C – Volume to Capacity Ratio

3) Formulas

Given, ADT:

DHV= ADT x K

DDHV= ADT x K x D

Given, DADT:

DDHV= DADT x K x D x 2

Example 1: *Develop DDHV, given the following design designations:*

ADT = 53770
K = 0.10
D = 0.55

DHV = 53770 x 0.10 = 5377
DDHV = 53770 x 0.10 x 0.55 = 2960

Example 2: *Develop DDHV, given the following design designations:*

NB DADT = 27770
SB DADT = 26000
K = 0.10
D = 0.55

(from count data, we determine the peak direction of traffic is northbound during the peak hour),

NB DDHV = 27770 x 0.10 x 0.55 x 2 = 3055
SB DDHV = 26000 x 0.10 x (1-0.55) x 2 = 2340