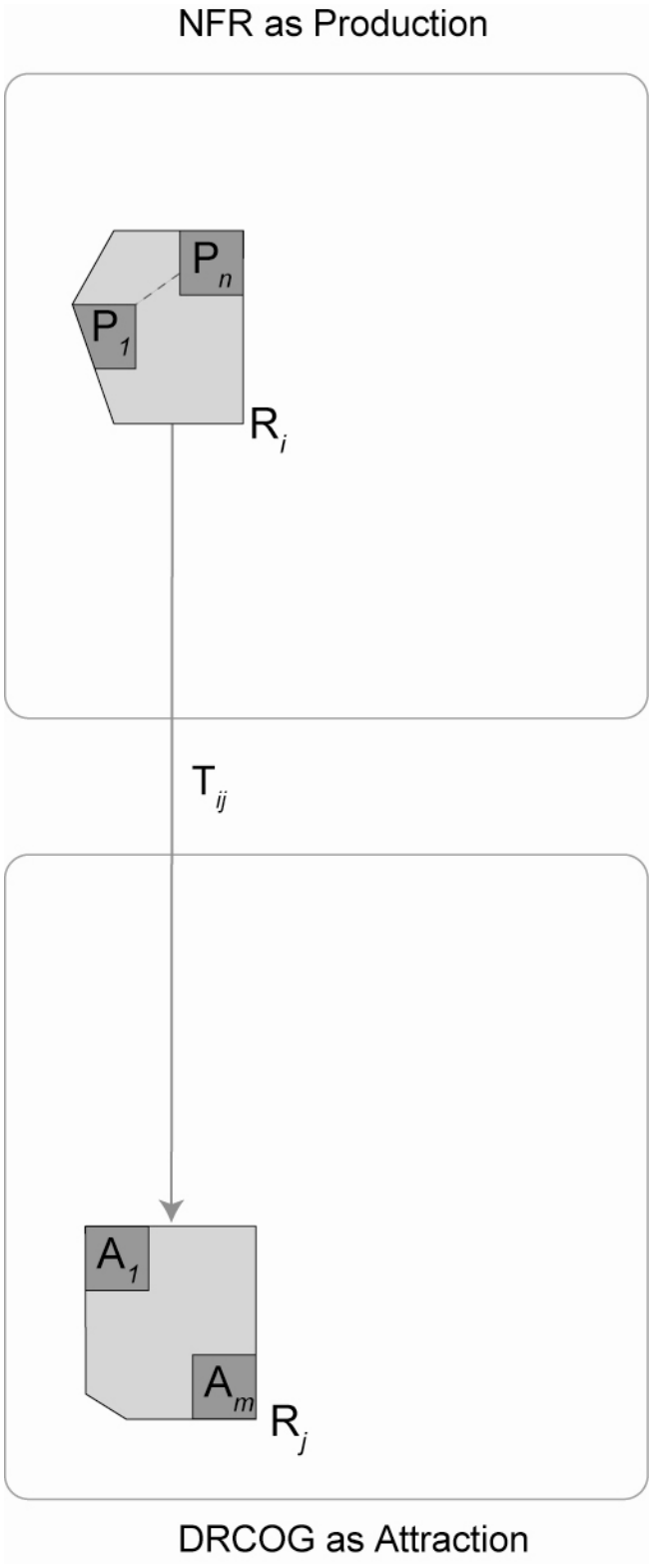
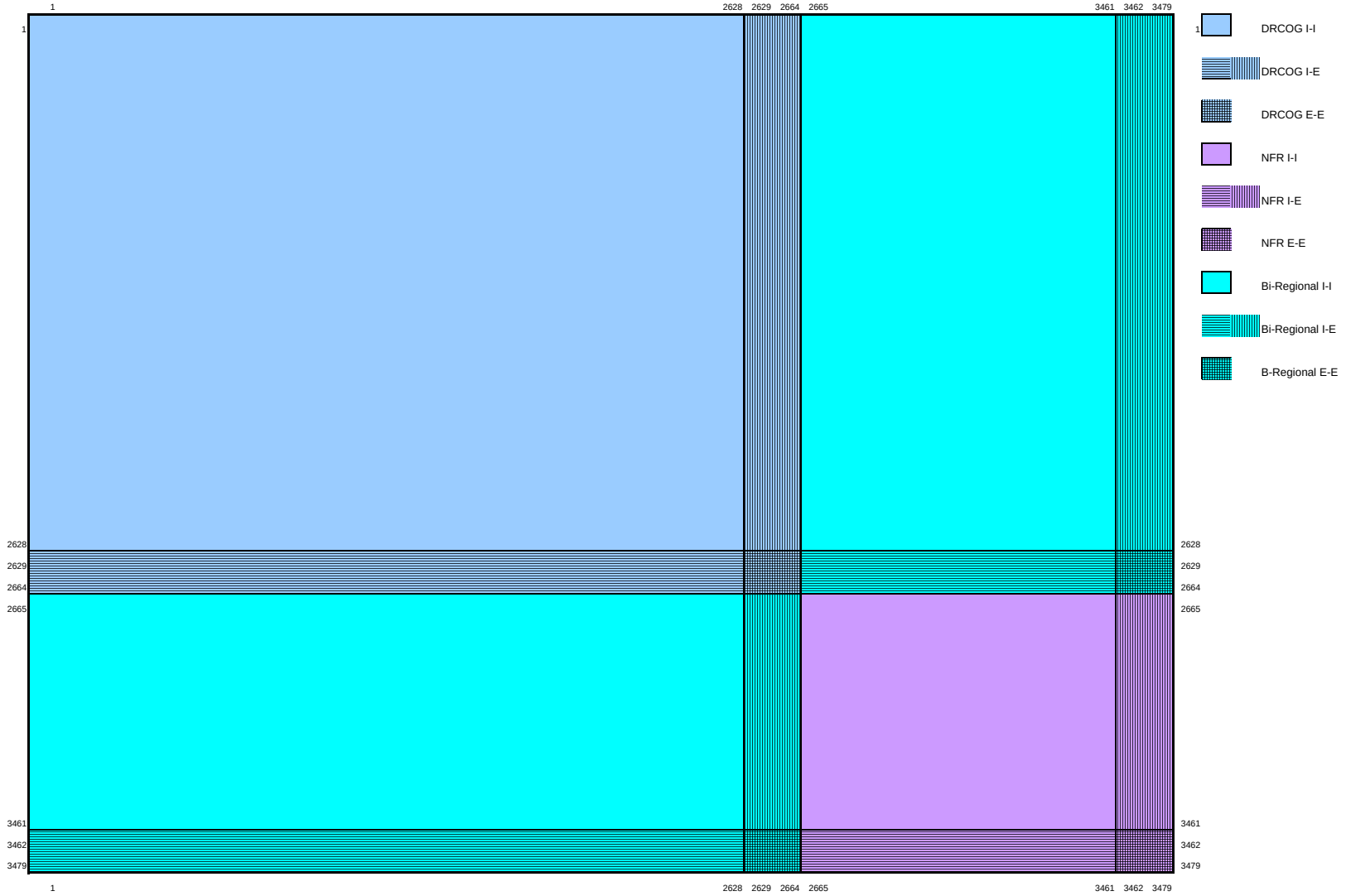
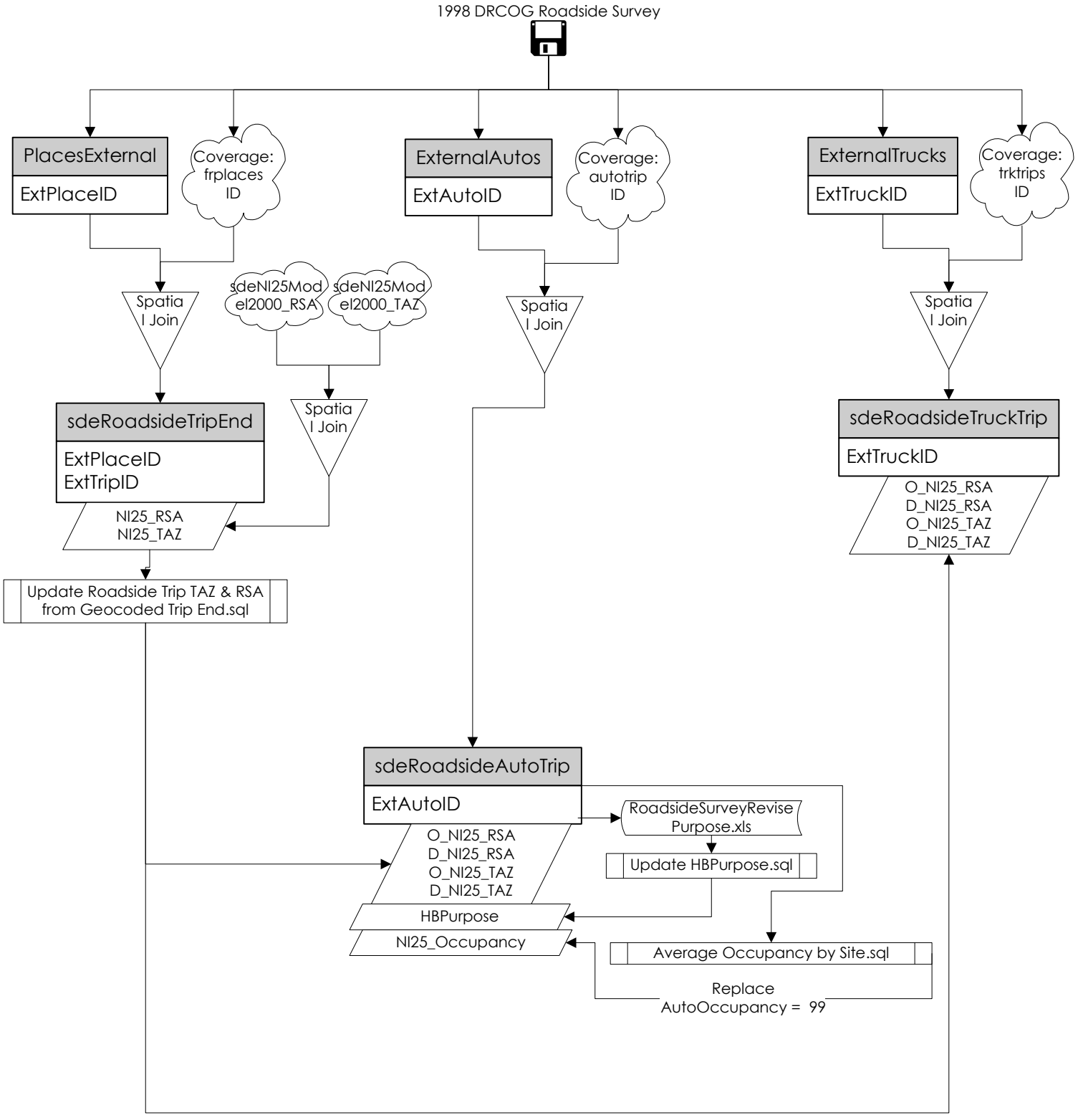

NFR as Production
P n
P 1
R i
T ij
A 1
A m
R j
DRCOG as Attraction

North I-25 EIS
Combined Travel Model
Trip Table Legend

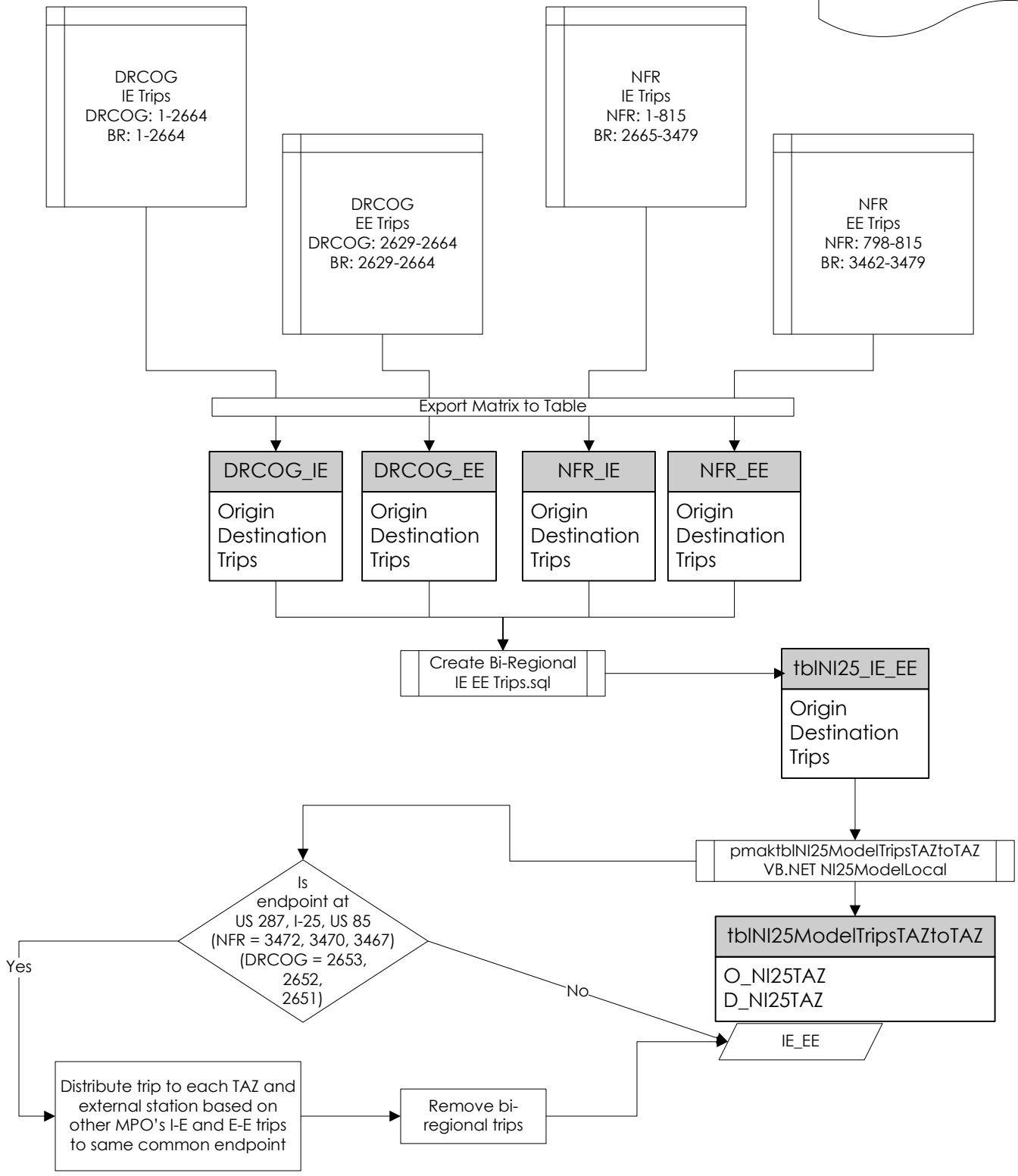


Roadside Survey



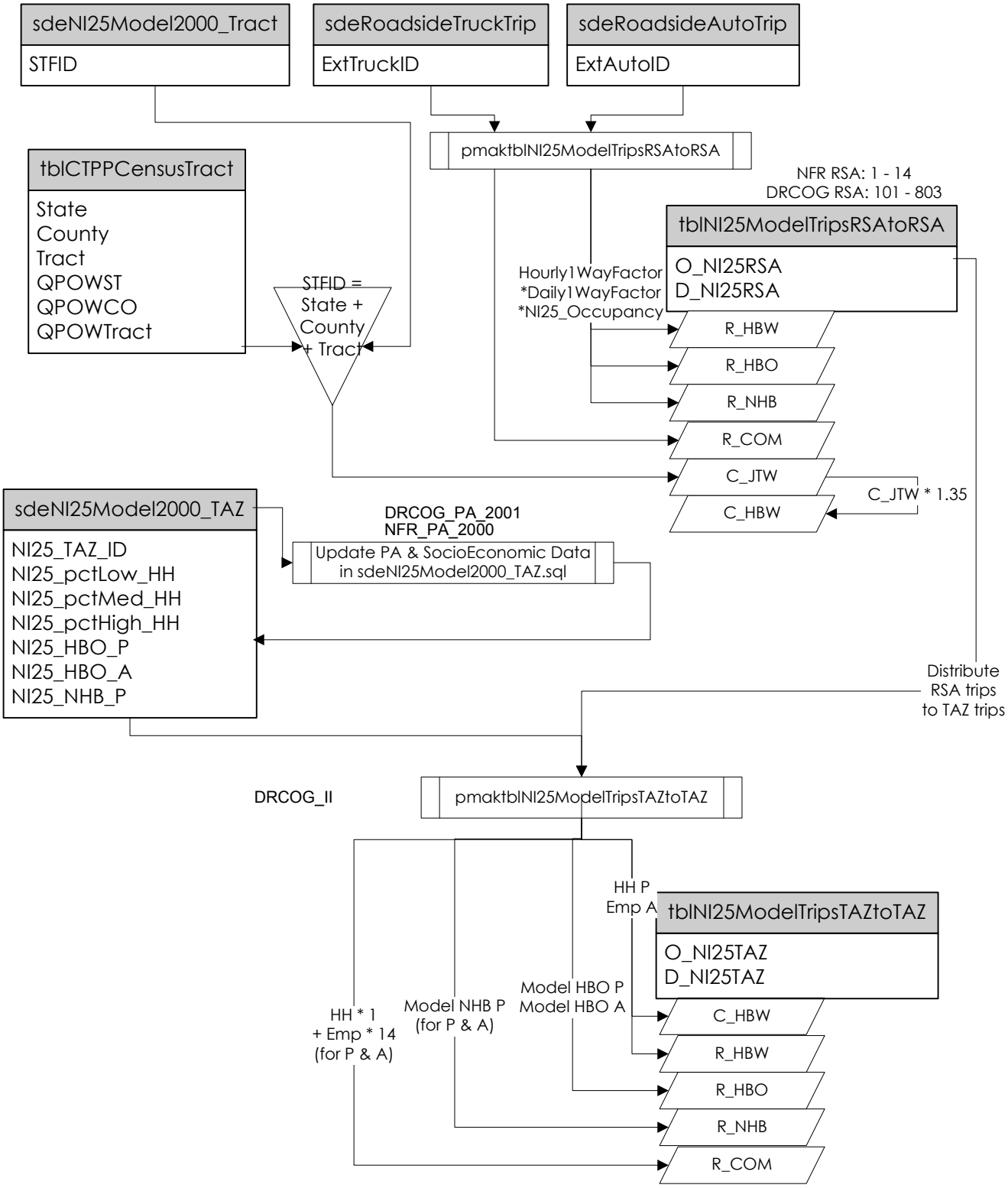
Combine IE & EE Trip Tables

(Trip Table Process.doc)

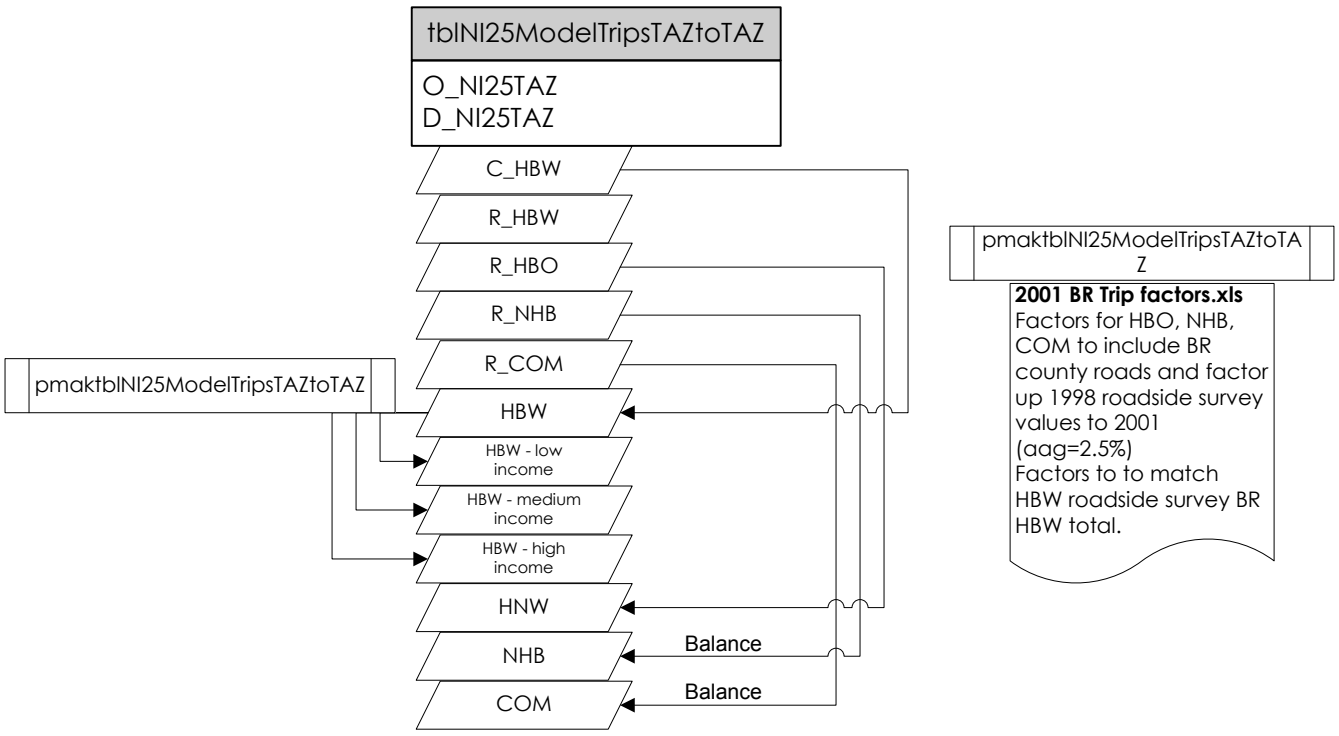


Create Bi-Regional Trips by Purpose

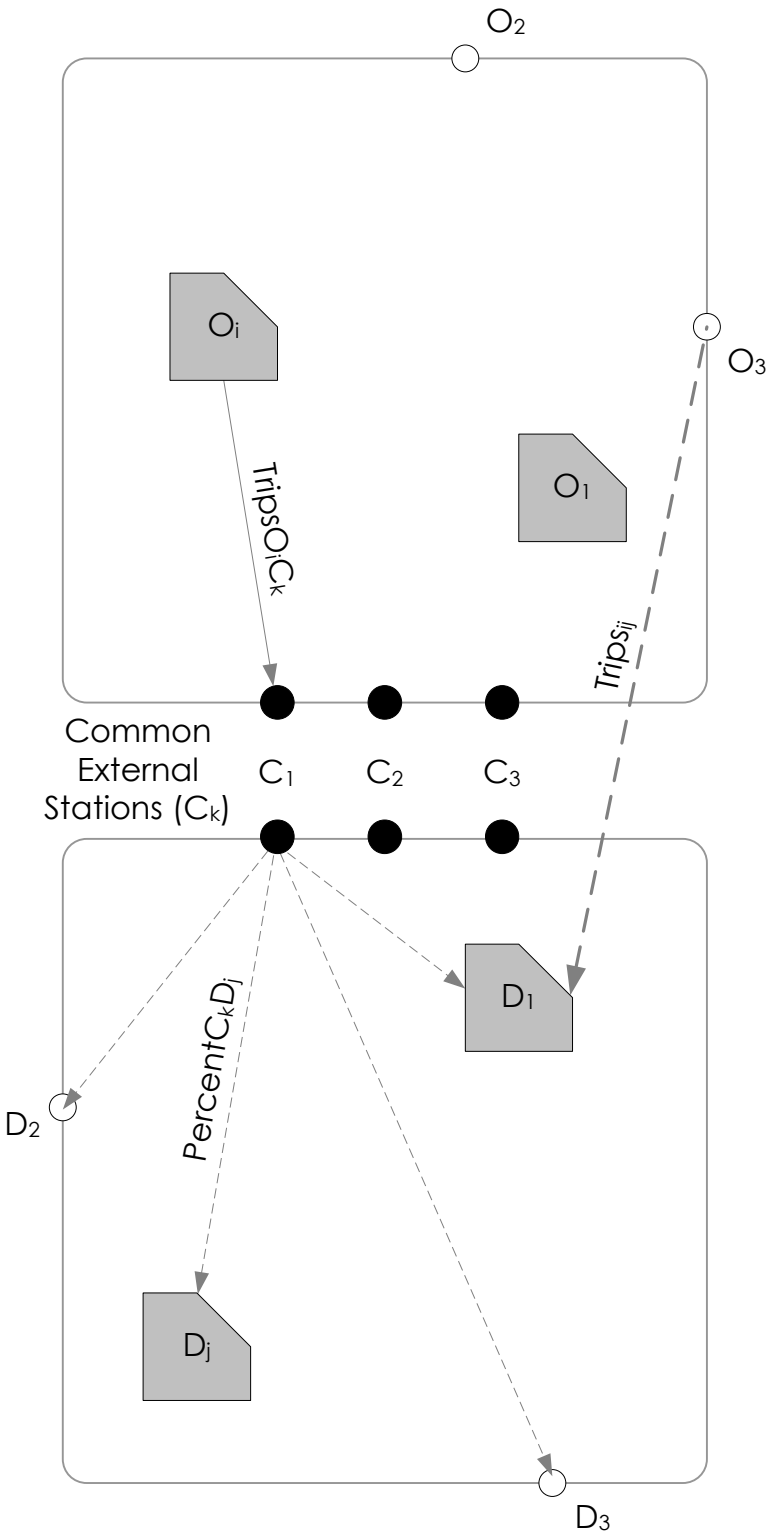
(Trip Table Process.doc)



Factor Bi-Regional Trips by Purpose
(Trip Table Process.doc)

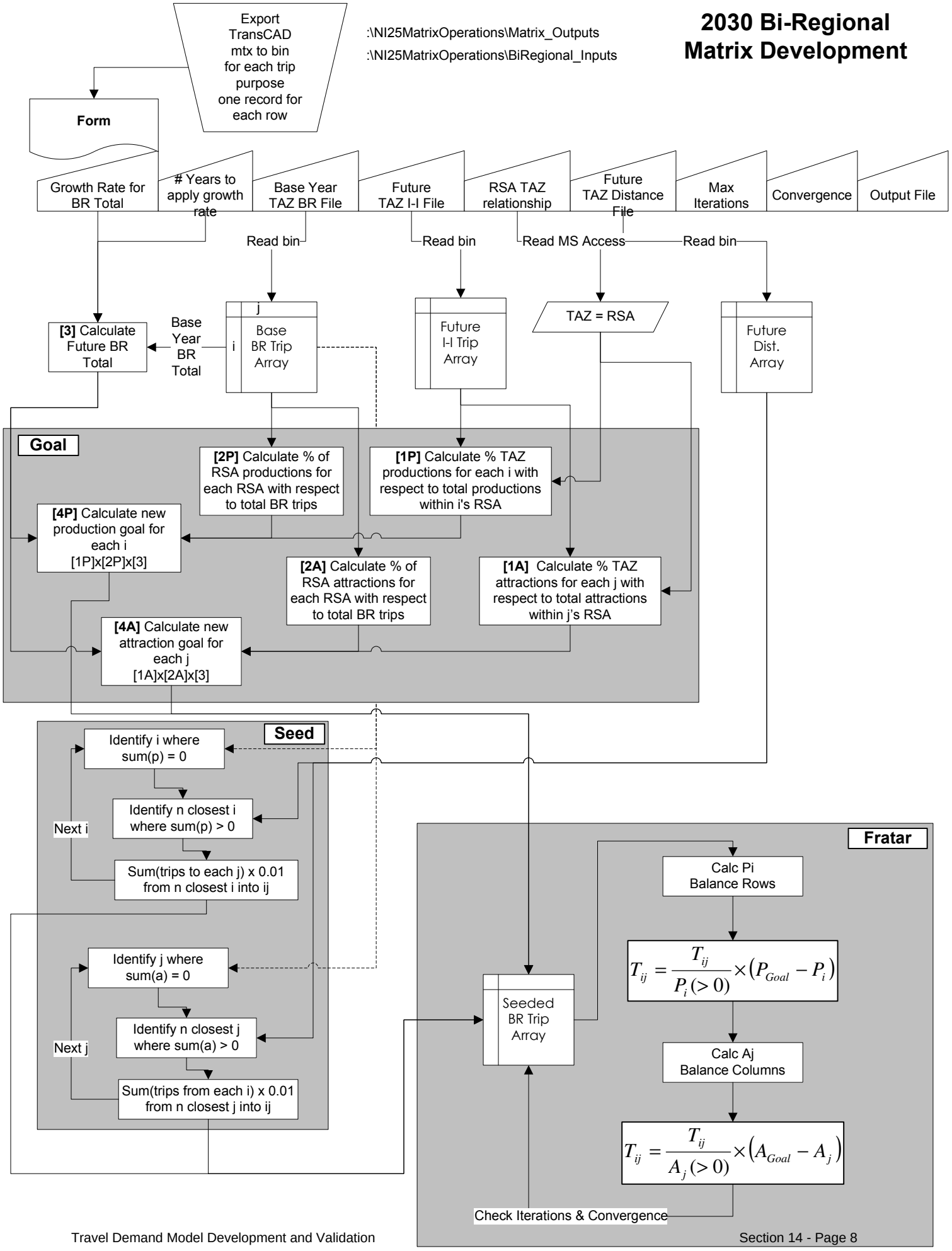


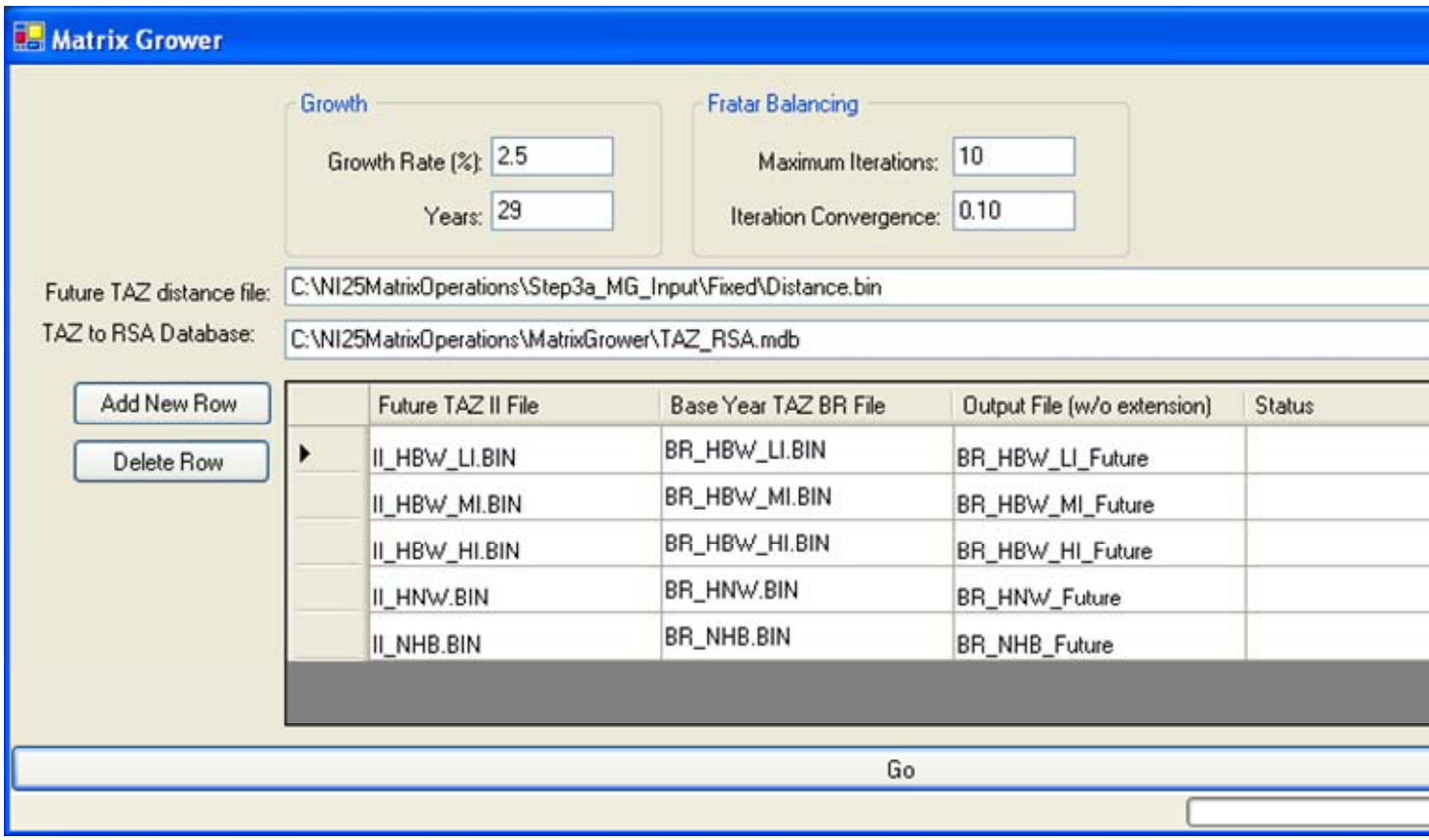
NFR as Origin (O_i)



DRCOG as Destination (D_j)

2030 Bi-Regional Matrix Development




Matrix Grower
Growth
Growth Rate (%): 2.5
Years: 29
Fratar Balancing
Maximum Iterations: 10
Iteration Convergence: 0.10
Future TAZ distance file: C:\NI25MatrixOperations\Step3a_MG_Input\Fixed\Distance.bin
TAZ to RSA Database: C:\NI25MatrixOperations\MatrixGrower\TAZ_RSA.mdb
Add New Row
Delete Row
Future TAZ II File
Base Year TAZ BR File
Output File (w/o extension)
Status
II_HBW_LI.BIN
BR_HBW_LI.BIN
BR_HBW_LI_Future
II_HBW_MI.BIN
BR_HBW_MI.BIN
BR_HBW_MI_Future
II_HBW_HI.BIN
BR_HBW_HI.BIN
BR_HBW_HI_Future
II_HNW.BIN
BR_HNW.BIN
BR_HNW_Future
II_NHB.BIN
BR_NHB.BIN
BR_NHB_Future
Go

Carter::Burgess

PROJECT

CLIENT

SUBJECT County Road Traffic

JOB NO.		NO.
DESIGNED BY	DATE	
CHECKED BY	DATE	OF

Boulder	CR	23	6,600
Weld	CR	13	2,300
Weld	CR	19	1,500
			10,400

HBW	35%	* 10,400	=	3,700
HBO	40%	* 10,400	=	4,200
NHB	25%	* 10,400	=	2,500

Carter Burgess

PROJECT

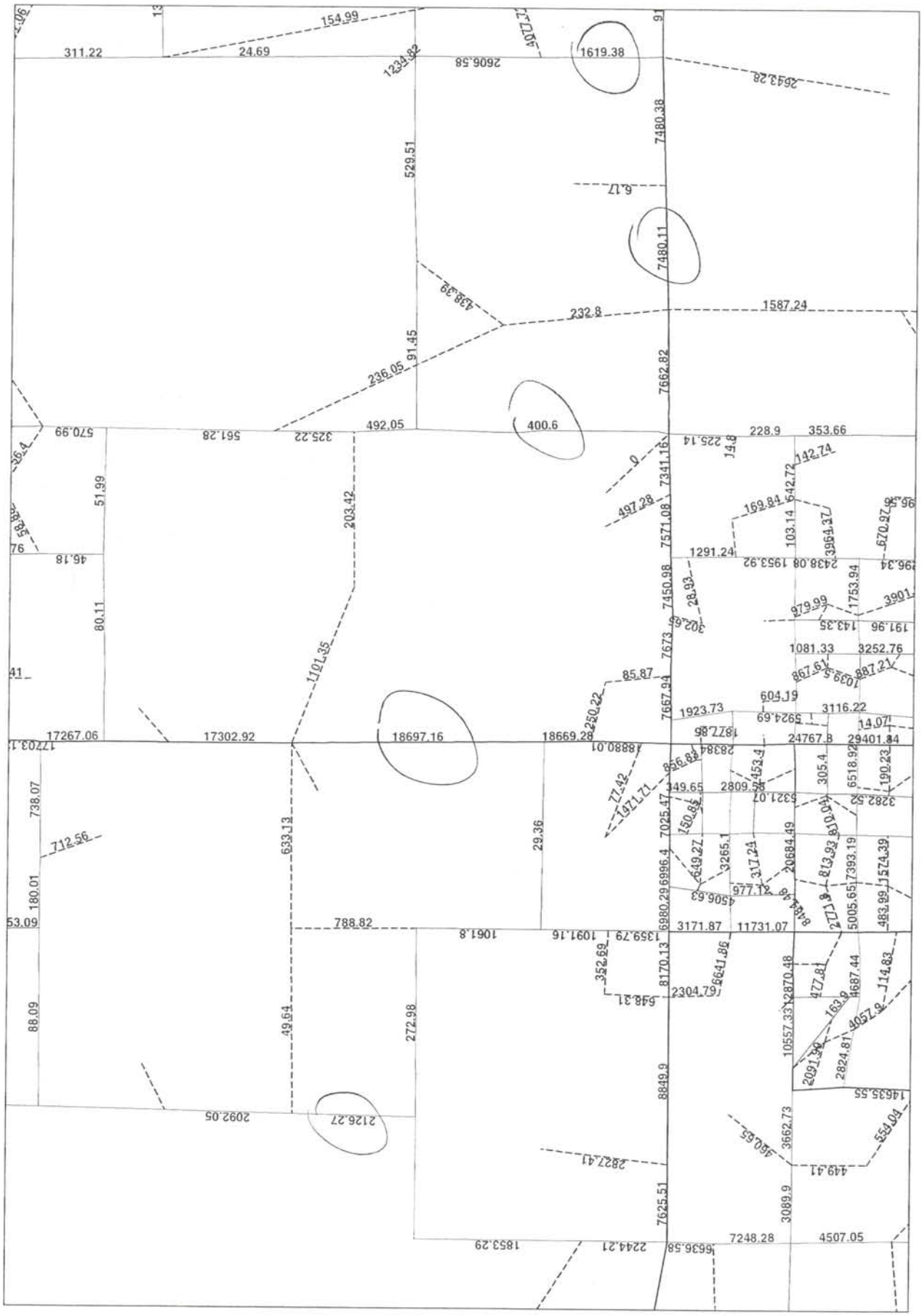
CLIENT

SUBJECT Screenline check

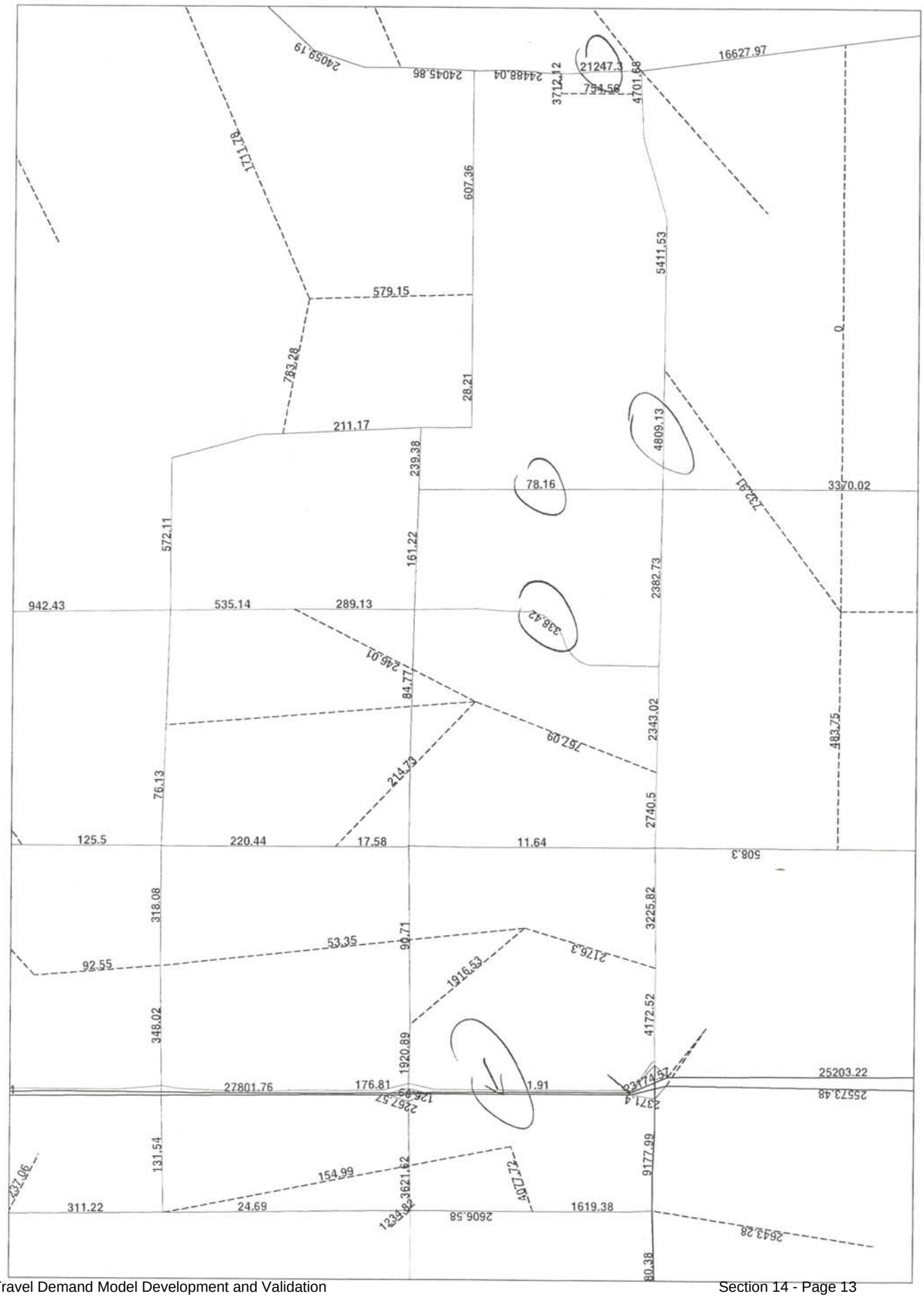
JOB NO.		NO.
DESIGNED BY	DATE	
CHECKED BY	DATE	OF

No-Act		Hwy 1	Hwy 2
~~7.4~~	CR	6.5	6.2
39.4	287	35.7	35.3
2.4	CR	2.4	1.6
1.2	CR	1.1	1.0
102.9	25	111.3	113.4
1.3	CR	0.9	0.5
-	CR	-	-
0.4	CR	0.3	0.2
41.9	85	38.3	39.5
196.9		196.5	196.7

Run #38 border all day volume



Run #38 border all day volumes



North I-25
External Station Comparison at Common Boundary

NFR Model

	I-25	US-287	US-85	Hwy Total	W CR13	W CR 19	B CR 23
2000	56,100	14,100	15,400	85,600	2,287	1,456	NA
2030	105,000	36,000	27,800	168,800	4,030	2,565	NA
Absolute Growth	48,900	21,900	12,400	83,200	1,743	1,109	
Percentage Growth	87%	155%	81%	97%	76%	76%	
Avg Ann. Growth	2.11%	3.17%	1.99%	2.29%	1.91%	1.91%	

DRCOG Model

	I-25	US-287	US-85	Total	W CR13	W CR 19	B CR 23
2001	54,600	16,200	17,200	88,000	NA	NA	6,600
2030	128,700	40,400	30,500	199,600	NA	NA	9,600
Absolute Growth	74,100	24,200	13,300	111,600	NA	NA	3,000
Percentage Growth	136%	149%	77%	127%			45%
Avg Ann. Growth	3.00%	3.20%	1.99%	2.86%			1.30%

2000 NFR compared to 2001 DRCOG (DRCOG - NFR)

	I-25	US-287	US-85	Total	W CR13	W CR 19	B CR 23
Absolute Difference	-1,500	2,100	1,800	2,400			
Percent Difference	-2.7%	14.9%	11.7%	2.8%			

2030 NFR compared to 2030 DRCOG (DRCOG - NFR)

	I-25	US-287	US-85	Total	W CR13	W CR 19	B CR 23
Absolute Difference	23,700	4,400	2,700	30,800			
Percent Difference	22.6%	12.2%	9.7%	18.2%			

	NFR IE		NFR EE	
	all	w/o south	all	w/o south
	1154	1154	1499	1499
	157	157	0	0
	4970	4970	4998	4998
	25	25	0	0
	910	910	500	500
	776	776	249	249
	973	973	249	249
	59	59	0	0
	2885	2885	401	401
	3065	3065	1500	1500
s us 85	10444		2499	
cr 19	1456		0	
cr 13	2287		0	
s i25	32072		12000	
sh66	4424		1799	
s 287	10097		1999	
	1000	1000	1999	1999
	1101	1101	500	500
Total	77855	17075	30192	11895

DRCOG

	ext total	ee portion	ie	ee
i25	54600	0.146	46,628	7,972
us 85	17200	0.098	15,514	1,686
us287	16200	0.008	16,070	130
cr23	6600	0	6,600	-
			84,813	9,787

	NFR IE		NFR EE	
	all	w/o south	all	w/o south
	1154	1154	1499	1499
	157	157	0	0
	4970	4970	4998	4998
	25	25	0	0
	910	910	500	500
	776	776	249	249
	973	973	249	249
	59	59	0	0
	2885	2885	401	401
	3065	3065	1500	1500
s us 85	10444		2499	
cr 19	1456		0	
cr 13	2287		0	
s i25	32072		12000	
sh66	4424		1799	
s 287	10097		1999	
	1000	1000	1999	1999
	1101	1101	500	500
Total	77855	17075	30192	11895

DRCOG

	ext total	ee portion	ie	ee
i25	54600	0.146	46,628	7,972
us 85	17200	0.098	15,514	1,686
us287	16200	0.008	16,070	130
cr23	6600	0	6,600	-
			84,813	9,787

IE Model Trip Table

	TripsUS287	TripsI25	TripsUS85	Trips	US285_Pf	I25_Pf	US85_Pf	Trips_Pf	US285_Df	I25_Df	US85_Df	Trips_Df	HBW_Pf	HBW_Df
I-I, I-E, E-E	15145	55316	16314	86775	14842	47019	14842	76702	14947	47031	14947	76926	27470	27539
Bi-Regional	10726	26483	9282	46491	10511	22510	10511	43533	10621	22356	10621	43598	14721	14396

20609.481

DEVELOPMENT OF BI-REGIONAL TRIP TABLE

Trip Terminology

Internal-Internal (I-I): I-I trips from either the NFR or DRCOG models.

Internal-External (I-E): I-E trips from either the NFR or DRCOG models.

External-External (E-E): E-E trips from either the NFR or DRCOG models.

Bi-Regional (B-R): Trips that have one endpoint in the NFR model area, and one endpoint in the COG model area.

Regional-External (R-E): Trips that have one endpoint in either the NFR or COG model areas, and the other endpoint external to the both NFR and COG model areas.

Super-External (S-E): Trips that have neither endpoint in either the NFR or COG model areas.

Trip-Half: The portion of an I-E trip within the MPO model area

The following will be applied for each highway (I-25, US-287, US-85):

Equalize external station traffic volume and

1) Compare external station vehicle volumes of both MPO models.
   - Determine the midpoint vehicle volume.

I-E and E-E Trips from MPO Models

		I-25	US-287	US-85
NFRMPO*	I-E Vehicle Trips	32,052	10,094	10,436
	E-E Vehicle Trips	24,000	3,998	4,998
	Total	56,052	14,092	15,434
DRCOG**	I-E Vehicle Trips	46,628	16,070	15,514
	E-E Vehicle Trips	7,792	130	1,686
	Total	54,600	16,200	17,200

* 2000 Model
** 2001 Model

2) Factor vehicle trips to person trips.

Auto Occupancy Factors

	I-25	US-287	US-85
Auto Occupancy	1.42	1.35	1.40

Source: DRCOG Roadside Survey, 1998

Build bi-regional trip table

3) Distribute trips:
   - For each NFR IE zone, distribute its trips ('from' and 'to' combined) to the DRCOG IE & EE zones using the DRCOG's distribution among IE & EE zones.
   - For each DRCOG IE zone, distribute its trips ('from' and 'to' combined) to the NFR IE & EE zones using the NFR's distribution among IE & EE zones.
   - Sum the two resulting matrices and halve.

Split into trip tables by trip purpose

4) Apportion the bi-regional trip table into trip purposes.
   - Use HBW, HBO, and NHB purposes.
   - Reference the roadside survey to determine the percentage of each purpose.
   - Note the I-E trips include large truck trips. Therefore, the HBW, HBO, and HNW percentages will sum to less than 100%.

Adjust for trip length

5) Check the trip tables for trip length.
   - Use peak distance skims to compute the trip length frequency distribution.
   - For each defined distance interval (bin), factor the number of trips to better match the observed trip length distribution by purpose from the roadside survey.
   - Balance each trip table.

Assign directionality

6) Assign directionality to the trips between Zone K and Zone L using the following assumptions:

   a. For each Zone K and Zone L, use the ratio of total households to total employment to identify the predominant land use characteristics.

Ratio of Total Households to Total Employment	Predominant Land Use
>3	Residential
1/3 to 3	Mix
<1/3	Work

Note: These ratios correspond to breakpoints of 25% and 75%. Zones with zero households and/or employment are handled separately.

b. Assign directional split for trips between Zone K and Zone L:

Zone K	Zone L	Percent of Trips	
		Zone K to Zone L	Zone L to Zone K
Residential	Work	85%	15%
Residential	Residential	50%	50%
Residential	Mix	60%	40%
Work	Work	50%	50%
Work	Residential	15%	85%
Work	Mix	40%	60%
Mix	Work	60%	40%
Mix	Residential	40%	60%
Mix	Mix	50%	50%

Check results

7) Perform reasonableness checks:
   - Compare to original I-E trip tables by subtracting row sum totals to find large discrepancies.
   - Check geographic distribution at the RSA level by comparing to roadside survey.

- Check geographic distribution at the RSA level by comparing to Census Journey-to-work census tract data.

J:_Transportation\071609.400\model\IE Processing.doc

Estimating the HBW Trip Tables by Income for NFR

1) Estimate the percentage of households in each income strata, for each NFR zone. For simplification, we are assuming the following:

   - NFR's $0-20K stratum is equal to DRCOG's low income
   - NFR's $20-40K, $40-60K, and $60-80K strata (need to be summed) are equal to DRCOG's middle income
   - NFR's $80K stratum is equal to DRCOG's high income

2) Once the percentage of households in each income stratum is determined for each zone from above, apply the percentage to the zone's row in the NFR HBW trip table (file name: dst_personpa.mtx; table is named HBW) to get estimated tables of HBW low income, HBW middle income, and HBW high income trip tables.

3) For the current year, you will find the estimates of households by income level in the NFR input file named "2a_SocioData.xls." Look in the Current Socioec tab. The appropriate columns are as follows:

   - H_20K (= to DRCOG's low income)
   - HH_20K40K (= to DRCOG's middle income)
   - HH_40K60K (= to DRCOG's middle income)
   - HH_60K75K (= to DRCOG's middle income)
   - HH_75K (= to DRCOG's high income)

   NOTE: NFR probably screwed up the last 2 field names, since they don't match the strata as described above. Don't worry about them.

4) For the future year (2030), you will find the estimates of households by income level in the NFR file named "Sociodata 2030.dbf." The appropriate fields are as follows:

   - INC1_HH (= to DRCOG's low income)
   - INC2_HH (= to DRCOG's middle income)
   - INC3_HH (= to DRCOG's middle income)
   - INC4_HH (= to DRCOG's middle income)
   - INC5_HH (= to DRCOG's high income)

5) Check that the sum of the three resulting trip tables (HBW Low, HBW Med, HBW High) match the total of the original NFR HBW table.

10/22/04

Non-Work

HNW

WITH ZONE 2577 I-I Trips

From	To	Trips
NFR Int	DRCOG Int	18,722
DRCOG Int	NFR Int	18,434
DRCOG Int	DRCOG Int	2,180
		39,336

Zone 2577 From = 2103
To = 1347
3450
Interzonal = 1271
2179

WITHOUT ZONE 2577 I-I Trips

From	To	Trips
NFR Int	DRCOG Int	18,722
DRCOG Int	NFR Int	18,434
		37,156

NHB

WITH ZONE 2577 I-I Trips

From	To	Trips
NFR Int	DRCOG Int	11,169
DRCOG Int	NFR Int	11,169
DRCOG Int	DRCOG Int	2,888
		25,226

Zone 2577 From = 1792
To = 1792
3584
Interzonal = 695
2889

WITHOUT ZONE 2577 I-I Trips

From	To	Trips
NFR Int	DRCOG Int	11,169
DRCOG Int	NFR Int	11,169
		22,338

IE

From	To	Trips
NFR I	DRCOG E	2,783
NFR I	NFR E	8,530
DRCOG E	NFR I	3,173
DRCOG E	DRCOG I	102,601
NFR E	DRCOG I	9,698
NFR E	NFR I	8,535
DRCOG I	NFR E	11,156
DRCOG I	DRCOG E	102,601
	Total	249,077

26810

HBW

LI

WITH ZONE 2577 I-I Trips

From	To	Trips
NFR Int	DRCOG Int	3,229
DRCOG Int	NFR Int	665
DRCOG Int	DRCOG Int	95
		3,989

Zone 2577 From = 75
To = 31
106
Interzonal = 10
96

WITHOUT ZONE 2577 I-I Trips

From	To	Trips
NFR Int	DRCOG Int	3,229
DRCOG Int	NFR Int	665
		3,894

MI

WITH ZONE 2577 I-I Trips

From	To	Trips
NFR Int	DRCOG Int	11,527
DRCOG Int	NFR Int	4,155
DRCOG Int	DRCOG Int	594
		16,276

Zone 2577 From = 467
To = 192
659
Interzonal = 65
594

WITHOUT ZONE 2577 I-I Trips

From	To	Trips
NFR Int	DRCOG Int	11,527
DRCOG Int	NFR Int	4,155
		15,682

HI

WITH ZONE 2577 I-I Trips

From	To	Trips
NFR Int	DRCOG Int	5,182
DRCOG Int	NFR Int	1,699
DRCOG Int	DRCOG Int	232
		7,113

Zone 2577 From = 185
To = 73
258
Interzonal = 26
232

WITHOUT ZONE 2577 I-I Trips

From	To	Trips
NFR Int	DRCOG Int	5,182
DRCOG Int	NFR Int	1,699
		6,881

26,457

COM

WITH ZONE 2577 I-I Trips

From	To	Trips
NFR Int	DRCOG Int	1,702
DRCOG Int	NFR Int	1,702
DRCOG Int	DRCOG Int	1,789
		5,193

Zone 2577	From =	1027
	To =	1027
		2054
	Interzonal =	266
		1788

WITHOUT ZONE 2577 I-I Trips

From	To	Trips
NFR Int	DRCOG Int	1,702
DRCOG Int	NFR Int	1,702
		3,404

EE

From	To	Trips
NFR	NFR	674
DRCOG	NFR	1,523
NFR	DRCOG	1,361
DRCOG	DRCOG	4,095
		7,653

DRCOG 2001 and NFRMPO 2000 Model IE and EE Sums for I-25, US-287, and US-85

DRCOG 2001 Model IE

Ext. Node ID	HWY	IE From	IE To	IE Sum
2651	US-85	7757	7757	15514
2652	I-25	23314	23314	46628
2653	287	8035	8035	16070

DRCOG 2001 Model EE

Ext. Node ID	HWY	EE From	EE To	EE Sum
2651	US-85	843	843	1686
2652	I-25	3986	3986	7972
2653	287	65	65	130

NFRMPO 2000 Model IE

Ext. Node ID	HWY	IE From	IE To	IE Sum
803	US-85	5222	5214	10436
806	I-25	16036	16016	32052
808	287	5048	5046	10094

NFRMPO 2000 Model EE

Ext. Node ID	HWY	EE From	EE To	EE Sum
803	US-85	2499	2499	4998
806	I-25	12000	12000	24000
808	287	1999	1999	3998

Sources: Drcog 2001 TransCAD model (Feb 2004) -- h_ie_od.mtx & h_ee_od.mtx
NFR 2000 TransCAD model (Fall 2003) -- asn_od.mtx

DRCOG 2001 and NFR 2000 IE EE Trips

DRCOG 2001 Model IE

Ext. Node ID	HWY	IE From	IE To	IE Sum
2651	US-85	7757	7757	15514
2652	I-25	23314	23314	46628
2653	287	8035	8035	16070
2654	CR-23 (83rd St.)	3300	3300	6600
2655	US-36	2793	2793	5586

DRCOG 2001 Model EE

Ext. Node ID	HWY	EE From	EE To	EE Sum
2651	US-85	843	843	1686
2652	I-25	3986	3986	7972
2653	287	65	65	130
2654	CR-23 (83rd St.)	0	0	0
2655	US-36	57	57	114

NFRMPO 2000 Model IE

Ext. Node ID	HWY	IE From	IE To	IE Sum
803	US-85	5222	5214	10436
804	CR-19	728	727	1455
805	CR-13	1144	1142	2286
806	I-25	16036	16016	32052
807	SH-66	2212	2209	4421
808	287	5048	5046	10094

NFRMPO 2000 Model EE

Ext. Node ID	HWY	EE From	EE To	EE Sum
803	US-85	2499	2499	4998
804	CR-19	0	0	0
805	CR-13	0	0	0
806	I-25	12000	12000	24000
807	SH-66	1799	1799	3598
808	287	1999	1999	3998

Sources: Drcog 2001 TransCAD model (Feb 2004) -- h_ie_od.mtx & h_ee_od.mtx
NFR 2000 TransCAD model (Fall 2003) -- asn_od.mtx & eetrips.dbf

Roadside Survey and CTPP Data Reconciliation

Two sources of survey data were available for examining trip patterns between the NFRMPO model and the DRCOG model: a roadside survey and journey-to-work data from the Census Bureau. After processing these data, a major challenge was presented.

DRCOG Roadside Survey

DRCOG had conducted a roadside survey on the three highways in 1998. The raw data was processed by trip purpose, with expansion factors provided by DRCOG. For example, the process for home-based work (HBW) trips is described below.

The number of HBW vehicle trips in 1998 between the north study area and the Denver metropolitan region is about 18,000. Using vehicle occupancy data from the survey, the number of HBW person trips in 1998 is about 21,000. The roadside survey did not include three county roads. The total traffic on these roads amounts to 10,100 vehicles. Assuming 33 percent are HBW trips (based on approximate average from roadside survey) and assuming an average auto occupancy of 1.1 yields an additional 3,700 HBW person trips not accounted for above. The total of HBW trips would be approximately 25,000. Finally, using a conservative growth of 2.5 percent per year, the roadside survey data indicates a year 2000 estimate of about 27,000 HBW trips between the two model areas.

The results for HBW trips are shown in **Table 1**.

Table 1
Roadside Survey HBW Trips

Trip Type	Number of Surveys	Expanded Number of Vehicle Trips
Trips Through North I-25, north US-287, and north US-85 external stations	1,240	20,620
Vehicle trips that begin and/or end in either model area	1,160	19,130
Vehicle trips with a known purpose	1,160	19,130

Vehicle trips that end in respective model areas	1,100	18,080
Person Trips		20,970
Inclusion of County Road Person Trips		24,670
Person Trips Factored to 2000		26,570

Source: DRCOG Roadside External Station Survey, 1998

2000 Census Journey-to-Work Data

For CTPP journey-to-work (JTW) workplace information, the US census long form inquires where the survey respondent worked most during the prior week for their primary job. The survey question is "At what location did this person work last week? If this person worked at more than one location, print where he or she worked most last week." The JTW definition of a work trip differs from the HBW definition used in travel models. A HBW trip, recorded by a household survey for a given weekday, is a trip made from home to work, with no regard to directionality.

For the travel model, JTW trips need to be converted to HBW trips. The conversion factor takes into account the return trip from work to home, the effect of multiple jobs, absenteeism (vacation and sick days), etc. The factor ranges from 1.35 to 1.41, depending on the population size of the area[1]. For the North I-25 Study Area, a conversion factor of 1.35 is appropriate.

Year 2000 CTPP JTW data between census tracts were summarized at an aggregated geographic level called the Regional Statistical Area (RSA). The RSA level of analysis allowed the summarization of data for the study area boundary, and to focus on the interregional trips between the north area and the Denver metropolitan area. The census tract data indicates about 30,000 journey-to -work trips between the north study area and the Denver metropolitan area in the year 2000. This equates to about 41,000 HBW trips.

Table 2 displays the resulting tabulation of journey-to-work trips converted to HBW trips.

Table 2
JTW Flow Between North Study Area and Denver Metro Area

[1] Transportation Planner's Handbook on Conversion Factors for the Use of Census Data, USDOT Federal Highway Administration, May 1996.

Trip Type	Origin	Destination	Trips
Journey-to-Work	North Study Area*	Denver Metro	22,890
	Denver Metro	North Study Area*	7,540
	Two-way Total		30,430
HBW	Two-way Total		41,000

**The North Study area approximately corresponds to the NFRMPO model area.*

Survey Data Reconciliation

The two primary data sources of work commute trips traveling between the two model areas did not indicate a similar number of trips. From the 1998 DRCOG roadside survey, the total number of HBW trips in 2000 is estimated to be about 27,000. The processing of the year 2000 CTPP data resulted in about 41,000 HBW trips between the two model areas.

The data processing of both the roadside survey and the CTPP data was double checked to make sure there were no errors in computation. After much discussion, it was recognized that both the roadside and the CTPP survey data have inherent limitations. It was also suggested that the appropriate factor for these very long trips is not 1.35, but something closer to 1.0. Since the trips are so long, different trip patterns may be experienced than in typical urban areas. It was also recognized that the high number of HBW trips suggested by the CTPP would imply an unusually high percentage of commute trips crossing between the regions, given the quantity of vehicle trips from traffic counts of about 90,000 to 95,000.

For these reasons, it was decided to use the geographic distribution from the CTPP for HBW trips and the control total from the DRCOG external survey. For HBO and NHB trips, the roadside survey was the primary source of data.

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Quick Summary:
Development of Bi-Regional Trips

A trip nomenclature became necessary to distinguish between the various trip types in the EIS combined model, as described in **Table 3** below.

Table 3
Trip Nomenclature

Trip Type	**Trip Definition**
Bi-Regional	Trips that have one endpoint in the NFR model area and one endpoint in the DRCOG model area.
Border trips	Trips that cross the common border (approximately SH-66) between the two MPO models.
Internal-Internal (I-I)	I-I trips from either the NFR or DRCOG MPO models
Internal-External (I-E)	I-E trips from either the NFR or DRCOG MPO models
External-External (E-E)	E-E trips from either the NFR or DRCOG MPO models
Regional-External	Trips that have one endpoint in either the NFR or DRCOG model areas, and the other endpoint external to the both NFR and DRCOG model areas
Super-External	Trips that have neither endpoint in either the NFR or DRCOG model areas

The border trips, represented as internal-external and external-external trips of the original MPO models, map to different trip types in the combined model structure (**Table 4**).

Table 4
Border Trip Mapping

Trip Type in Original MPO Model	Trip Types in Combined Model
Internal-External Trip	▪ Bi-regional residential trips o HBW o HBO o NHB ▪ Bi-regional truck trips ▪ Regional-External trips
External-External Trip	▪ Regional-External trips ▪ Super-External trips

The quantity of border person trips is controlled by the number of vehicle trips from the roadside survey data, by trip purpose. **Figure 3** displays the number of trips of each type, and shows as a reference the original MPO model internal-external and external-external vehicle trips.

Figure 3
Combined Travel Model
Summary of Border Trips

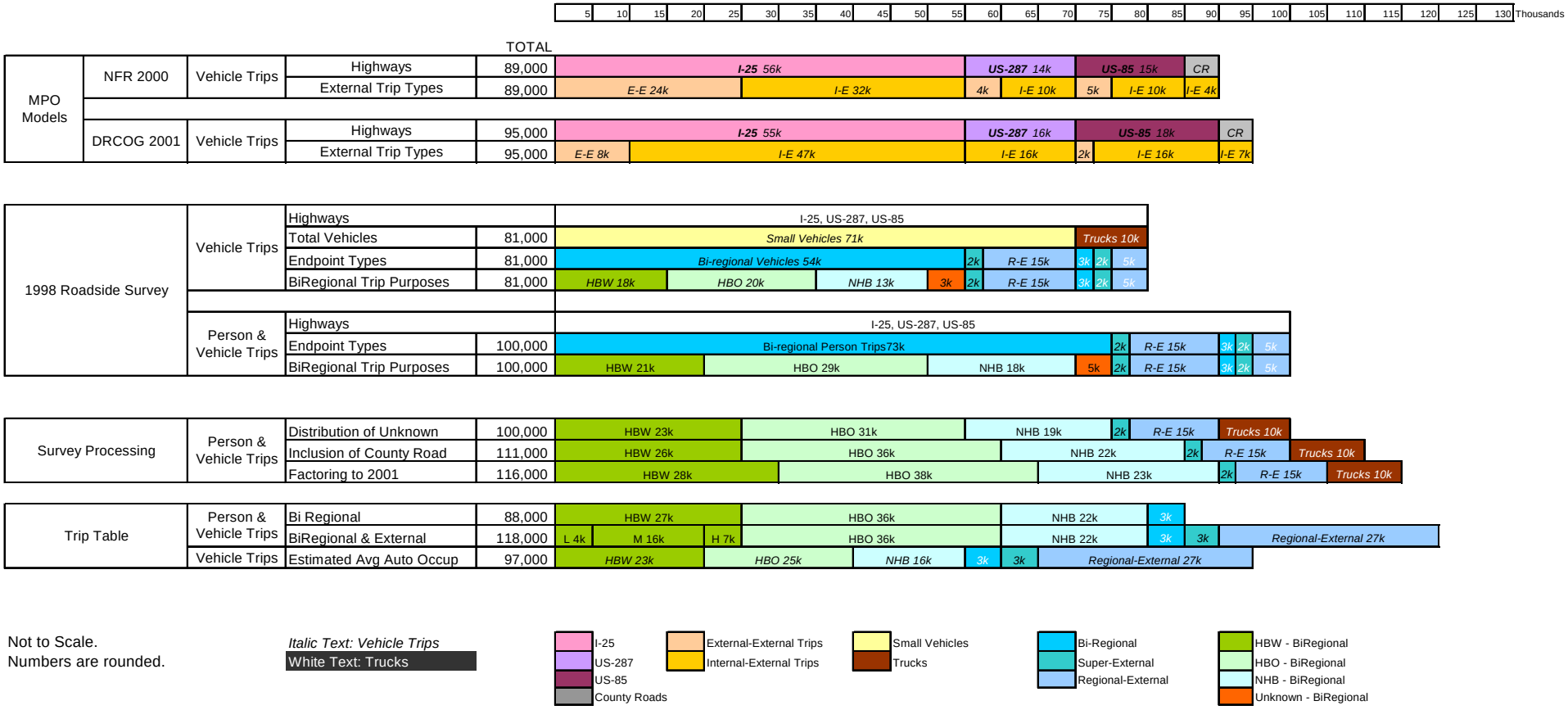
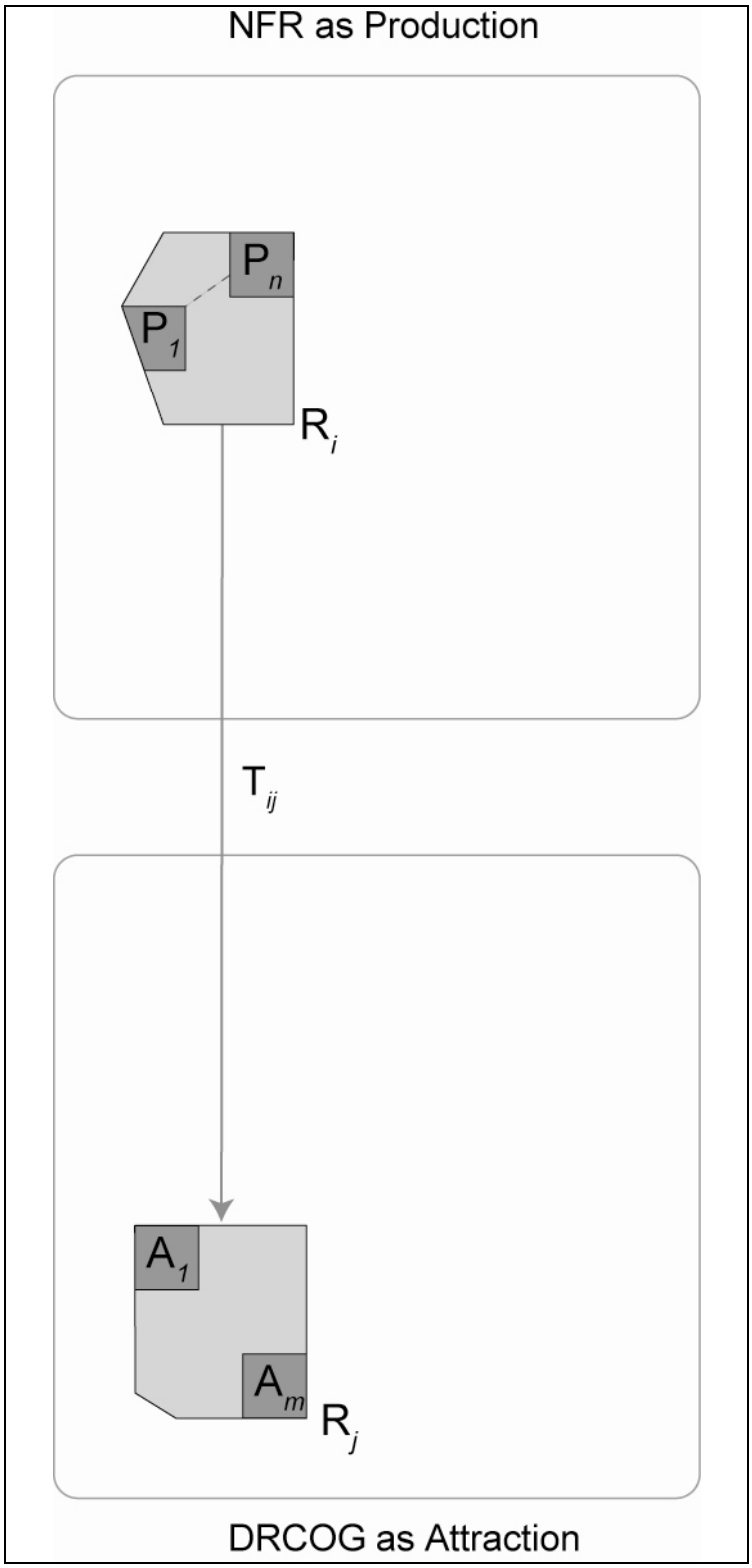


Figure 4
Bi-Regional HBW Trip Distribution



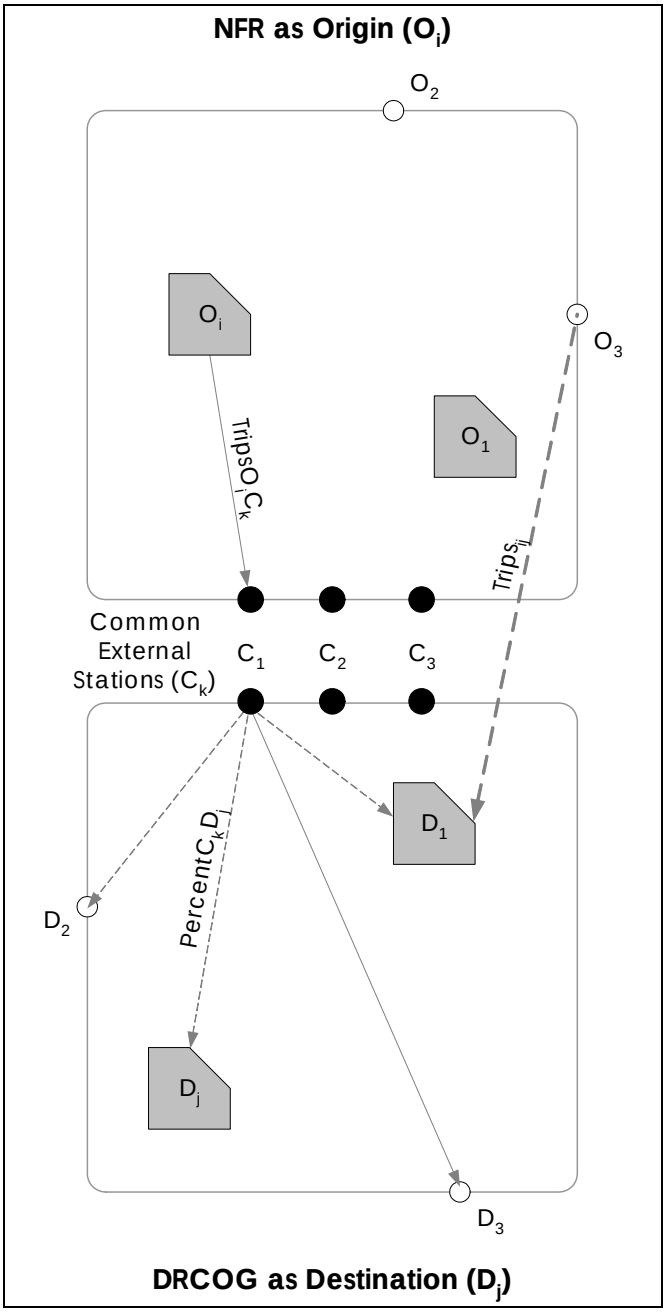
Overall, the distribution processing of border trips was a major challenge. The processing of trips utilized the 2000 CTPP, the 1998 DRCOG roadside automobile and truck surveys, and the MPO models' external station submodels. This was accomplished using a combination of GIS, SQL Server, TransCAD, and C# programming. The data sources mentioned above were first aggregated to districts, termed Regional Statistical Area (RSA). A RSA production-attraction matrix by purpose was then developed. Subsequently, a TAZ production-attraction matrix was generated by distributing RSA trips to the TAZ level by using zonal production and attraction values. The process is described in more detail below.

Bi-Regional Trip Distribution

As an example, the processing for bi-regional HBW trips is as follows. The CTPP and roadside survey data was processed to the district level of RSAs. The CTPP data provided the geographic distribution of bi-regional trips between RSAs, and the roadside survey provided the control total of HBW trips between RSAs. In this way, a HBW RSA to RSA production-attraction trip matrix was generated.

The next step involved allocating the trips to zones. **Figure 4** illustrates the process. The trips T_{ij} from RSA R_i to RSA R_j are distributed first for the production end among the *n* zones of R_i based on the internal-internal distribution of HBW productions $P_1 \ldots P_n$. Then, for the trips from each zone *k* of RSA R_i, the attraction end is allocated to the *m* zones of RSA R_j based on the internal-to-internal distribution of HBW attractions $A_1 \ldots A_m$.

Figure 5
Regional-External and Super-External Trip Distribution



The same process was used for HBO, NHB, and truck bi-regional trips, but the roadside survey provided both the geographic distribution and quantity of trips between RSAs.

Regional-External and Super-External Trips

Regional-External and Super-External trips were developed from the external station elements of the MPO models: the internal-external and external-external trip models.
Figure 5 illustrates the steps used to calculate the regional-external and super-external trips, for NFRMPO as origin and DRCOG as destination.

$TripsO_iC_k$ are the number of internal or external trips originating in one NFR zone or external station (O_i) to a common external station (C_k).

The $PercentC_kD_j$ are the number of trips from a DRCOG common external station (C) to one DRCOG internal zone or external station (D_i) divided by the sum of trips from that common station to all internal zones and external stations. Then, $Trips_{ij}$ are the number of trips from the origin (O_i) to the common external station multiplied by the percent of trips from the common station to the destination (D_j). Trips were calculated through each common external station and then summed.

$$Trips_{ij} = \sum_{k}^{1} TripsO_iC_k \times PercentC_kD_j$$

Any resulting bi-regional trips (NFR internal to DRCOG internal in this example) are removed since these trips are handled separately by purpose.

The process was repeated for the other MPO model as origin model; the origin and destination MPOs were reversed to calculate the trips from DRCOG to NFR.

Using this labeling, Regional-External Trips are $TripsO_iD_i$ with origin as internal zone of origin MPO and destination as external station of destination MPO. Similarly, $TripsO_iD_i$ with origin as external station of origin MPO and destination as internal zone destination MPO are Regional-External trips.

Super-External trips are TripsO_iD_i with the origin as an external station of the origin MPO and the destination as an external station of the destination MPO.

Internal-Internal Trips

The internal-internal trips of each respective model are unaffected, except for the overlap zones. There are ten NFR zones that overlap with two DRCOG zones. The NFR zones remain as internal zones to the NFR model area. The DRCOG zones are factored down (the socioeconomic data) to reflect the portion of each that is not covered by the overlapping NFRMPO zone(s):

- Zone 2576: Zero out population, households, and employment (Zone 2576 is entirely covered by the overlapping NFRMPO zones).
- Zone 2577: Factor population, households, and employment by 51 percent.

Internal-External and External-External Trips

The internal-external and external-external trips of each respective MPO model are unaffected, except for external stations in the border area. Internal-external trips at these border locations are zeroed out from the internal-external trip tables of the MPO models:

Future Year Bi-Regional Trip Tables

Development of the future year bi-regional trip table was another challenge. For future forecasts, the bi-regional trip tables are factored up from the base year to the year 2030 using a fratar process. The fratar process is an iterative row and column factoring process that increases matrix cell values to match row and column marginals.

The sum of the future year row (column) marginal total is defined to be the bi-regional trip base year total increased by an average growth of 2.5 percent per year. The 2.5 percent is the average of the external station annual increases for the three major highways of both the NFRMPO and DRCOG models. In general, the MPO future forecasts for these common external stations matched very well.

The distribution of the marginal total to the rows and columns was defined to be the average of the bi-regional marginal distribution and the marginal distribution of the 2030 internal-internal trips. The bi-regional marginal distribution reflects the propensity of near-border zones in the bi-regional trips, and the internal-internal distribution reflects the future activity of zones that may not exhibit activity in the base year.

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Source	SiteName	HBPurpose	TripLength_0_10	TripLength_10_20	TripLength_20_30	TripLength_30_40	TripLength_40_50	TripLength_50_60	TripLength_60_70	TripLength_70_80	TripLength_80_90	TripLength_90_100	TripLength_100	SUM		
NI25 Model	I25	NHB	0.620387836	22.12031596	158.477796	585.9420343	1210.417936	1641.642549	1540.548581	905.8197252	332.6663794	68.02590861	16.85159824	6483.133		
NI25 Model	I25	HBO	0.723785809	25.80703529	184.8907621	683.59904	1412.154259	1915.249641	1797.306678	1056.789679	388.1107759	79.36356005	19.66019795	7563.655		
NI25 Model	I25	HBW	0.853033275	30.41543444	217.9069696	805.6702971	1664.324663	2257.258505	2118.254299	1245.502122	457.4162717	93.53562434	23.17094758	8914.308	22961.1	
NI25 Model	US287	NHB	32.49303637	396.0688483	509.2450526	499.5299539	301.6321982	185.0392353	122.0092521	69.47517247	27.94885459	6.773897408	1.976134068	2152.192		
NI25 Model	US287	HBW	56.86281365	693.1204845	891.178842	874.1774194	527.8563468	323.8186618	213.5161911	121.5815518	48.91049553	11.85432046	3.45823462	3766.335		
NI25 Model	US287	HBO	69.8600282	851.5480238	1094.876863	1073.989401	648.5092261	397.8343559	262.319892	149.3716208	60.09003736	14.56387943	4.248688247	4627.212	10545.74	
NI25 Model	US85	NHB	0.70626882	11.90269644	80.84393666	283.5808462	416.3432294	474.4820961	462.6162539	318.023539	103.9592528	28.21130109	8.265524574	2188.935		
NI25 Model	US85	HBW	0.770475077	12.98475975	88.19338544	309.3609231	454.1926139	517.6168321	504.672277	346.9347698	113.410094	30.77596483	9.016935899	2387.929		
NI25 Model	US85	HBO	1.412537641	23.80539287	161.6878733	567.1616924	832.6864588	948.9641923	925.2325078	636.0470779	207.9185056	56.42260218	16.53104915	4377.87	8954.734	42461.57
Roadside	I25	NHB	101.3488381	293.2961316	1161.135148	1276.641265	1839.638117	1950.665688	924.6441135	240.1047521	94.9527772	0	140.2975132	8022.724		
Roadside	I25	HBO	116.2500177	819.8755529	1095.106703	1715.714728	1874.2257	2207.000159	1232.83174	192.5146567	105.5943391	96.99581756	62.03069781	9518.14		
Roadside	I25	HBW	159.7312743	1103.238765	2023.720272	2422.043007	2182.133952	2107.204781	621.2360417	95.89285764	65.55739746	27.02369793	0	10807.78	28348.65	
Roadside	US287	NHB	420.8550551	865.4686958	723.4639101	373.1385552	193.7451556	65.61596936	38.23511914	0	0	10.14651015	0	2690.669		
Roadside	US287	HBW	640.8158885	1813.53567	1464.064406	572.2340586	250.92653	25.80089981	17.66786969	10.54248025	9.926729783	0	9.926729783	4815.441		
Roadside	US287	HBO	1258.906212	2209.340187	1065.439091	682.9329762	359.0823247	151.7916869	65.92589953	8.547630147	29.95112976	15.87417003	0	5847.791	13353.9	
Roadside	US85	HBW	104.9709599	660.172731	569.8889958	741.8421012	755.2404734	510.0494224	74.22171866	0	24.41339948	0	0	3440.8		
Roadside	US85	NHB	135.4931001	309.0942044	712.7082872	568.9037396	980.7025028	400.9174422	140.6011373	40.42763958	8.411039653	16.82207931	17.08343961	3331.165		
Roadside	US85	HBO	401.0544224	1173.779749	957.7151584	926.6002603	1496.824504	794.7686438	201.0675641	44.68067823	0	8.945639976	0	6005.437	12777.4	54479.95
Source	SiteName	HBPurpose	TripLength_0_10	TripLength_10_20	TripLength_20_30	TripLength_30_40	TripLength_40_50	TripLength_50_60	TripLength_60_70	TripLength_70_80	TripLength_80_90	TripLength_90_100	TripLength_100	SUM		
NI25 Model	I25	NHB	0.01%	0.34%	2.44%	9.04%	18.67%	25.32%	23.76%	13.97%	5.13%	1.05%	0.26%	1		
NI25 Model	I25	HBO	0.01%	0.34%	2.44%	9.04%	18.67%	25.32%	23.76%	13.97%	5.13%	1.05%	0.26%	1		
NI25 Model	I25	HBW	0.01%	0.34%	2.44%	9.04%	18.67%	25.32%	23.76%	13.97%	5.13%	1.05%	0.26%	1		
NI25 Model	US287	NHB	1.51%	18.40%	23.66%	23.21%	14.02%	8.60%	5.67%	3.23%	1.30%	0.31%	0.09%	1		
NI25 Model	US287	HBW	1.51%	18.40%	23.66%	23.21%	14.02%	8.60%	5.67%	3.23%	1.30%	0.31%	0.09%	1		
NI25 Model	US287	HBO	1.51%	18.40%	23.66%	23.21%	14.02%	8.60%	5.67%	3.23%	1.30%	0.31%	0.09%	1		
NI25 Model	US85	NHB	0.03%	0.54%	3.69%	12.96%	19.02%	21.68%	21.13%	14.53%	4.75%	1.29%	0.38%	1		
NI25 Model	US85	HBW	0.03%	0.54%	3.69%	12.96%	19.02%	21.68%	21.13%	14.53%	4.75%	1.29%	0.38%	1		
NI25 Model	US85	HBO	0.03%	0.54%	3.69%	12.96%	19.02%	21.68%	21.13%	14.53%	4.75%	1.29%	0.38%	1		
Roadside	I25	NHB	1.26%	3.66%	14.47%	15.91%	22.93%	24.31%	11.53%	2.99%	1.18%	0.00%	1.75%	1		
Roadside	I25	HBO	1.22%	8.61%	11.51%	18.03%	19.69%	23.19%	12.95%	2.02%	1.11%	1.02%	0.65%	1		
Roadside	I25	HBW	1.48%	10.21%	18.72%	22.41%	20.19%	19.50%	5.75%	0.89%	0.61%	0.25%	0.00%	1		
Roadside	US287	NHB	15.64%	32.17%	26.89%	13.87%	7.20%	2.44%	1.42%	0.00%	0.00%	0.38%	0.00%	1		
Roadside	US287	HBW	13.31%	37.66%	30.40%	11.88%	5.21%	0.54%	0.37%	0.22%	0.21%	0.00%	0.21%	1		
Roadside	US287	HBO	21.53%	37.78%	18.22%	11.68%	6.14%	2.60%	1.13%	0.15%	0.51%	0.27%	0.00%	1		
Roadside	US85	HBW	3.05%	19.19%	16.56%	21.56%	21.95%	14.82%	2.16%	0.00%	0.71%	0.00%	0.00%	1		
Roadside	US85	NHB	4.07%	9.28%	21.40%	17.08%	29.44%	12.04%	4.22%	1.21%	0.25%	0.50%	0.51%	1		
Roadside	US85	HBO	6.68%	19.55%	15.95%	15.43%	24.92%	13.23%	3.35%	0.74%	0.00%	0.15%	0.00%	1		
														0		

Note bi-regional only

Trip Table Processing

TRIP TERMINOLOGY

Bi-Regional: Trips that have one endpoint in the NFR model area, and one endpoint in the DRCOG model area.

Border trips: Trips that cross the common border (approximately SH-66) between the two MPO models.

Internal-Internal (I-I): I-I trips from either the NFR or DRCOG MPO models.

Internal-External (I-E): I-E trips from either the NFR or DRCOG MPO models.

External-External (E-E): E-E trips from either the NFR or DRCOG MPO models.

Regional-External: Trips that have one endpoint in either the NFR or DRCOG model areas, and the other endpoint external to the both NFR and DRCOG model areas.

Super-External: Trips that have neither endpoint in either the NFR or DRCOG model areas.

RESTRUCTURING OF BORDER TRIPS

The border trips, represented as internal-external and external-external trips of the original MPO models, become different trip types in the combined model structure:

Restructure of Border Trips

Trip Type in Original MPO Model	Trip Types in Combined Model
Internal-External Trip	➢ Bi-regional residential trips o HBW o HBO o NHB ➢ Bi-regional truck trips ➢ Regional-External trips
External-External Trip	➢ Regional-External trips ➢ Super-External trips

The processing of trips utilized the 2000 Census Transportation Planning Package (CTPP), the 1998 DRCOG roadside survey, and the MPO models external station models. The attached table quantifies the number of trips of each type.

DATA PROCESSING FOR EACH TRIP TYPE

Bi-Regional

HBW Trips

Data Sources:

1. The 2000 Census Transportation Planning Package (CTPP) provided the geographic distribution of work trips.

2. The DRCOG roadside survey provided the total number of HBW trips.

Data processing:

1. Journey-to-work CTPP worker flow data[1] at the census tract level was aggregated to Regional Statistical Area (RSA) districts. The attached figure displays the RSA districts.

2. HBW trips between RSAs were allocated to TAZs by:

   i. The number of households by TAZ within the RSA, for the production (residential) end of the trip.

   ii. The number of employees by TAZ within the RSA, for the attraction (work) end of the trip.

3. The total number of HBW trips was based on the 1998 roadside survey. This total was increased for two reasons:

   i. Traffic on county roads was not included in the roadside survey of the three major highways. The year 2000/2001 traffic on Weld CR 13, Weld CR 9, and Boulder CR 23 totaled 10,400 vehicles per day. Using the distribution of trip purposes from the roadside survey, it was determined 3,700 HBW trips should be added to account for county road traffic.

[1] Census Transportation Planning Package 2000 (Part 3) Table 301 Total Worker Flow

ii. Growth to the year 2001. The 2030 MPO models were examined for the growth in external station traffic. An average of the two models' annual average growth rate was 2.5%. This was applied for 3 years to increase the total HBW trips.

4. The JTW trips were factored by approximately 0.74 to match the total number of HBW roadside survey trips. Another technical memorandum (draft in progress as of this date) documents the need to factor the JTW trips.

5. Divide HBW trips into low, medium, and high income level HBW trips

   i. Use DROCG TAZ socioeconomic data (households by the same three income levels) for the origin TAZ to proportion HBW trips into low, medium, and high income trips

   ii. Use NFR TAZ socioeconomic data (households by five income levels) for the origin TAZ to proportion HBW trips into low income (using NFR HH_20K), medium income (using the sum of NFR HH_20K40K, HH_40K60K, HH_60K75K), and high income (using NFR HH_75K)

<u>HBO Trips</u>

Data Source:

1. The DRCOG roadside survey provided the geographic distribution and the total number of HBO trips.

Data processing:

1. Geocoded HBO trip data from the roadside survey was aggregated to RSA districts, because the geocoded survey data did not have the precision needed for processing at the TAZ level.

2. HBO trips between RSAs were allocated to TAZs by:

   i. The number of HBO productions (from each respective model's trip generation) by TAZ within the RSA, for the production (residential) end of the trip.

   ii. The number of HBO attractions (from each respective model's trip generation) by TAZ within the RSA, for the attraction end of the trip.

3. The total number of HBO trips was based on the 1998 roadside survey. This total was increased for two reasons:

    i. Traffic on county roads was not included in the roadside survey of the three major highways. The year 2000/2001 traffic on Weld CR 13, Weld CR 9, and Boulder CR 23 totaled 10,400 vehicles per day. Using the distribution of trip purposes from the roadside survey, it was determined 4,200 HBO trips should be added to account for county road traffic.

    ii. Growth to the year 2001. The 2030 MPO models were examined for the growth in external station traffic. An average of the two models annual average growth rate was 2.5%. This was applied for 3 years to increase the total HBO trips.

NHB Trips

Data Source:

1. The DRCOG roadside survey provided the geographic distribution and the total number of NHB trips.

Data processing:

1. Geocoded trip data from the roadside survey was aggregated to RSA districts, because the geocoded survey data did not have the precision needed for processing at the TAZ level.

2. NHB trips between RSAs were allocated to TAZs by:

    i. The number of NHB productions (from each respective model's trip generation) by TAZ within the RSA, for each end of the trip.

3. The total number of NHB trips was based on the 1998 roadside survey. This total was increased to account for two reasons:

    i. Traffic on county roads was not included in the roadside survey of the three major highways. The year 2000/2001 traffic on Weld CR 13, Weld CR 9, and Boulder CR 23 totaled 10,400 vehicles per day. Using the distribution of trip purposes from the roadside survey, it was determined 2,500 NHB trips should be added to account for county road traffic.

ii. Growth to the year 2001. The 2030 MPO models were examined for the growth in external station traffic. An average of the two models annual average growth rate was 2.5%. This was applied for 3 years to increase the total NHB trips.

Truck Trips

Data Source:

1. The 1998 DRCOG truck roadside survey was used to obtain the total number and distribution of truck trips.

Data processing:

1. Geocoded truck trip data from the truck roadside survey was aggregated to RSA districts, because the geocoded survey data did not have the precision needed for processing at the TAZ level.

2. The total number and geographic distribution was based on the RSA-to-RSA truck trip totals. Truck trips were allocated to TAZs using:

   - The total number of households plus employment in the TAZ, with households and employment weighted by the DRCOG truck production rates for each respectively. Specifically, the ratio of DRCOG household truck rates to employment truck rates is 1:14. Therefore total employment is weighted 14 times the total number of households.

3. Regional-external and super-external truck trips were not directly modeled, but are included within the general regional-external and super-external trips of the combined model.

4. The total number of COM trips was based on the 1998 roadside survey. This total was increased to account for growth:

   i. Growth to the year 2001. The 2030 MPO models were examined for the growth in external station traffic. An average of the two models annual average growth rate was 2.5%. This was applied for 3 years to increase the total COM trips.

Note, the internal truck (COM) trips within the DRCOG model are not affected, i.e., remain active in the DRCOG portion of the model.

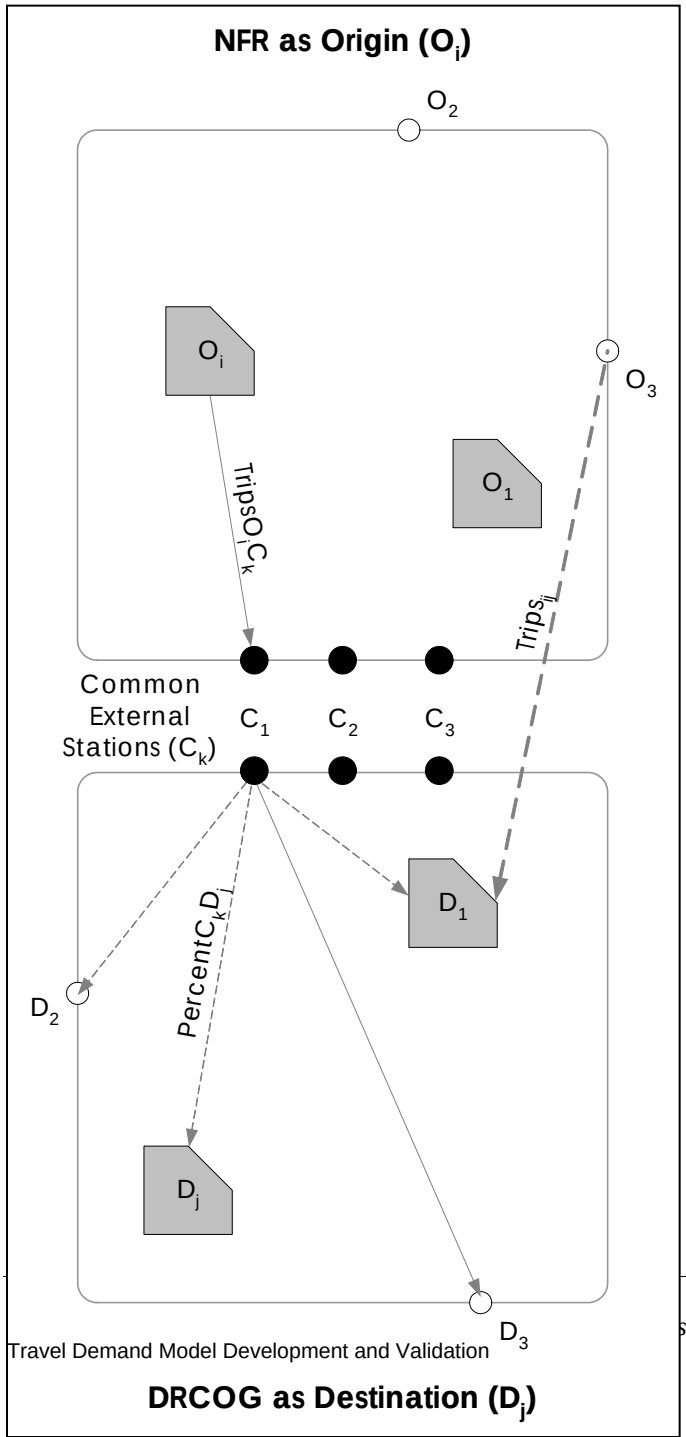
Regional-External and Super-External Trips

Data Source:

Regional-External trips were developed from the external station elements of the MPO models: the internal-external and external-external trip models.

Data processing:

1. The following graphic illustrates the steps used to calculate the regional-external and super-external trips.



- **Origin (O):** TAZs and external stations in NFR MPO
- **Destination (D):** TAZs and external stations in DRCOG
- **TripsOiCk**: The number of internal or external trips originating in one NFR zone or external station (Oi) to a common external station (Ck). Data Source: I-E and E-E tables.
- **PercentCkDj:** The number of trips from a DRCOG common external station (C) to one DRCOG internal zone or external station (Di) divided by the sum of trips from that common station to all internal zones and external stations. Data Source: I-E and E-E tables.
- **Tripsij:** The number of trips from the origin (Oi)to the common external station multiplied by the percent of trips from the common station to the destination (Dj). Trips were calculated through each

common external station and then summed.

$$Trips_{ij} = \sum_{k}^{1} TripsO_i C_k \times PercentC_k D_j$$

2. The process was repeated for the other MPO model as origin model; the origin and destination MPOs were reversed to calculate the trips from DRCOG to NFR.

   - **Regional-External Trips:** TripsOiDi with origin as internal zone of origin MPO and destination as external station of destination MPO. Also TripsOiDi with origin as external station of origin MPO and destination as internal zone destination MPO.

   - **Super-External Trips:** TripsOiDi with the origin as an external station of the origin MPO and the destination as an external station of the destination MPO.

Internal-Internal Trips

The internal-internal trips of each respective model are unaffected, except for the overlap zones. (See *Merging Zones and Networks_update.doc*). There are ten NFR zones that overlap with two DRCOG zones. The NFR zones remain as internal zones to the NFR model area. The DRCOG zones are factored down (the socioeconomic data in *zonexxx.bin;* specifically the attributes HH POP, LOW INC HH, MED INC HH, HIGH INC HH, P/D EMP, RETAIL EMP, SERVICE EMP) to reflect the portion of each that is not covered by the overlapping NFRMPO zone(s):

- Zone 2576: Zero out population, households, and employment (Zone 2576 is entirely covered by the overlapping NFRMPO zones).

- Zone 2577: Factor population, households, and employment by 51%. For example, the combined model HH POP = 0.51*(original HH POP).

Internal-External and External-External Trips

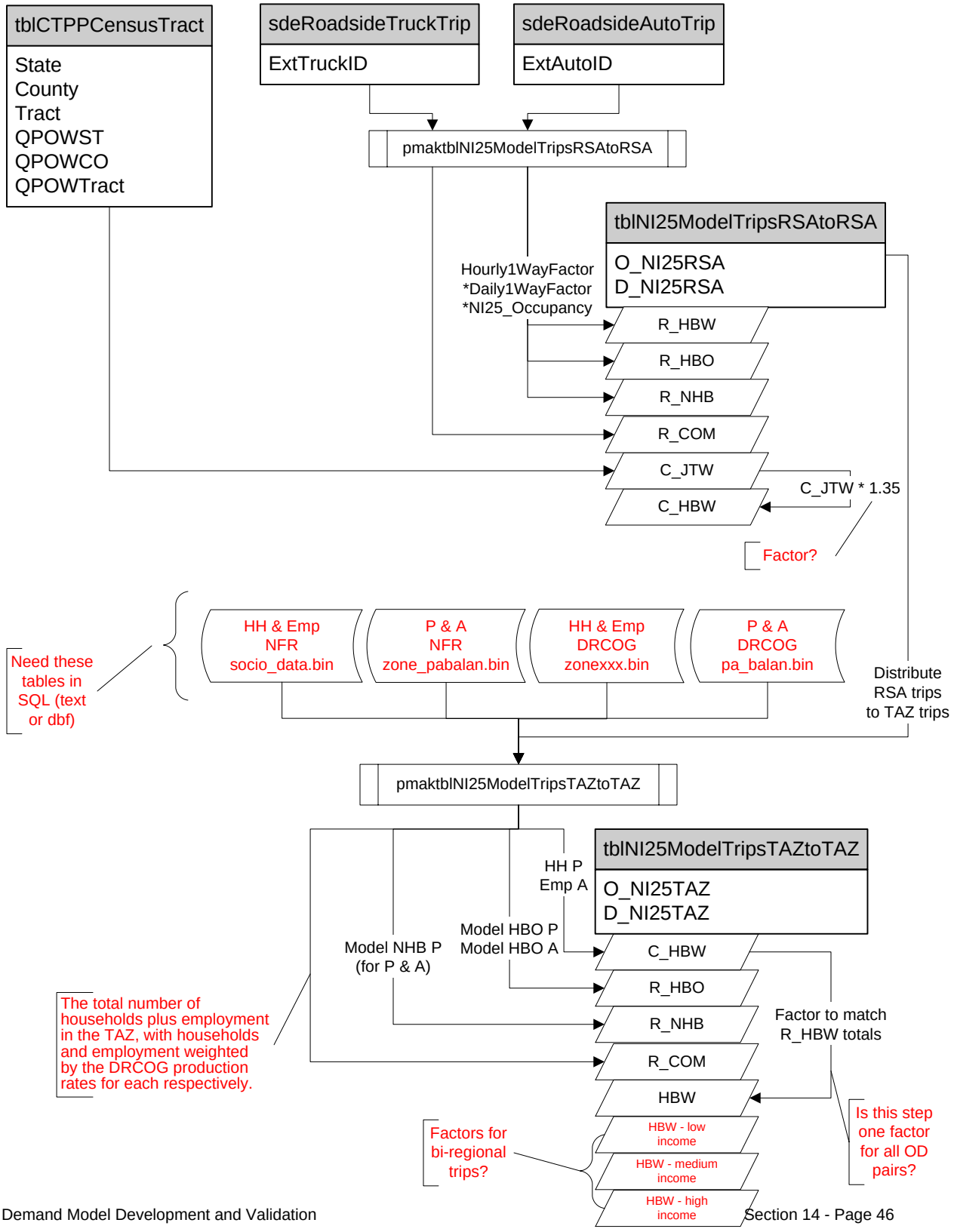
The internal-external and external-external trips of each respective MPO model are unaffected, except for external stations in the border area. Internal-external

trips at these border locations are zeroed out from the internal-external trip tables of the MPO models:

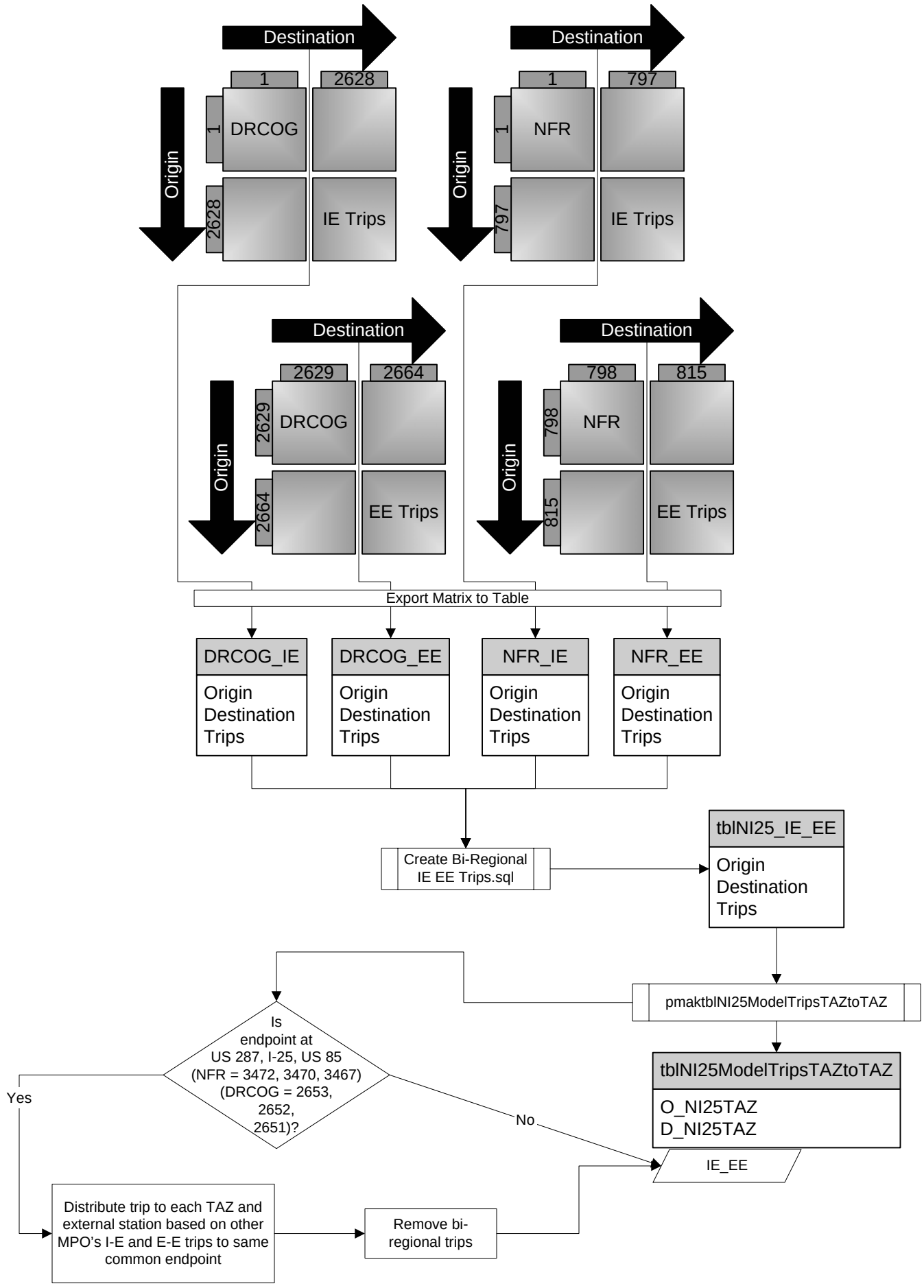
- NFRMPO Model
  - I-25 External Station 806 (3470 combined)
  - US-287 External Station 808 (3472 combined)
  - US-85 External Station 803 (3467 combined)
  - Weld CR-19 External Station 804 (3468 combined)
  - Weld CR-13 External Station 805 (3469 combined)
  - SH-66 External Station 807 (3471 combined)
- DRCOG Model
  - I-25 External Station 2652
  - US-287 External Station 2653
  - US-85 External Station 2651
  - Boulder CR-23 External Station 2654

Bi-Regional Trip Table Processing

(Trip Table Process.doc)



Combine IE & EE Trip Tables



North I-25 EIS

Bi-Regional Trip Table

	2001	2030	annual rate
HBW L	3,916	8,382	2.66%
HBW M	15,774	34,583	2.74%
HBW H	6,916	15,049	2.72%
HBW TOTAL	28,607	60,044	2.59%
HNW	35,985	80,355	2.81%
NHB	21,826	48,081	2.76%

9/11/2007
J:_Transportation\071609.400\manage\report\Chris Primus Notebook\Notebook 3\5-2030 Trip Table\[2001 203

Calculate goals with existing tables

2030 I-I Trip Tables

Marginal % distribution within RSA ([1A], [1P])

From trip table or trip gen

2000 BR Trip Tables

Compute marginal % of RSA distribution as % of total BR trip table ([2A], [2P])

Total 2030 BR goal [3]

Calculate the goal

([4P] = [1P]x[2P]x[3])

([4A] = [1A]x[2A]x[3])

Program to create seeding

Productions

Identify zones with zero P

Using skims, identify four closest zones with P >0

Attractions

Identify zones with zero A

Using skims, identify four closest zones with A >0

Calculate seed

P seed

Sum nearest 4 rows separately for each column into temp row

Multiply each cell in temp row by 0.01

Replace zero row with temp row

A seed

Sum nearest 4 columns separately for each row into temp column

Multiply each cell in temp column by 0.01

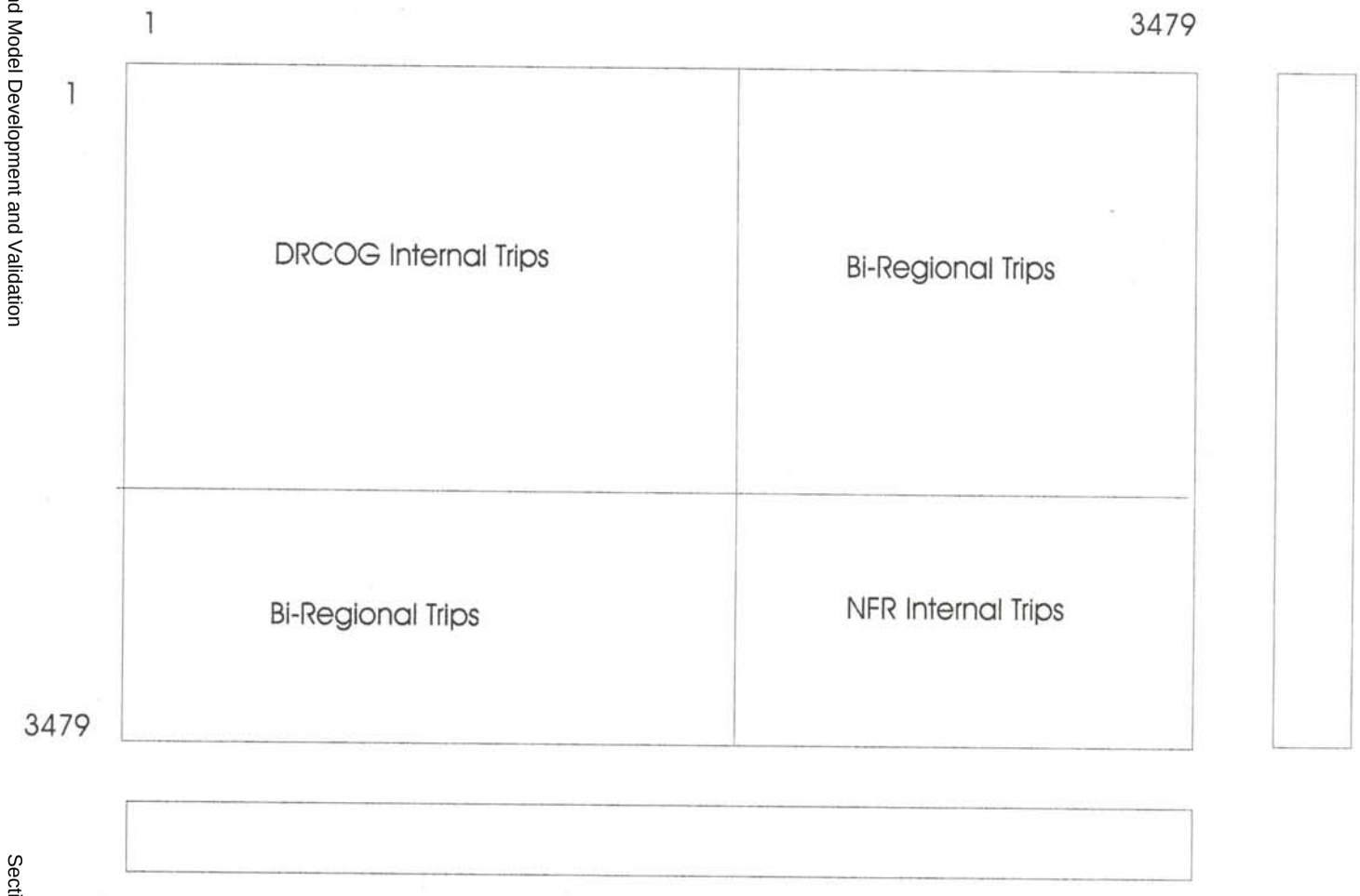
Replace zero column with temp column

Fratar

Iterations < 10

Tolerance ~ 0.1

2030 Bi-Regional Future Year Trip Table Development



Row Marginals =

2030 Internal Productions +

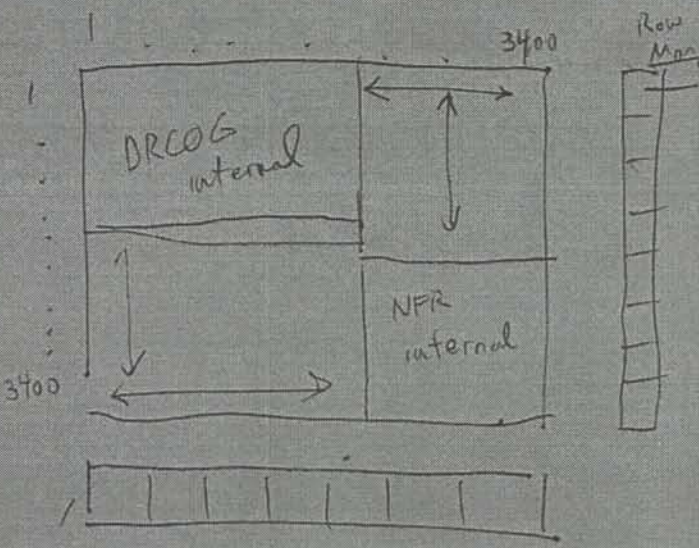
2001 Bi-Regional Productions *

(1+.025)^29

Column Marginals =

2030 Internal Attractions + 2001 Bi-Regional Attractions * (1+.025)^29

For each trip purpose



Row Marginals

2030 raw internal P's + biregional P's * $(1 + .025)^{29}$

sum of Ps 1-2664
AS - 2665-3400

Column Marginals

(raw internal A's + biregional A's * $(1 + .025)^{29}$)
2030

I will need ① bi-regional trip tables
② zone layer
③ DRCOG 2030 ps and as (unbalanced)

ExtStations.asc

2629	7000	1.500000	4.500000	10780	10295	485	243	243
2630	44200	4.700000	11.800000	167446	147688	19759	9879	9879
2631	1700	1.300000	0	2472	2472	0	0	0
2632	4200	1.300000	0	6108	6108	0	0	0
2633	13600	3.300000	2.400000	34870	34033	837	418	418
2634	1000	2.500000	7	2046	1903	143	72	72
2635	1200	2.500000	0	2456	2456	0	0	0
2636	58000	2.500000	10.200000	118692	106585	12107	6053	6053
2637	2500	2.500000	0	5116	5116	0	0	0
2638	12300	2.600000	4.100000	25893	24831	1062	531	531
2639	1800	2.600000	0	3789	3789	0	0	0
2640	3600	2.600000	0	7578	7578	0	0	0
2641	2100	2.600000	0	4421	4421	0	0	0
2642	200	1.700000	0	326	326	0	0	0
2643	300	1.700000	0	489	489	0	0	0
2644	13000	2	26.400000	23086	16991	6095	3047	3047
2645	3000	2	0	5328	5328	0	0	0
2646	200	1.400000	0	299	299	0	0	0
2647	300	1.400000	0	449	449	0	0	0
2648	1200	1.700000	0	1957	1957	0	0	0
2649	1400	1.100000	0	1923	1923	0	0	0
2650	10200	2.800000	16	22720	19084	3635	1818	1818
2651	17200	2	9.800000	30545	27551	2993	1497	1497
2652	54600	3	14.600000	128668	109883	18786	9393	9393

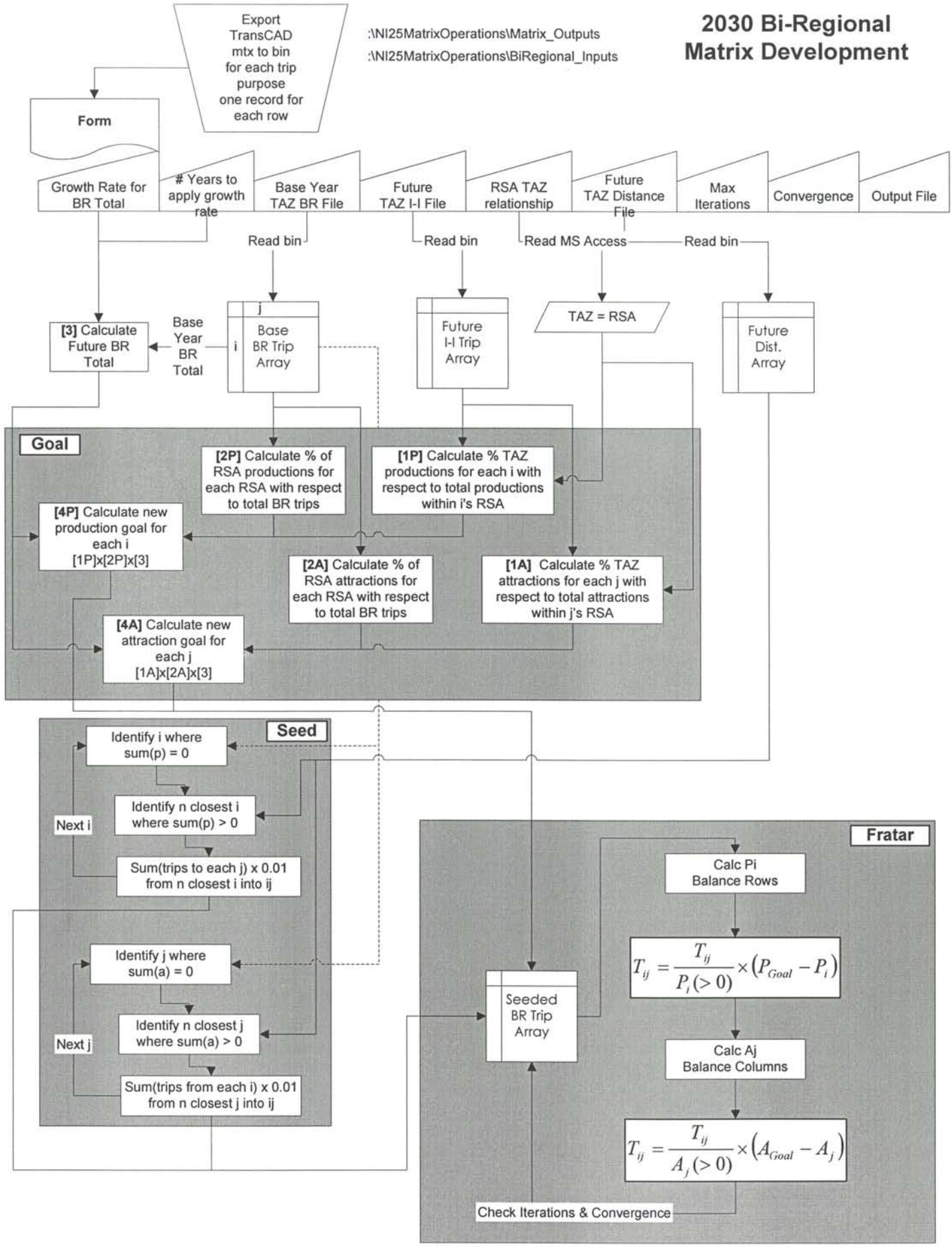
2653	16200	3.200000	0.800000	40386	40062	323	162
162							
2654	6600	1.300000	0	9599	9599	0	0
0							
2655	5700	2.800000	2	12696	12442	254	127
127							
2656	1600	2.500000	0	3274	3274	0	0
0							
2657	1800	1.300000	0	2618	2618	0	0
0							
2658	5000	1.300000	0	7272	7272	0	0
0							
2659	2900	1.300000	0	4218	4218	0	0
0							
2660	3100	1.300000	0	4509	4509	0	0
0							
2661	11400	1.600000	0.500000	18064	17974	90	45
45							
2662	2500	1.300000	0	3636	3636	0	0
0							
2663	4600	1.600000	0	7289	7289	0	0
0							
2664	1200	1.600000	0	1902	1902	0	0
0							

ZONE	Z798	Z799	Z800	Z801	Z802	Z803	Z804	Z805	Z806	Z807	Z808	Z809	Z810	Z811	Z812	Z813	Z814	Z815	
798	0	0	0	0	0	46	0	0	311	11	63	9	2	6	0	20	0	2	**470**
799	0	0	0	0	0	38	0	0	258	9	52	7	1	5	0	17	0	1	**388**
800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
801	0	0	0	0	0	68	0	0	456	16	92	13	3	9	0	30	0	3	**690**
802	0	0	0	0	0	287	0	0	1930	69	390	56	11	39	0	126	0	11	**2919**
803	46	38	0	68	287	0	0	0	1673	555	0	422	81	292	0	957	0	82	**4501**
804	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
805	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
806	311	258	0	456	1930	1673	0	0	0	3484	2014	2844	542	1966	0	6444	0	550	**22472**
807	11	9	0	16	69	555	0	0	3484	0	0	0	19	71	0	232	0	20	**4486**
808	63	52	0	92	390	0	0	0	2014	0	0	575	110	398	0	1304	0	111	**5109**
809	9	7	0	13	56	422	0	0	2844	0	575	0	16	57	0	186	0	16	**4201**
810	2	1	0	3	11	81	0	0	542	19	110	16	0	11	0	36	0	3	**835**
811	6	5	0	9	39	292	0	0	1966	71	398	57	11	0	0	0	0	0	**2854**
812	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
813	20	17	0	30	126	957	0	0	6444	232	1304	186	36	0	0	0	0	0	**9352**
814	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
815	2	1	0	3	11	82	0	0	550	20	111	16	3	0	0	0	0	0	**799**
	470	**388**	**0**	**690**	**2919**	**4501**	**0**	**0**	**22472**	**4486**	**5109**	**4201**	**835**	**2854**	**0**	**9352**	**0**	**799**	

US-85 9002
I-25 44,944
US-287 10,218

NFR

ZONE	IE_P
793	0
794	0
795	0
796	0
797	0
798	1460
799	1519
800	100
801	4971
802	5963
803	18800
804	2565
805	4030
806	60058
807	11027
808	25784
809	2100
810	1834
811	2195
812	300
813	9296
814	45
815	1453


2030 Bi-Regional Matrix Development
Export TransCAD mtx to bin for each trip purpose one record for each row
:\NI25MatrixOperations\Matrix_Outputs
:\NI25MatrixOperations\BiRegional_Inputs
Form
Growth Rate for BR Total
Years to apply growth rate
Base Year TAZ BR File
Future TAZ I-I File
RSA TAZ relationship
Future TAZ Distance File
Max Iterations
Convergence
Output File
Read bin
Read bin
Read MS Access
Read bin
[3] Calculate Future BR Total
Base Year BR Total
Base BR Trip Array
Future I-I Trip Array
TAZ = RSA
Future Dist. Array
Goal
[2P] Calculate % of RSA productions for each RSA with respect to total BR trips
[1P] Calculate % TAZ productions for each i with respect to total productions within i's RSA
[4P] Calculate new production goal for each i [1P]x[2P]x[3]
[2A] Calculate % of RSA attractions for each RSA with respect to total BR trips
[1A] Calculate % TAZ attractions for each j with respect to total attractions within j's RSA
[4A] Calculate new attraction goal for each j [1A]x[2A]x[3]
Seed
Identify i where sum(p) = 0
Identify n closest i where sum(p) > 0
Next i
Sum(trips to each j) x 0.01 from n closest i into ij
Identify j where sum(a) = 0
Identify n closest j where sum(a) > 0
Next j
Sum(trips from each i) x 0.01 from n closest j into ij
Fratar
Seeded BR Trip Array
Calc Pi Balance Rows
$T_{ij} = \frac{T_{ij}}{P_i(>0)} \times (P_{Goal} - P_i)$
Calc Aj Balance Columns
$T_{ij} = \frac{T_{ij}}{A_j(>0)} \times (A_{Goal} - A_j)$
Check Iterations & Convergence

Carter Burgess

PROJECT

CLIENT

SUBJECT

JOB NO.		NO.
DESIGNED BY	DATE 9/29	
CHECKED BY	DATE	OF

Factor 1997 data to 2001:

Use 2.5% per year annual avg growth

1. Andy Gomez's recommendation

2. a DRCOG's avg annual growth forecast of border ext st'n, 2001 to 2030:
2.86%

b. NFRS: 2.29%

c. ≈ avg is 2.5%

See 2030 trip table das

2030 Bi-Regional Trip Table Development Process

1. Use a fratar process to grow the bi-regional trip table from 2001 to 2030.

2. The fratar process requires:
   1) A base year trip table
   2) Future year row and column marginal totals

3. Base Year table:
   - The 2001 bi-regional trip table, by purpose. This table is exclusively composed of bi-regional trips.

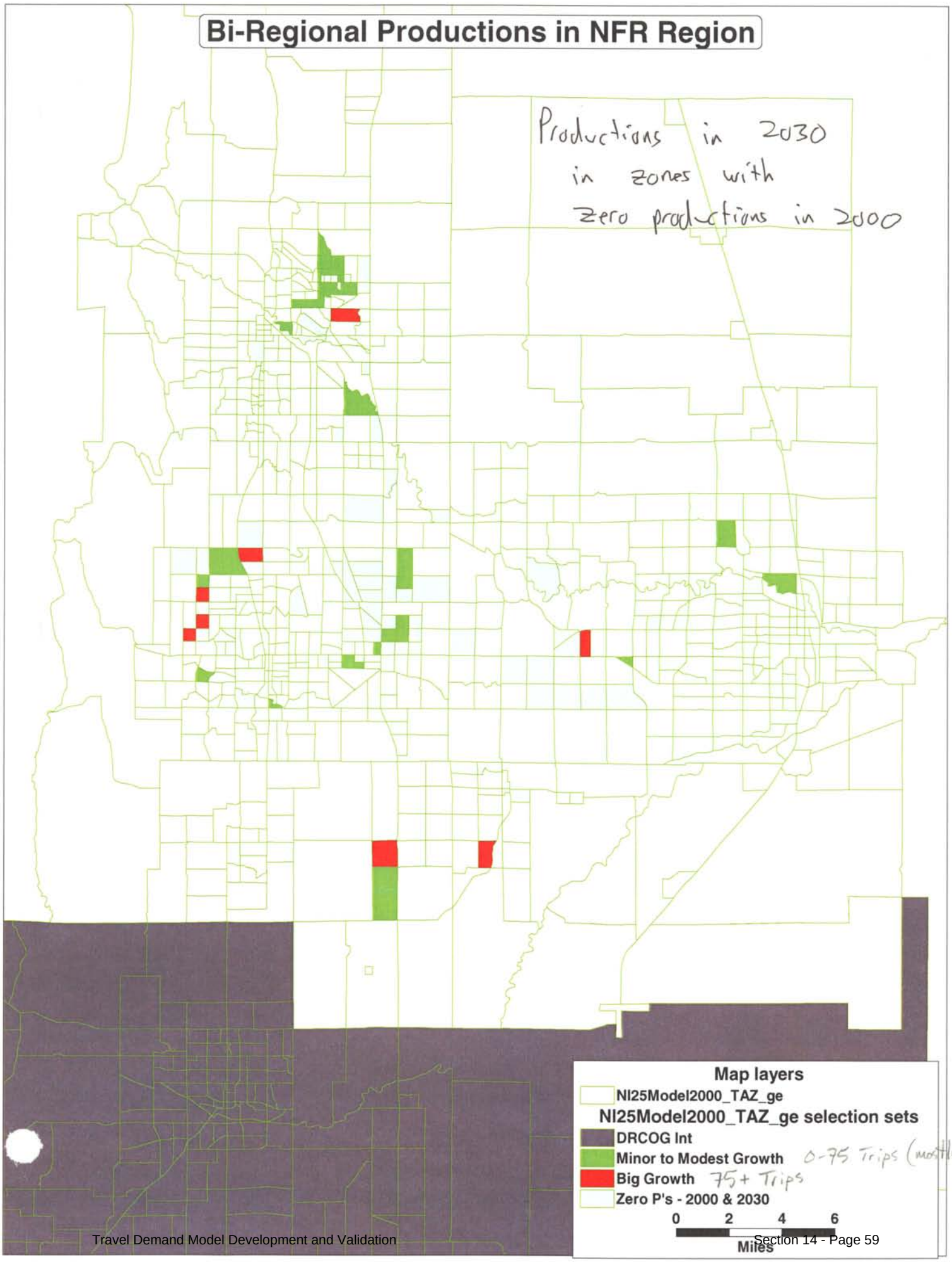
4. Future year row and column marginals:
   - The sum of the row (column) marginal total is defined to be the base year total increased by an average growth rate of 2.5% per year.
     - The 2.5% is the average of the external station average annual increases of the US-287, I-25, and US-85 external stations, of both the NFRMPO and DRCOG 2030 models.
   - The distribution of the marginal total is defined to be the average of the bi-regional marginal distribution and the marginal distribution of the 2030 internal-internal trips.
     - The bi-regional trip distribution reflects the propensity of near-border zones in the bi-regional trips
     - The internal-internal distribution reflects the future activity of zones that may not exhibit activity in the base year.

5. Fratar

6. Review

7. Combine the 2030 bi-regional trip table with the original 2030 trip tables for internal-internal trip purposes, as part of the standard combined model process.

J:_Transportation\071609.400\model\model development\2030 Trip Table Process.doc August 29, 2007


Bi-Regional Productions in NFR Region
Productions in 2030 in zones with zero productions in 2000
Map layers
NI25Model2000_TAZ_ge
NI25Model2000_TAZ_ge selection sets
DRCOG Int
Minor to Modest Growth
0-75 Trips (mostly <
Big Growth
75+ Trips
Zero P's - 2000 & 2030
0 2 4 6
Miles

North I-25
External Station Comparison at Common Boundary

NFR Model

	I-25	US-287	US-85	Hwy Total	W CR13	W CR 19	B CR 23
2000	56,100	14,100	15,400	85,600	2,287	1,456	NA
2030	105,000	36,000	27,800	168,800	4,030	2,565	NA
Absolute Growth	48,900	21,900	12,400	83,200	1,743	1,109	
Percentage Growth	87%	155%	81%	97%	76%	76%	
Avg Ann. Growth	2.11%	3.17%	1.99%	2.29%	1.91%	1.91%	

DRCOG Model

	I-25	US-287	US-85	Total	W CR13	W CR 19	B CR 23
2001	54,600	16,200	17,200	88,000	NA	NA	6,600
2030	128,700	40,400	30,500	199,600	NA	NA	9,600
Absolute Growth	74,100	24,200	13,300	111,600	NA	NA	3,000
Percentage Growth	136%	149%	77%	127%			45%
Avg Ann. Growth	3.00%	3.20%	1.99%	2.86%			1.30%

2000 NFR compared to 2001 DRCOG (DRCOG - NFR)

	I-25	US-287	US-85	Total	W CR13	W CR 19	B CR 23
Absolute Difference	-1,500	2,100	1,800	2,400			
Percent Difference	-2.7%	14.9%	11.7%	2.8%			

2030 NFR compared to 2030 DRCOG (DRCOG - NFR)

	I-25	US-287	US-85	Total	W CR13	W CR 19	B CR 23
Absolute Difference	23,700	4,400	2,700	30,800			
Percent Difference	22.6%	12.2%	9.7%	18.2%			

Method for Developing the Future Trip Table

- Use a fratar process to “grow” the base year (2000/2001) combined trip table to the year 2030.
- The row and column marginals are the sum of the:
    - 2030 unbalanced Productions (rows) & Attractions (columns) trip totals from each respective model (These production and attraction estimates are internal estimates only).
    - The average external growth rates of the two models at the three common external stations (I-25, US-287, and US-85) applied to the bi-regional trips (those trips that cross between the two MPO areas) by zone (These growth rates would be used to increase the un-normalized productions and attractions to represent total values – internal and external).
        - As an example of what I recall we discussed: Zone A has internal 100 productions and has 10 internal/external productions in 2000/2001. In 2030, the number of internal productions increase to 150. Based upon the projected growth in the nearest external station (say 30%), then the number of internal/external productions would increase to 13. Therefore the total number of productions for the 2030 matrix balancing would be 163.
- Apply the fratar process (for each individual purpose).
- Replace the internal MPO portions of the balanced, combined trip table with the originals from the two models. (Important to compare the fratar output internal distribution with the internal distributions before replacement. This may lead to a revision/adjustment to the procedure).
- Check the resulting future bi-regional trip total to make sure that a growth rate is produced that is close (and probably slightly higher) than the MPO external station growth rates.

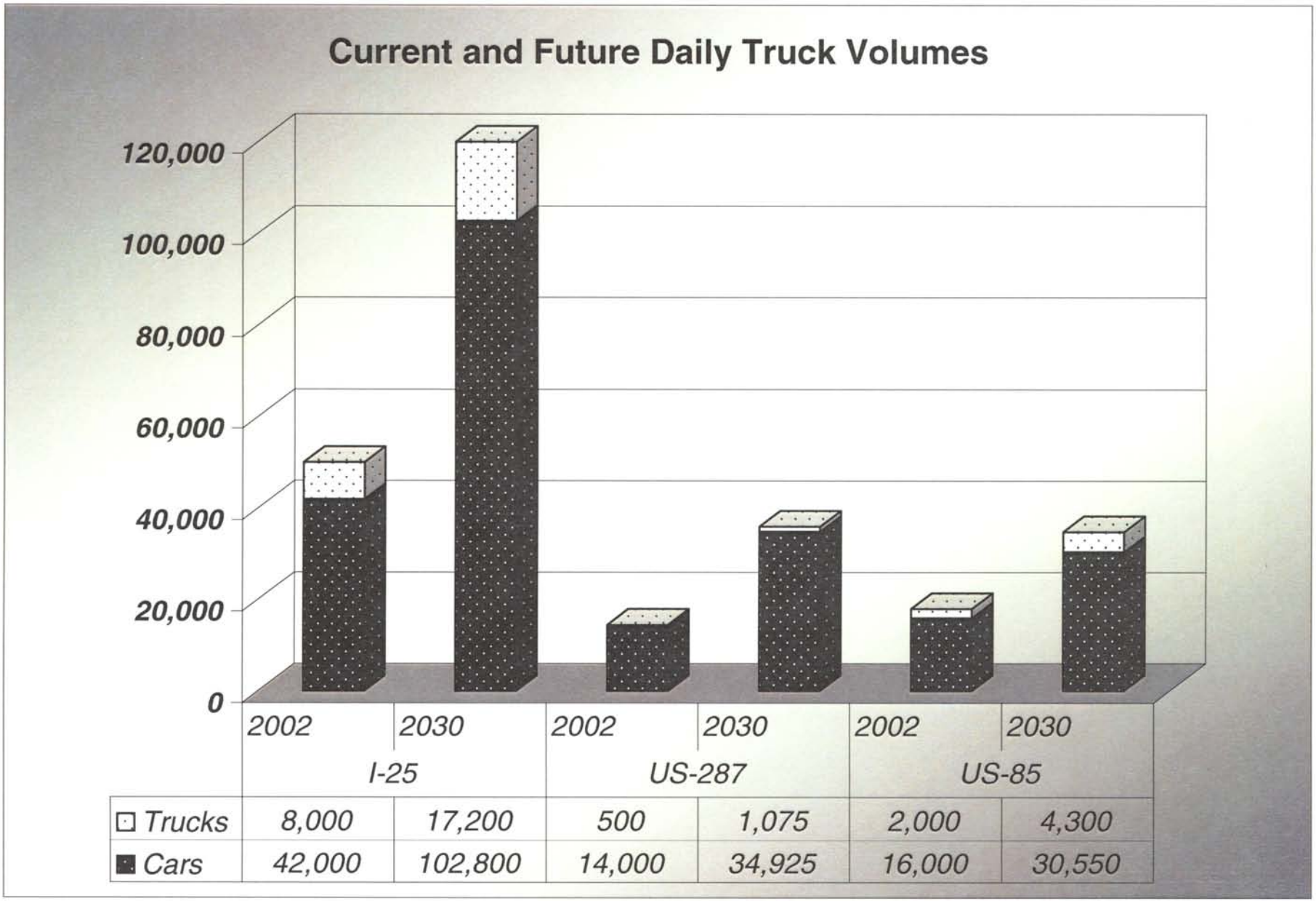
J:_Transportation\071609.400\model\Future Trip Table Method.doc

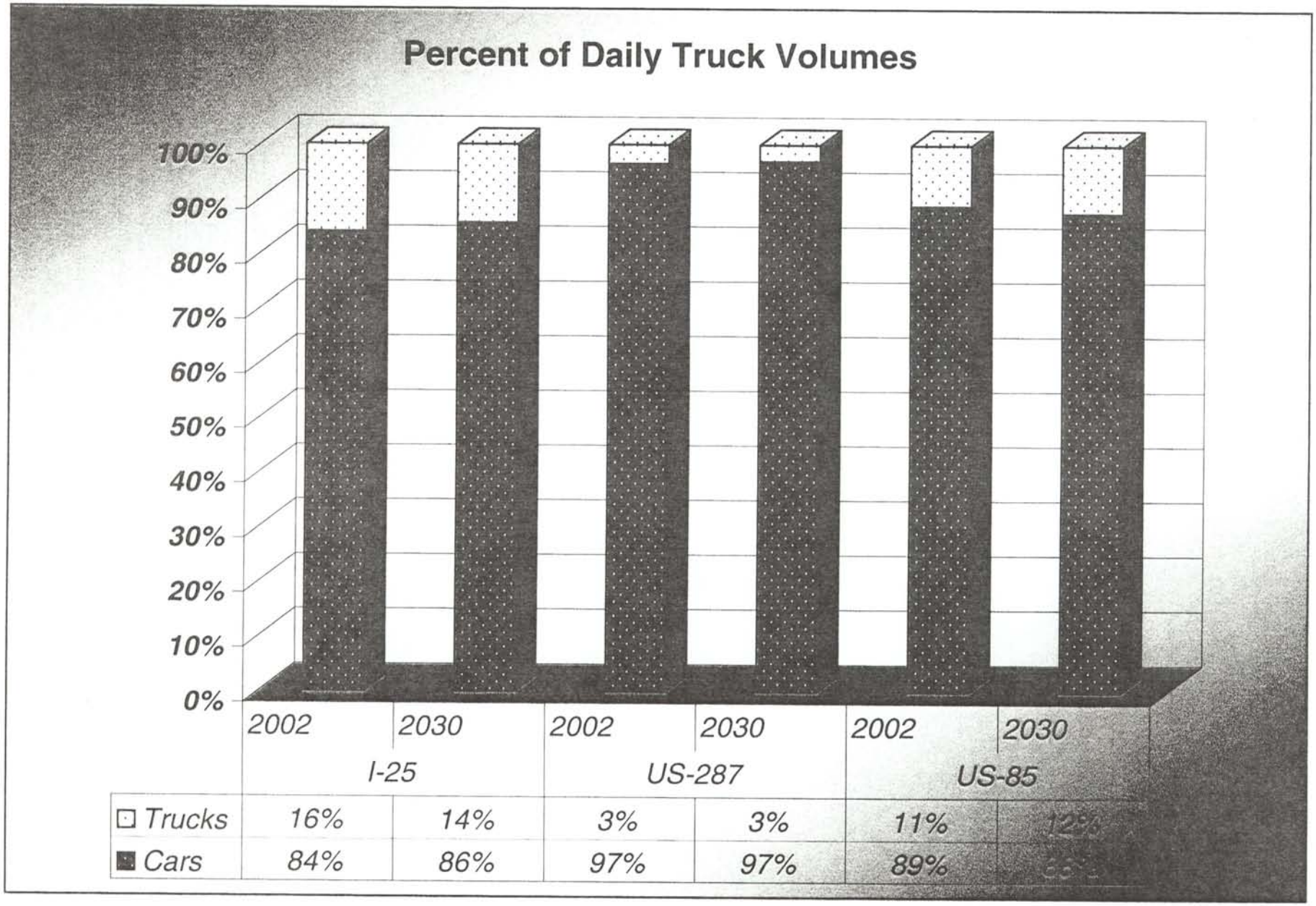
Comparison of MPO Trip Growth Rates

DRCOG	2001	2030	Growth	Annual Growth
HBW	1,904,516	3,168,430	66.4%	1.77%
HBO	4,592,737	6,580,595	43.3%	1.25%
NHB	3,010,018	5,024,281	66.9%	1.78%
COM	1,135,739	1,649,683	45.3%	1.30%

NFRMPO	2000	2030	Growth	Annual Growth
HBW	305,526	578,956	89.5%	2.23%
HBO	965,725	1,707,638	76.8%	1.98%
NHB	512,935	962,792	87.7%	2.20%

9/11/2007
J:_Transportation\071609.400\manage\report\Chris Primus Notebook\Notebook 3\5-2030 Trip Table\[T


Current and Future Daily Truck Volumes
120,000
100,000
80,000
60,000
40,000
20,000
0
2002
2030
2002
2030
2002
2030
I-25
US-287
US-85
Trucks
8,000
17,200
500
1,075
2,000
4,300
Cars
42,000
102,800
14,000
34,925
16,000
30,550

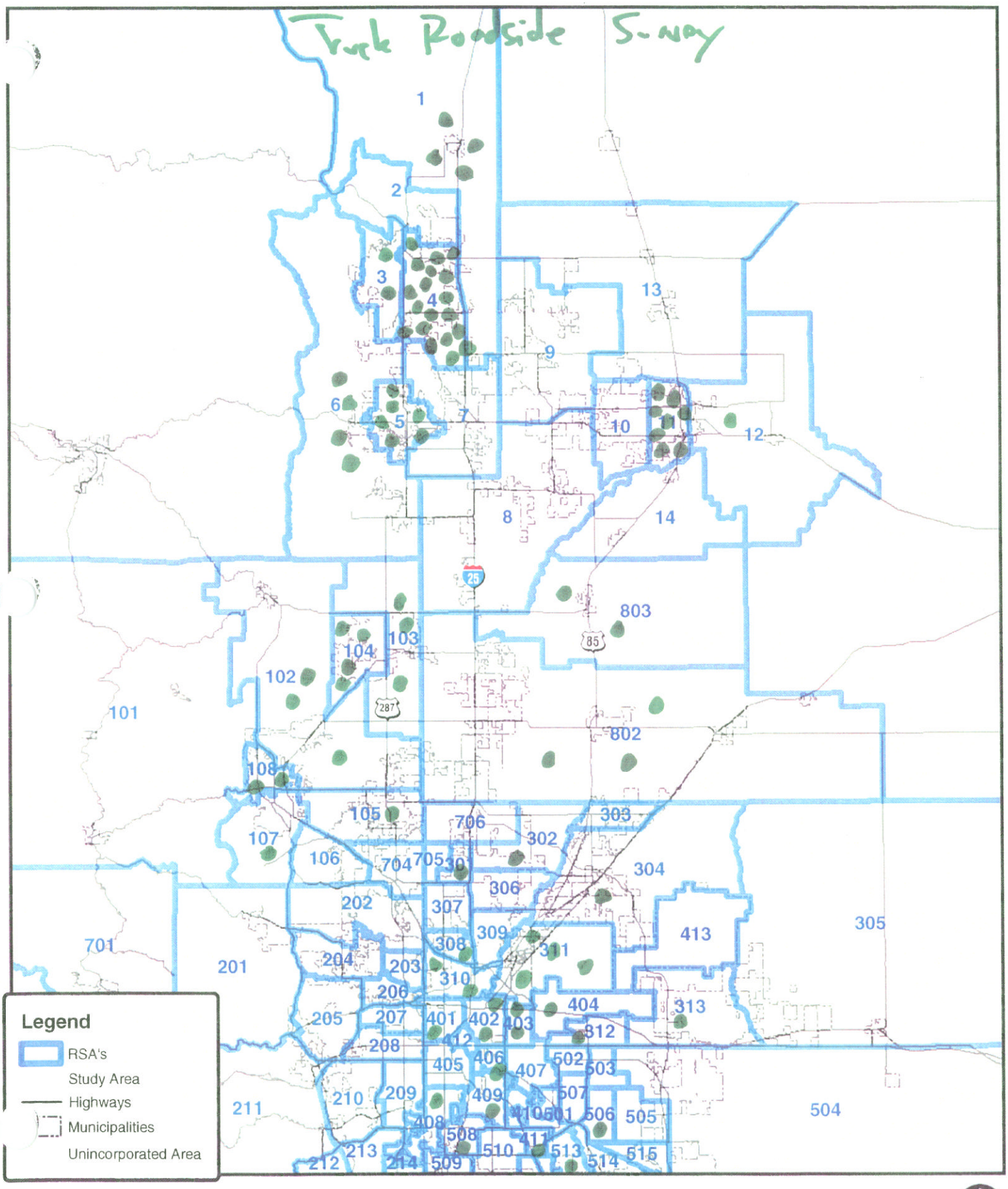

Percent of Daily Truck Volumes
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2002
2030
2002
2030
2002
2030
I-25
US-287
US-85
Trucks
16%
14%
3%
3%
11%
12%
Cars
84%
86%
97%
97%
89%

Scenario	Total	I25Multi	US287NBMulti	US85NBMulti	I25Single	US287Single	US85Single
Truck Trips through three stations	8362	6086	91	470	1184	205	325
Truck Trips with destination in DRCOG	1830	1698	6	28	68	12	19
Truck Trips with destination in NFR	2551	1257	45	235	700	121	192
Truck Trips with origin and destination outside DRCOG and NFR	1426	1370	3	14	27	5	7
Truck Trips with origin in DRCOG	3616	1615	72	371	1076	186	296
Truck Trips with origin in DRCOG and destination in DRCOG	132	0	6	28	68	12	19
Truck Trips with origin in DRCOG and destination in NFR	1594	457	36	185	633	109	174
Truck Trips with origin in NFR	1468	1313	12	64	54	9	15
Truck Trips with origin in NFR and destination in DRCOG	329	329	0	0	0	0	0
Truck Trips with origin in NFR and destination in NFR	474	381	6	28	40	7	11
	1426	17%	O&D Elsewhere				
	3616	43%	DRCOG Origin				
	1468	18%	NFR Origin			Origins	
	1853	22%	Origin Elsewhere, MPO Destination				
	8362	100%	TOTAL				
	1426	17%	O&D Elsewhere				
	1830	22%	DRCOG Destination				
	2551	31%	NFR Destination			Destinations	
	2555	31%	Destination Elsewhere, MPO Origin				
	8362	100%	TOTAL				
	1426		O&D Elsewhere				
	1923		O&D in either MPOs				
	605		O&D in same MPO				
	4408		O or D in MPOs				
	8362		Sum				
	1426	17%	O&D Elsewhere				
	2528	30%	O&D in MPOs				
	4408	53%	O or D in MPOs				
	8362	100%	Sum				

Truck Data

Regional Statistical Areas

Truck Roadside S-way



PA_trk_r.asc

Z type	socio-econ	AT	Truck Ps		Truck As		
0	1	1	0.099000	0.099000	0.031000	0.124000	0.475000
0	1	2	0.099000	0.099000	0.031000	0.249000	0.475000
0	1	3	0.099000	0.099000	0.031000	0.362000	0.237000
0	1	4	0.230000	0.230000	0.054000	0.554000	0.237000
0	1	5	0.230000	0.230000	0.165000	0.441000	0.237000
1	1	1	0.099000	0.099000	0.031000	0.124000	0.475000
1	1	2	0.099000	0.099000	0.031000	0.249000	0.475000
1	1	3	0.099000	0.099000	0.031000	0.362000	0.237000
1	1	4	0.230000	0.230000	0.054000	0.554000	0.237000
1	1	5	0.230000	0.230000	0.165000	0.441000	0.237000
0	2	1	0.361000	0.361000	0.032000	0.034000	0.407000
0	2	2	0.361000	0.361000	0.061000	0.079000	0.407000
0	2	3	0.755000	0.755000	0.068000	0.215000	0.531000
0	2	4	1.017000	1.017000	0.113000	0.215000	0.599000
0	2	5	1.017000	1.017000	0.495000	1.074000	1.006000
1	2	1	0.361000	0.361000	0.032000	0.034000	0.407000
1	2	2	0.361000	0.361000	0.061000	0.079000	0.407000
1	2	3	0.755000	0.755000	0.068000	0.215000	0.531000
1	2	4	1.017000	1.017000	0.113000	0.215000	0.599000
1	2	5	1.017000	1.017000	0.495000	1.074000	1.006000
0	3	1	0.787000	0.787000	0.032000	3.051000	4.147000
0	3	2	0.787000	0.787000	0.061000	3.944000	4.147000
0	3	3	0.886000	0.886000	0.068000	6.712000	4.147000
0	3	4	0.886000	0.886000	0.113000	6.712000	4.147000
0	3	5	0.886000	0.886000	0.495000	7.989000	6.870000
1	3	1	0.787000	0.787000	0.032000	3.051000	4.147000
1	3	2	0.787000	0.787000	0.061000	3.944000	4.147000
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1	3	4	0.886000	0.886000	0.113000	6.712000	4.147000
1	3	5	0.886000	0.886000	0.495000	7.989000	6.870000
0	4	1	0.427000	0.427000	0.032000	0.780000	0.689000
0	4	2	0.427000	0.427000	0.061000	0.780000	0.904000
0	4	3	0.787000	1.180000	0.068000	3.277000	1.853000
0	4	4	0.787000	0.787000	0.113000	6.046000	2.430000
0	4	5	0.787000	0.787000	0.495000	6.870000	2.802000
1	4	1	0.427000	0.427000	0.032000	0.780000	0.689000
1	4	2	0.427000	0.427000	0.061000	0.780000	0.904000
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Carter:Burgess

For allocating truck trips to RSAs

PROJECT

CLIENT

SUBJECT Truck vs Com trip rate

JOB NO.		NO.
DESIGNED BY	DATE	
CHECKED BY	DATE	OF

	HH	Empl P	Empl R	Empl S	Empl Sum	HH/Emp Ratio
AT 1	.099	0.361	0.787	0.427	1.575	.06
AT 2	.099	.361	.787	.427		.06
AT 3	.099	.755	.886	.787	2.428	.04
AT 4	.23	1.017	.886	.787	2.69	.08
AT 5	.23	1.017	.886	.787		.08

Note $\frac{1}{14} \approx .07$

So ratio of HH to Total Empl for truck rates is 1 to 14

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