CHAPTER 3

TRAFFIC SURVEY AND ANALYSIS

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3.1 OBJECTIVES

Two different types of traffic surveys were carried out within the scope of the current study, namely traffic count survey and Willingness-to-Pay (WTP) survey. The main objectives of traffic count survey are to:

- Assist in the validation of CREATS transport demand model which will be used to test different scenarios of introducing toll expressway network along with different levels of toll values.
- Provide up-to-date information of year 2005 concerning traffic volumes, composition and characteristics.
- Estimate the traffic growth rate within the time span 2001 till 2005 by comparing the traffic volumes in 2005 versus previous relevant data set of CREATS Phase 1 in 2001.
- Provide input to a growing GIS database for Greater Cairo.

The WTP survey aims at:

- Simulating the road user opinion and potential to use the proposed urban expressway network of Greater Cairo.
- Identifying indicators on the attitude of road users' willingness to pay different levels of toll in accordance with higher level-of service expressed as different levels of travel time savings.

3.2 METHODOLOGY

Figure 3.2-1 illustrates the methodology applied to carry out the traffic surveys. The methodology comprises four consecutive tasks as follows:

- **Task 1: Preparatory works**, which include the following items:
  - Identification of the traffic survey locations including traffic count stations and candidate sites to carry out the willingness-to-pay survey.
  - Determination of the required manpower.
  - Preparation of the traffic survey program.
  - Mobilization and recruitment of surveyors and supervisor engineers.

- Proceeding in security and traffic administration permissions.
- Preparation of the traffic survey forms.
- Training of the surveyors and supervisor engineers.

- **Task 2: Field survey** was conducted after completion of all preparatory works in Task 1. This task consists of two major surveys; traffic count survey at 28 locations for 16 hours and willingness-to-pay survey for more than 2000 interviewees in addition to 7 passenger and freight companies.
- **Task 3: Data processing** started as soon as the field survey began. This task comprises data coding, data entry and quality checks (validation) to ensure a reasonable accuracy of the collected data.

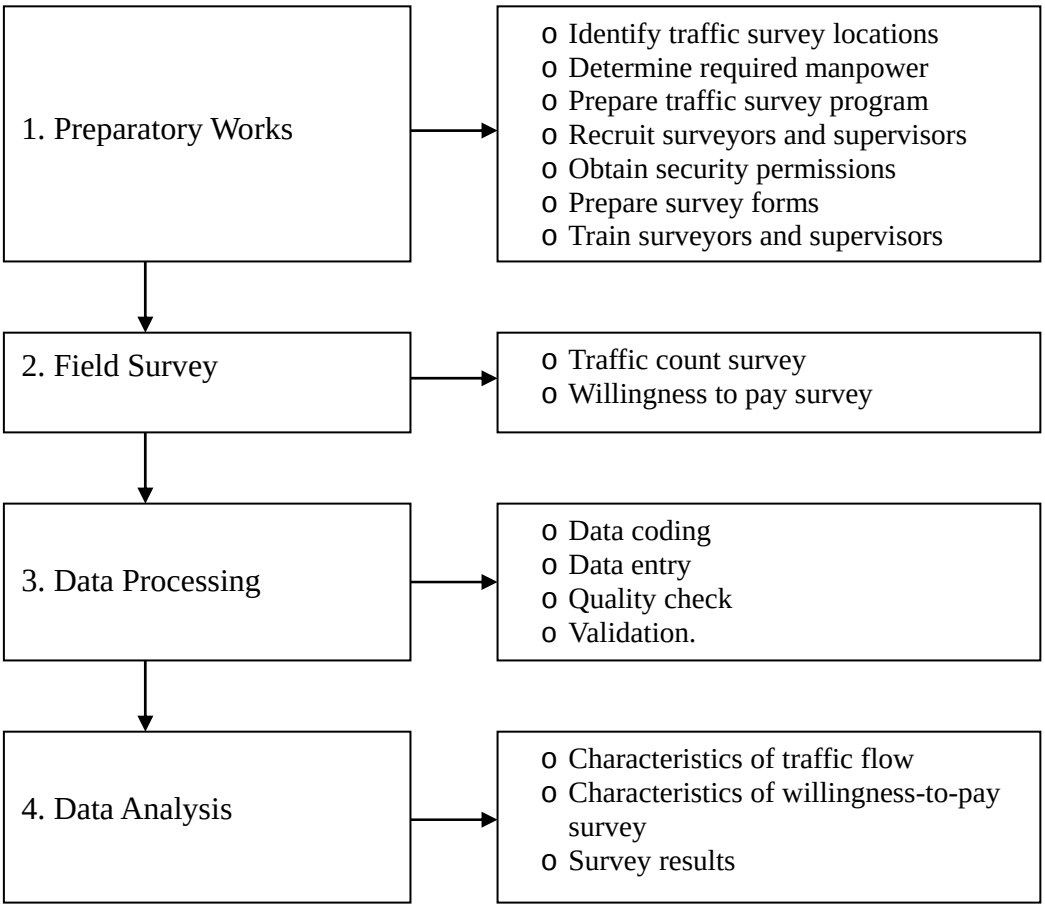


Figure 3.2-1 Methodology of Traffic Surveys

- **Task 4: Data analysis** included several mathematical and statistical analyses to identifying, describing and explaining the main characteristics and trends of the collected data. This analysis includes some traffic indicators such as rush hours, peak hour factor (PHF), peak hour volume (PHV), directional distribution (D), ratio of the peak hour traffic volume to the daily traffic volume (K),. The analysis of willingness-to-pay interview data includes a descriptive statistical presentation of

the sample distribution of different items such as personal information, trip characteristics and toll values at different levels of travel time reduction.

The site description of survey stations is included in Appendix 3.1, while the survey forms are presented in Appendix 3.2. Detailed descriptions of different tasks are included in Appendix 3.3.

3.3 RESULTS OF TRAFFIC COUNT SURVEY

It is normal to exert a great effort to collect manual classified traffic count data with a reasonable accuracy. The aforementioned methodology steps were specified and then followed to secure the targeted objective of obtaining a reliable data set, based on which many decisions might be built.

The following items are typically obtained and extracted from the traffic count data:

- Traffic volume fluctuation within the survey period (16 hours) for each count station per direction.
- Peak hour traffic volume for each site per direction.
- Time of the day, in which the traffic reach the peak(s).
- Estimated 24-hour traffic volume based on the counted data and gross-up factors obtained from historical data.
- Traffic composition or the percentage of each vehicle type within the traffic stream for each count station.
- Estimated traffic volume expressed in passenger car unit (PCU) based on the traffic composition and passenger car equivalents (PCE).
- Characteristics of traffic volume such as peak hour factor (PHF), distributional factor (D), percentage of peak hour volume to the daily traffic volume (K).

3.3.1 Traffic Fluctuation and Peak Hour Volume

Traffic count data was recorded based on 15-minute intervals, which were summed up to intervals of one hour. It should be noted that the arrangement of survey outcome for different sites and traffic directions is compatible with the same sequence given by Table 3.3-1. The bridges, arterials and new sites are coded as (B), (A) and (NW), respectively.

Appendix 3.4 presents the tabular format for the 28 count stations by direction including 10 Bridges, 7 Arterials and 11 New sites on the Expressway Corridors. On the other hand, Appendix 3.5 illustrates the hourly fluctuation of traffic volume for 16

hours starting at 6:00 A.M. till 10:00 P.M. For the sake of keeping the reader acquainted with data presentation, it might be helpful to extract some examples of these appendices. Therefore, an example of each site category (bridges, arterials and new sites) will be presented.

Table 3.3-1 and Figure 3.3-1 show the tabular and graphical formats of hourly traffic volume for 6th of October Bridge (B05) as an example for the category of Nile Bridges. Similarly, the tabular and graphical formats of traffic volume fluctuation on Cairo-Alex Agriculture Road (A35) are selected to represent a sample of Major Arterial Road as shown in Table 3.3-2 and Figure 3.3-2. Finally, the third category (New-Site) is represented by Salah Salem Road (NW09) as illustrated in Table 3.3-3 and Figure 3.3-3.

To identify some of the characteristics of traffic volume fluctuation within the study area, it might be appropriate to extract some information for different count stations as shown in Table 3.3-4, which indicates the peak hour traffic volume per site per direction along with its corresponding hour. The total number of occurrences for each peak period and some comments is outlined below:

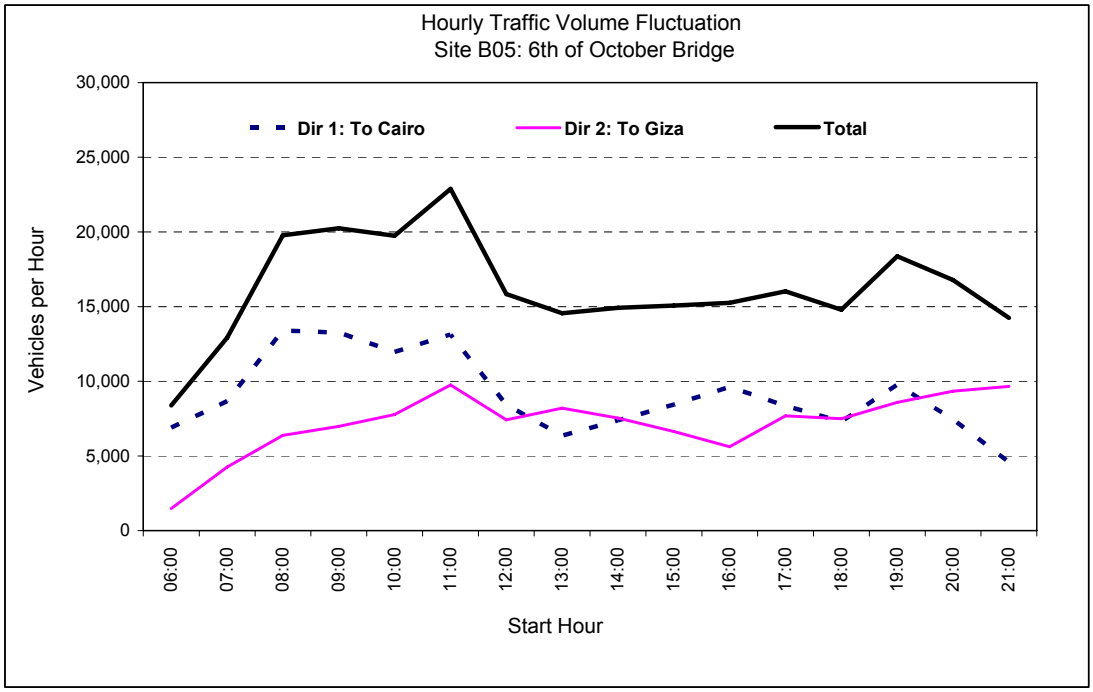
Peak	Period	Occurrence	Percent
Morning	07:00 - 09:00	16	29.1%
	10:00 - 12:00	12	21.8%
Afternoon	13:00 - 16:00	15	27.3%
	17:00 - 18:00	5	9.1%
Evening	20:00 - 21:00	7	12.7%
Total		55	100.0%

- It should be noted that the total number of directions for the 28 sites is 55 because NW05 site (Lotfy El-Sayed St.) is a one-way street. The morning peak (07:00 – 9:00) occurred in 29% of traffic count stations, followed by the afternoon peak (13:00 – 16:00), which accounts for 27%. Moreover, other peak periods exist during the day such as the evening peak (20:00 – 21:00).
- It is interesting to notice that even the period (10:00 – 12:00) was observed to has the peak traffic volume in some locations (e.g., 15th of May Bridge (6,862 veh/hr), Moneeb Bridge (4,516 veh/hr), 26th of July Corridor (3,176 veh/hr) and Lotfy El-Sayed St (4,078 veh/hr).
- As for the hourly traffic volume, 6th of October Bridge (B05) shows the highest value of 13,400 veh/hr at 8:00 A.M for the traffic traveling from Giza to Cairo. Nasr Road (AC20) occupies the second rank as it carries 8,050 veh/hr at 8:00.

Table 3.3-1 Traffic Count Data for Nile Bridges (6th of October Bridge)

Site : 6th of October Bridge											Code: B05		
Dir 1: Cairo											Date: 23/5/2005		
Start Hour	Number of Vehicles												Total
			Bus				Truck						
	Car	Taxi	Shared Taxi	Mini	Public	Private	Pickup	2-Axle	3-Axle	> 3 Axle	Motorcycle	Other	
06:00	5,243	897	235	49	100	124	167	30	0	7	31	12	6,895
07:00	6,623	843	402	72	88	342	141	50	2	1	97	9	8,670
08:00	10,401	1,578	282	65	86	398	277	113	0	0	179	21	13,400
09:00	9,770	2,024	277	56	154	292	354	123	1	0	199	14	13,264
10:00	8,303	1,881	295	34	220	299	381	236	1	0	280	29	11,959
11:00	9,253	1,766	94	55	203	441	590	323	2	0	372	32	13,131
12:00	5,201	1,449	31	54	179	396	495	326	0	0	267	23	8,421
13:00	2,312	1,866	89	46	145	417	698	376	0	0	375	29	6,353
14:00	4,596	2,024	113	0	51	69	396	23	6	12	77	10	7,377
15:00	6,536	1,290	113	0	45	103	262	25	0	0	56	8	8,438
16:00	7,614	1,420	153	2	55	61	239	29	0	0	43	2	9,618
17:00	6,393	1,376	131	2	69	78	225	23	0	0	46	1	8,344
18:00	5,458	1,247	222	0	55	64	210	17	0	0	27	2	7,302
19:00	7,328	1,505	274	0	77	115	293	47	0	0	124	18	9,781
20:00	5,532	1,190	189	18	76	69	236	15	0	0	110	11	7,446
21:00	3,663	645	35	1	27	42	120	9	0	0	34	11	4,587
Total	**104,226**	**23,001**	**2,935**	**454**	**1,630**	**3,310**	**5,084**	**1,765**	**12**	**20**	**2,317**	**232**	**144,986**
%	**71.9**	**15.9**	**2.0**	**0.3**	**1.1**	**2.3**	**3.5**	**1.2**	**0.0**	**0.0**	**1.6**	**0.2**	**100**

Site : 6th of October Bridge											Code: B05		
Dir 2: Giza											Date: 23/5/2005		
Start Hour	Number of Vehicles												Total
			Bus				Truck						
	Car	Taxi	Shared Taxi	Mini	Public	Private	Pickup	2-Axle	3-Axle	> 3 Axle	Motorcycle	Other	
06:00	549	274	304	2	68	268	13	3	0	0	0	7	1,488
07:00	2,525	618	606	2	87	288	51	15	0	0	27	32	4,251
08:00	2,812	1,876	1,163	1	88	181	66	20	0	0	104	60	6,371
09:00	4,001	1,638	857	0	73	101	116	25	0	0	144	25	6,980
10:00	4,833	1,569	735	1	84	68	235	58	1	0	197	0	7,781
11:00	7,594	954	476	0	82	52	241	72	0	0	276	0	9,747
12:00	4,725	1,131	674	5	89	99	326	74	0	0	297	0	7,420
13:00	6,009	817	516	3	82	144	247	90	3	1	283	1	8,196
14:00	5,618	892	319	71	75	68	467	7	1	6	24	1	7,549
15:00	4,492	1,062	284	149	75	108	446	2	2	6	12	0	6,638
16:00	3,755	1,049	272	89	38	52	241	1	4	4	117	3	5,625
17:00	4,915	1,800	381	96	78	32	292	9	2	0	82	1	7,688
18:00	4,438	2,046	380	87	71	18	296	8	1	5	135	3	7,488
19:00	5,804	1,677	434	78	53	11	303	24	1	2	200	3	8,590
20:00	5,969	2,251	544	47	63	8	282	27	0	0	147	1	9,339
21:00	6,472	2,149	496	61	49	18	254	29	0	0	131	2	9,661
Total	**74,511**	**21,803**	**8,441**	**692**	**1,155**	**1,516**	**3,876**	**464**	**15**	**24**	**2,176**	**139**	**114,812**
%	**64.9**	**19.0**	**7.4**	**0.6**	**1.0**	**1.3**	**3.4**	**0.4**	**0.0**	**0.0**	**1.9**	**0.1**	**100**



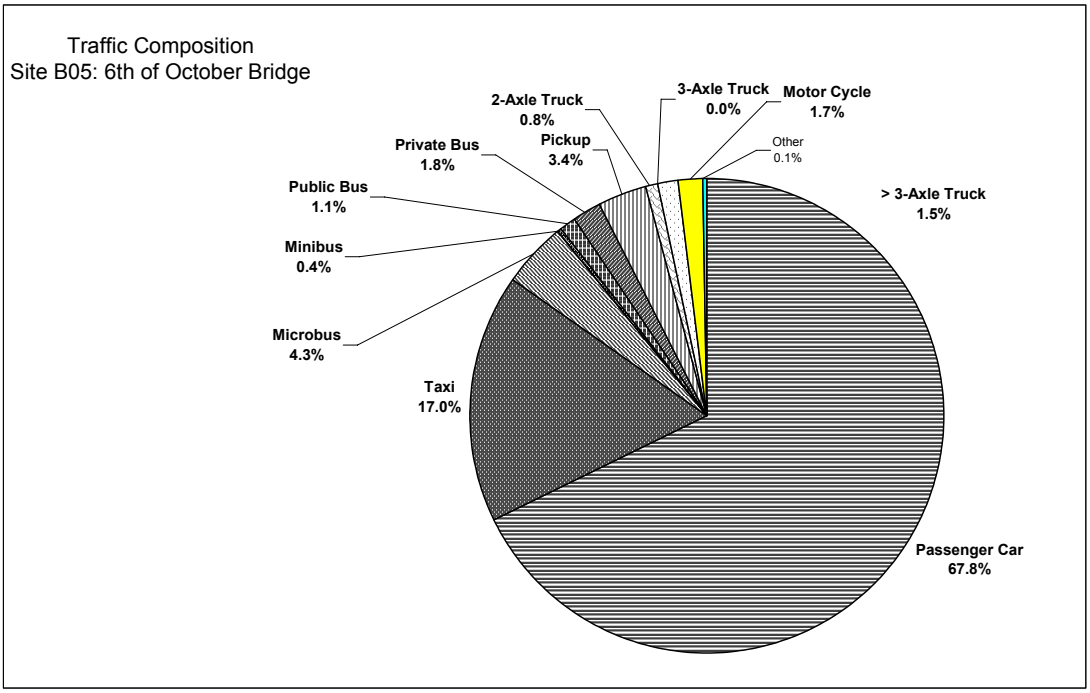
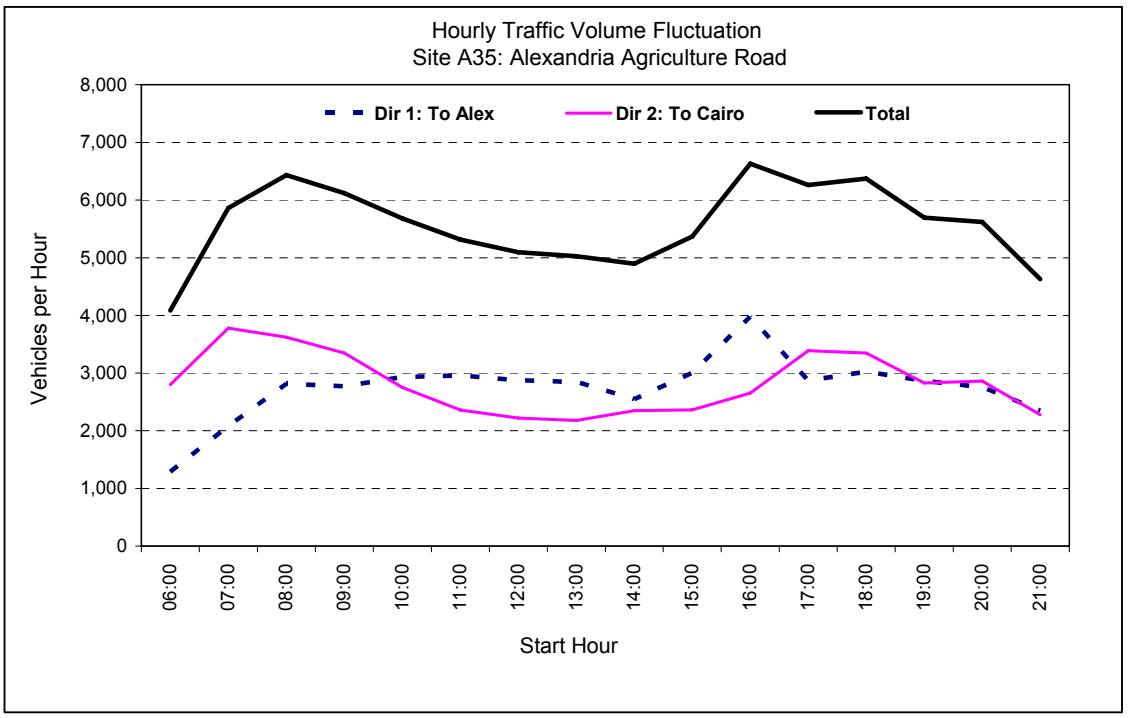


Figure 3.3-1 Fluctuation and Composition of Traffic Volume for Nile Bridges (6^{th} of October Bridge)

Table 3.3-2 Traffic Count Data for Major Arterials (Alex. Agriculture Road)

Site : Alex. Agriculture Road									Code: A35				
Dir 1: Alexandria									Date: 24/5/2005				
Start Hour	Number of Vehicles												Total
			Bus				Truck						
	Car	Taxi	Shared Taxi	Mini	Public	Private	Pickup	2-Axle	3-Axle	> 3 Axle	Motorcycle	Other	
06:00	189	48	342	20	27	68	196	241	6	141	9	0	1,287
07:00	506	30	706	106	30	66	246	263	5	103	18	0	2,079
08:00	966	30	920	156	45	26	290	237	6	97	36	2	2,811
09:00	1,101	42	728	152	56	18	301	260	2	98	14	2	2,774
10:00	1,117	50	724	150	52	16	364	373	2	66	19	0	2,933
11:00	965	76	691	145	47	13	403	499	5	89	23	1	2,957
12:00	920	85	761	122	63	16	377	427	2	87	16	0	2,876
13:00	966	80	710	126	61	33	371	390	6	83	16	3	2,845
14:00	683	60	732	104	43	22	368	421	6	80	26	3	2,548
15:00	571	61	906	165	110	68	481	504	7	101	31	1	3,006
16:00	913	72	998	161	139	155	869	344	130	125	49	20	3,975
17:00	789	95	807	153	97	76	348	131	66	246	32	33	2,873
18:00	738	171	807	88	75	79	535	209	142	171	8	2	3,025
19:00	587	200	803	102	75	78	432	382	37	141	24	4	2,865
20:00	519	161	769	128	79	38	444	379	44	169	17	10	2,757
21:00	550	96	600	122	48	52	328	158	117	246	12	19	2,348
Total	**12,080**	**1,357**	**12,004**	**2,000**	**1,047**	**824**	**6,353**	**5,218**	**583**	**2,043**	**350**	**100**	**43,959**
%	**27.5**	**3.1**	**27.3**	**4.5**	**2.4**	**1.9**	**14.5**	**11.9**	**1.3**	**4.6**	**0.8**	**0.2**	**100**

Site : Alex. Agriculture Road									Code: A35				
Dir 2: Cairo									Date: 24/5/2005				
Start Hour	Number of Vehicles												Total
			Bus				Truck						
	Car	Taxi	Shared Taxi	Mini	Public	Private	Pickup	2-Axle	3-Axle	> 3 Axle	Motorcycle	Other	
06:00	266	48	918	0	18	737	213	306	87	167	38	0	2,798
07:00	687	92	1,268	0	36	842	246	328	76	124	80	1	3,780
08:00	953	144	1,076	1	71	197	479	354	108	138	95	5	3,621
09:00	992	71	977	0	70	129	558	288	101	101	58	1	3,346
10:00	923	69	742	2	52	91	435	296	7	83	32	17	2,749
11:00	708	56	669	0	61	82	366	254	15	116	21	9	2,357
12:00	682	70	537	0	61	98	369	245	6	121	31	0	2,220
13:00	775	75	512	2	42	141	321	207	7	71	26	1	2,180
14:00	933	96	381	0	34	131	405	167	74	78	26	22	2,347
15:00	601	49	575	1	64	181	444	179	114	124	20	10	2,362
16:00	599	26	565	0	56	144	617	297	160	182	7	2	2,655
17:00	1,144	183	568	0	51	146	673	336	124	147	15	2	3,389
18:00	892	145	738	1	84	288	541	471	31	152	1	2	3,346
19:00	956	105	621	0	40	168	371	464	3	99	1	2	2,830
20:00	1,210	187	531	0	64	159	290	332	3	74	10	1	2,861
21:00	656	87	586	9	67	147	306	342	6	48	24	2	2,280
Total	**12,977**	**1,503**	**11,264**	**16**	**871**	**3,681**	**6,634**	**4,866**	**922**	**1,825**	**485**	**77**	**45,121**
%	**28.8**	**3.3**	**25.0**	**0.0**	**1.9**	**8.2**	**14.7**	**10.8**	**2.0**	**4.0**	**1.1**	**0.2**	**100**



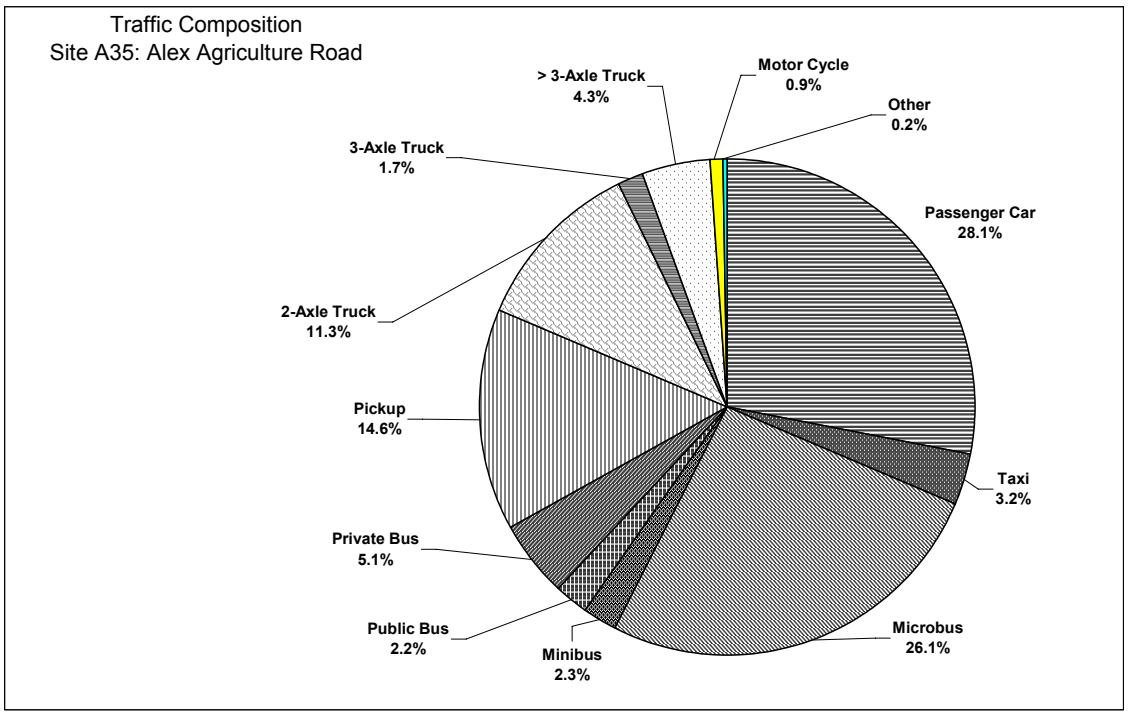
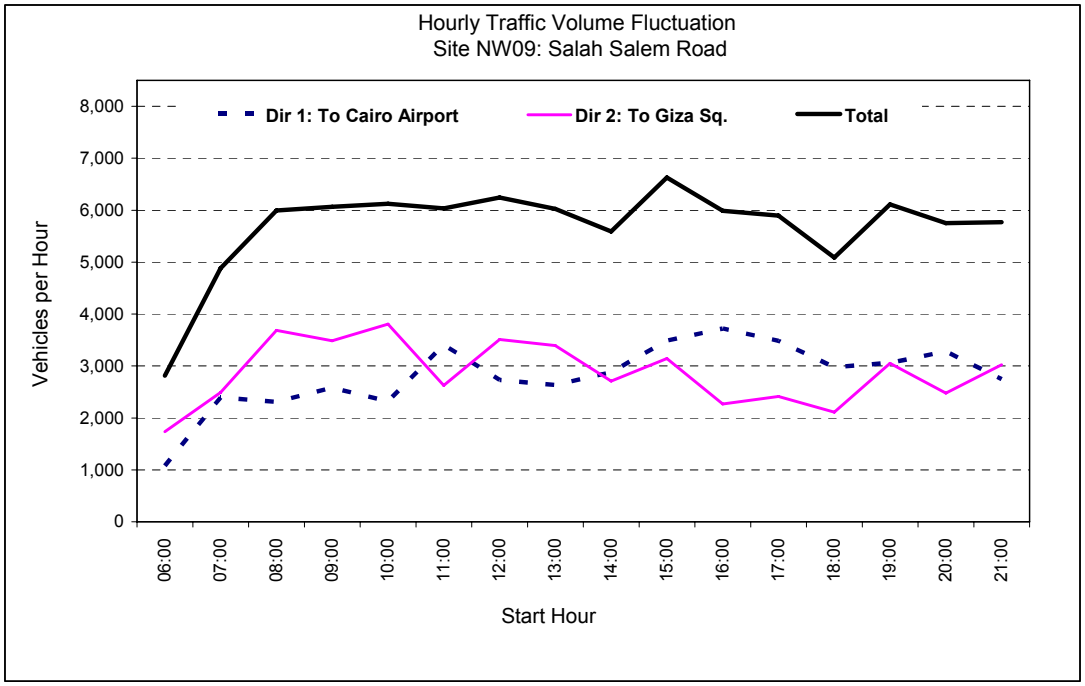


Figure 3.3-2 Fluctuation and Composition of Traffic Volume for Major Arterials (Alex. Agriculture Road)

Table 3.3-3 Traffic Count Data for New Sites on Expressway Corridors (Salah Salem Road)

Site : Salah Salem Road									Code: NW09				
Dir 1: Cairo Airport									Date: 24/5/2005				
Start Hour	Number of Vehicles												Total
			Bus				Truck						
	Car	Taxi	Shared Taxi	Mini	Public	Private	Pickup	2-Axle	3-Axle	> 3 Axle	Motorcycle	Other	
06:00	353	179	278	12	57	66	85	9	0	0	15	23	1,077
07:00	1,020	352	586	6	116	83	147	7	5	0	61	8	2,391
08:00	1,080	349	527	10	60	55	144	43	4	3	19	15	2,309
09:00	1,159	269	643	7	48	10	278	113	5	0	37	9	2,578
10:00	1,123	278	352	19	57	18	254	99	1	2	97	17	2,317
11:00	1,345	924	417	5	52	13	392	118	3	3	121	16	3,409
12:00	1,323	567	353	8	46	18	286	24	2	2	88	15	2,732
13:00	1,173	292	589	15	126	30	328	13	4	1	41	19	2,631
14:00	1,420	577	291	11	43	70	282	94	0	0	0	91	2,879
15:00	1,640	815	327	13	20	123	383	84	0	0	76	6	3,487
16:00	1,985	587	412	20	51	121	340	114	3	0	72	14	3,719
17:00	1,600	635	405	8	35	127	399	191	0	0	79	4	3,483
18:00	1,351	628	385	7	31	61	347	70	2	0	90	4	2,976
19:00	1,585	455	382	2	30	47	336	139	3	1	79	2	3,061
20:00	1,705	680	360	0	27	37	322	61	1	0	81	3	3,277
21:00	1,375	630	326	0	27	44	235	37	1	0	68	3	2,746
Total	**21,237**	**8,217**	**6,633**	**143**	**826**	**923**	**4,558**	**1,216**	**34**	**12**	**1,024**	**249**	**45,072**
%	**47.1**	**18.2**	**14.7**	**0.3**	**1.8**	**2.0**	**10.1**	**2.7**	**0.1**	**0.0**	**2.3**	**0.6**	**100**

Site : Salah Salem Road									Code: NW09				
Dir 2: Giza Sq.									Date: 24/5/2005				
Start Hour	Number of Vehicles												Total
			Bus				Truck						
	Car	Taxi	Shared Taxi	Mini	Public	Private	Pickup	2-Axle	3-Axle	> 3 Axle	Motorcycle	Other	
06:00	1,031	147	250	9	63	88	80	53	4	0	2	8	1,735
07:00	1,126	323	461	3	133	221	138	80	1	1	2	1	2,490
08:00	2,145	481	582	1	82	102	201	74	7	1	10	0	3,686
09:00	1,666	499	787	1	93	48	238	83	7	3	59	3	3,487
10:00	2,200	468	629	4	78	35	250	54	8	6	67	5	3,804
11:00	1,171	653	298	11	40	33	276	91	0	2	45	6	2,626
12:00	2,000	845	284	7	38	23	220	51	0	1	33	8	3,510
13:00	2,055	716	244	8	73	27	193	39	0	3	30	6	3,394
14:00	1,110	890	277	12	67	41	225	53	1	2	30	4	2,712
15:00	1,569	872	257	33	39	63	170	63	0	2	27	46	3,141
16:00	1,203	254	309	35	53	51	297	10	4	6	34	12	2,268
17:00	1,232	323	375	14	31	49	250	56	0	0	64	20	2,414
18:00	977	316	367	12	41	29	212	92	0	0	53	12	2,111
19:00	1,450	716	368	16	41	36	271	88	0	0	60	5	3,051
20:00	1,279	568	242	11	39	14	236	27	2	4	43	10	2,475
21:00	1,376	418	571	11	55	21	386	107	3	1	68	6	3,023
Total	**23,590**	**8,489**	**6,301**	**188**	**966**	**881**	**3,643**	**1,021**	**37**	**32**	**627**	**152**	**45,927**
%	**51.4**	**18.5**	**13.7**	**0.4**	**2.1**	**1.9**	**7.9**	**2.2**	**0.1**	**0.1**	**1.4**	**0.3**	**100**



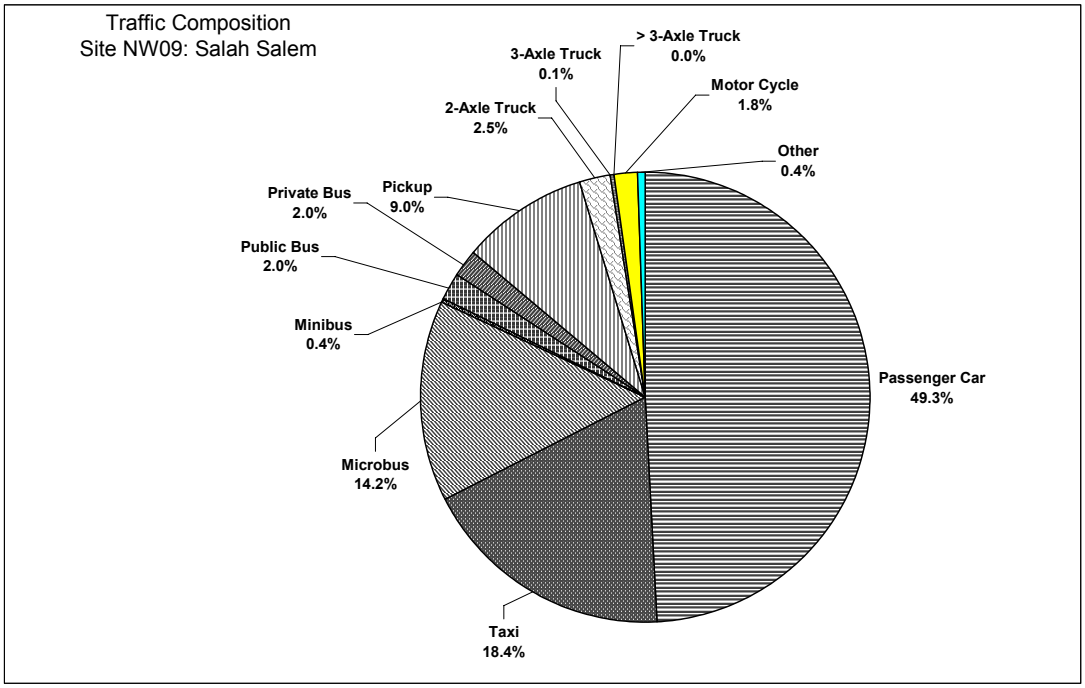


Figure 3.3-3 Fluctuation and Composition of Traffic Volume for New Sites on Expressway Corridors (Salah Salem Road)

Table 3.3-4 Peak Hour Traffic Volume and Time of Peak Hour for Different Count Stations

Site	No.	Code	Site Name	Direction of Traffic Flow		Peak Hour Traffic Volume		Peak Hour	
				Dir 1: To	Dir 2: To	Dir 1	Dir 2	Dir 1	Dir 2
BRIDGES	1	B01	Warraq Bridge	Qalyobeya	Giza	2,192	2,125	18:00	08:00
	2	B02	Rodh El-Farag Bridge	Cairo	Giza	3,604	4,572	08:00	20:00
	3	B03	Imbaba Bridge	Cairo	Giza	817	1,420	08:00	20:00
	4	B04	15th of May Bridge	Cairo	Giza	4,300	6,862	12:00	12:00
	5	B05	6th of October Bridge	Cairo	Giza	13,400	9,747	08:00	11:00
	6	B06	Galaa Bridge	Cairo	Giza	2,962	2,803	09:00	13:00
	7	B07	Gamah Bridge	Cairo	Giza	3,357	3,800	08:00	09:00
	8	B08	Giza Bridge	Cairo	Giza	3,259	3,433	15:00	17:00
	9	B09	Moneeb Bridge	Cairo	Giza	4,516	6,222	12:00	09:00
	10	B10	Marazeeq Bridge	Cairo	Giza	704	502	07:00	16:00
ARTERIALS	11	A18	26th of July Corridor	Lebanon Sq.	6th of Oct. City	3,176	4,204	10:00	16:00
	12	A21	Suez Desert Road	Suez	Cairo	1,692	1,851	08:00	15:00
	13	A35	Alex. Agriculture Road	Alexadria	Cairo	3,975	3,780	16:00	07:00
	14	A36	Ismailia Agriculture Road	Ismailia	Cairo	1,237	1,255	16:00	20:00
	15	A39	Ismailia Desert Road	Ismailia	Cairo	3,832	3,328	09:00	13:00
	16	A42	Autostrade	Cairo Airport	Helwan	1,443	2,018	08:00	18:00
	17	AC20	Nasr Road	Cairo Airport	Helwan	8,050	6,529	08:00	12:00
EXPRESSWAY ROUTES	18	NW01	Gesr El-Suez St.	Ismailia	CBD	2,619	3,346	15:00	15:00
	19	NW02	Suez Desert Road	Suez	Cairo	2,258	2,151	20:00	21:00
	20	NW03	Abo Bakr El-Sedeeq St.	Orooba St.	Tagneed Sq.	2,753	2,458	12:00	18:00
	21	NW04	Kablat St.	Mataria Sq.	Ismailia Canal	980	828	11:00	17:00
	22	NW05	Lotfy El-Sayed St.**	Ramsis Sq.	**	4,078	**	10:00	**
	23	NW06	Autostrade	Cairo Airport	Helwan	5,011	3,122	11:00	15:00
	24	NW07	Ahmed Helmy St.	Qalyob	CBD	1,624	2,223	13:00	08:00
	25	NW08	Ramsis St.	Abbassia Sq.	Ramsis Sq.	3,067	5,103	12:00	13:00
	26	NW09	Salah Salem Road	Cairo Airport	Giza Sq.	3,719	3,804	16:00	10:00
	27	NW10	Tereat El-Zomor Road	Haram St.	Ring Road	2,298	1,701	20:00	21:00
	28	NW11	Sudan St.	Imbaba	Haram St.	1,281	1,514	16:00	09:00

** Note: One-way Street

- On the other hand, the lowest hourly traffic volume was recorded at Marazeeq Bridge (B10) in the afternoon (16:00), which is expected due to its limited capacity. Similarly, the peak hour traffic volume at Imbaba Bridge (B03) was rather low (817 veh/hr).
- The distribution of hourly traffic volume shows that some sites have obvious peak periods such as B01, B02, A18, A21 and A42, NW02 and NW08, while other sites do not have clear peak hours. This implies that traffic volume is almost distributed all over the working hours.

This sub-section is ended by a schematic map of the study area illustrating the peak hour traffic volumes expressed in PCU for different count stations as shown in Figure 3.3-4.

3.3.2 Daily Traffic Volume

It was mentioned earlier that the results of traffic count survey was obtained for a period of 16 hours, which need to be grossed up to reflect the traffic volume on a daily basis. This will facilitate the comparison with the counts of CREATS Phase 1, in which screen line locations (bridges) were counted for 24 hours. The screen-line traffic counts for 24 hours are totalled for each vehicle type and then divided by the total number of traffic counts for 16 hours for the same vehicle type to estimate the gross-up factor as shown in Table 3.3.5. These gross-up factors are applied to the counted vehicles by type and summed up to yield the total daily traffic at each location. For the sake of comparison among different traffic volumes with different traffic compositions, it is preferable to convert the unit of traffic volume from vehicle to passenger car unit (PCU) by applying passenger car equivalencies. The gross-up factors of expanding the traffic volume from 16-hour count into 24-hour volume and passenger car equivalencies (PCE) are given in Table 3.3-5. These factors were applied to the total observed traffic counts in 2005 to estimate the traffic volume expressed in PCU per day.

Table 3.3-5 PCU and Gross-up Factors by Vehicle Time

Vehicle Type	PCU Equivalencies	Gross-up Factors
Car	1.0	1.20
Taxi	1.0	1.23
Shared Taxi	1.5	1.19
Mini	2.0	1.11
Public	2.5	1.13
Private	2.0	1.08
Pickup	1.0	1.17
2-Axle	2.0	1.25
3-Axle	2.5	1.34
> 3 Axle	3.0	1.49
Motorcycle	0.3	1.18
Other	1.0	1.15

Source: CREATS Phase 1

In Appendix 3.6, the Sections 3.6-1 through 3.6-3 present the summary of observed (16-hour) and estimated daily traffic volumes (vehicles) in 2005 for bridges, major arterials and new sites, respectively. The same information was presented for PCU volumes by the Sections 3.6-4 through 3.6-6, respectively.

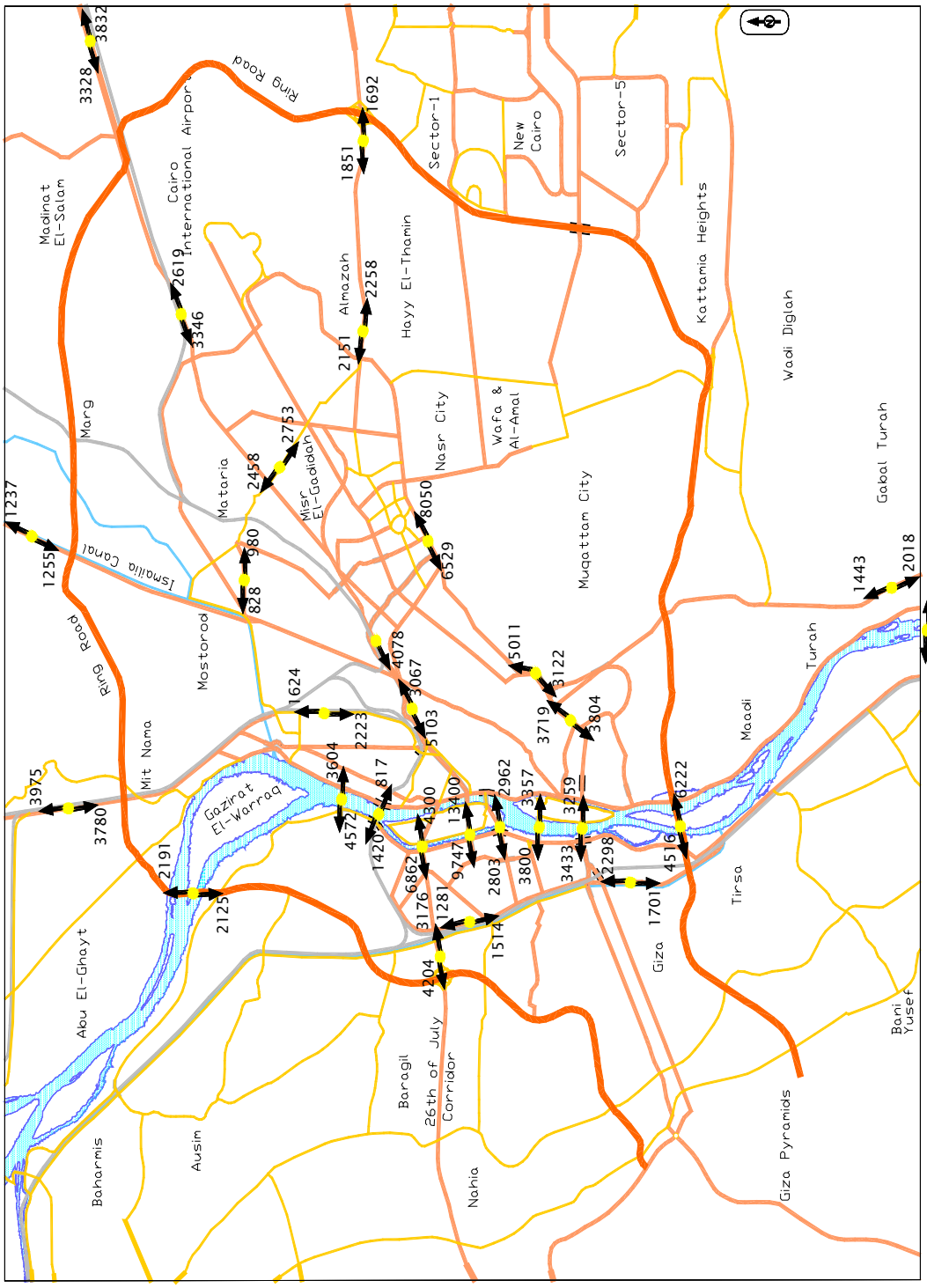


Figure 3.3-4 Traffic Volume during Peak Hour for Different Count Stations per Direction

As for the traffic count data in 2001, Appendix 3.6-7 through Appendix 3.6-10 shows the summary of this data expressed in vehicles and PCU's for bridges and major arterials, respectively. The data of 2001 is used for comparison with the collected data in 2005 to estimate the growth of traffic volumes within the last four years as presented later in this chapter.

Some relevant information is extracted from Appendix 3.6 to summarize the traffic counts for 16 hours and the estimated daily traffic volume expressed in vehicles and PCU per day for each count station as presented in Table 3.3-6. The daily traffic volumes expressed in PCU and vehicles per day are depicted for different count stations in Figures 3.3-5 and 3.3-6, respectively. Around 1.96 million vehicles were counted in 28 locations for 16 hours, which are expanded to 2.35 million vehicles per day. The total daily traffic volume crossing the selected Nile bridges represents 44% of total daily traffic volume of all sites compared with 26% and 30% for selected arterials and new sites, respectively.

Figure 3.3-6 illustrates that 6th of October Bridge exhibits the highest daily traffic volume among the 28 count stations accounting for 30% of total number of vehicles crossing the Nile River and 13% of total counted traffic volume of all sites. Similarly, the daily traffic volume on Nasr Road (Autostrade), represents 30% of total number of vehicles on the selected major arterials and 8% of total counted traffic volume of all sites.

It should be noted that the average traffic volume of new sites, which are located on the proposed expressway network is around 64,000 veh/day (75,000 PCU/day). Salah Salem Road carries 15% (109,000 veh/day or 124,000 PCU/day) of total traffic volumes of the new sites.

3.3.3 Traffic Composition

Traffic composition is one of the essential characteristics of traffic flow, especially when the need arises to convert the traffic flow from vehicles into passenger car unit (PCU). Fortunately, the manual classified count (MCC) procedure, which was followed in this study, provides the opportunity to identify the share of each vehicle type within the traffic flow per site per direction per hour. Table 3.3-7 summarizes the daily classified traffic volumes for each count station, while Table 3.3-8 presents the traffic composition for different sites. Figure 3.3-7 illustrates the traffic compositions for three site categories (Nile Bridges, Major Arterials and New Sites along the Expressway Corridors) in addition to the average traffic composition of all count stations in the study area. The following can be inferred from these figures:

Table 3.3-6 Summary of Traffic Volumes for 16-Hour Counts and Expanded 24-Hour Estimates in Vehicles and PCU

Site	No.	Code	16-Hour Count			24-Hour Vehicles	24-Hour PCU
			Dir 1	Dir 2	Total		
BRIDGES	1	B01	24,820	21,172	45,992	56,161	83,198
	2	B02	44,113	39,553	83,666	100,379	119,716
	3	B03	8,500	13,074	21,574	25,898	28,619
	4	B04	47,456	71,092	118,548	141,847	159,359
	5	B05	144,986	114,812	259,798	311,933	329,331
	6	B06	29,069	26,833	55,902	67,118	74,528
	7	B07	32,807	38,184	70,991	85,284	93,595
	8	B08	39,209	43,216	82,425	98,967	110,297
	9	B09	43,707	60,359	104,066	125,381	145,532
	10	B10	6,288	6,206	12,494	14,989	21,591
	Sub-Total		**420,955**	**434,501**	**855,456**	**1,027,957**	**1,165,766**
ARTERIALS	11	A18	43,096	35,343	78,439	93,843	103,891
	12	A21	17,085	18,781	35,866	42,861	48,411
	13	A35	43,959	45,121	89,080	107,287	157,960
	14	A36	13,623	13,546	27,169	32,662	45,657
	15	A39	38,960	40,574	79,534	95,907	130,693
	16	A42	14,445	18,134	32,579	39,984	58,716
	17	AC20	92,674	77,040	169,714	202,874	241,226
	Sub-Total		**263,842**	**248,539**	**512,381**	**615,417**	**786,554**
EXPRESSWAY ROUTES	18	NW01	33,557	33,897	67,454	80,741	97,693
	19	NW02	27,525	24,347	51,872	62,032	71,264
	20	NW03	24,545	24,919	49,464	59,382	64,624
	21	NW04	12,214	10,351	22,565	26,991	31,791
	22	NW05	51,533	**	51,533	61,437	71,725
	23	NW06	30,225	33,560	63,785	76,486	86,196
	24	NW07	15,700	19,680	35,380	42,328	50,717
	25	NW08	35,661	42,877	78,538	93,653	114,283
	26	NW09	45,072	45,927	90,999	109,037	123,850
	27	NW10	24,820	18,173	42,993	51,556	58,325
	28	NW11	15,962	19,480	35,442	42,151	50,721
	Sub-Total		**316,814**	**273,211**	**590,025**	**705,795**	**821,191**
TOTAL			**1,001,611**	**956,251**	**1,957,862**	**2,349,169**	**2,773,511**

** Note: One-way Street

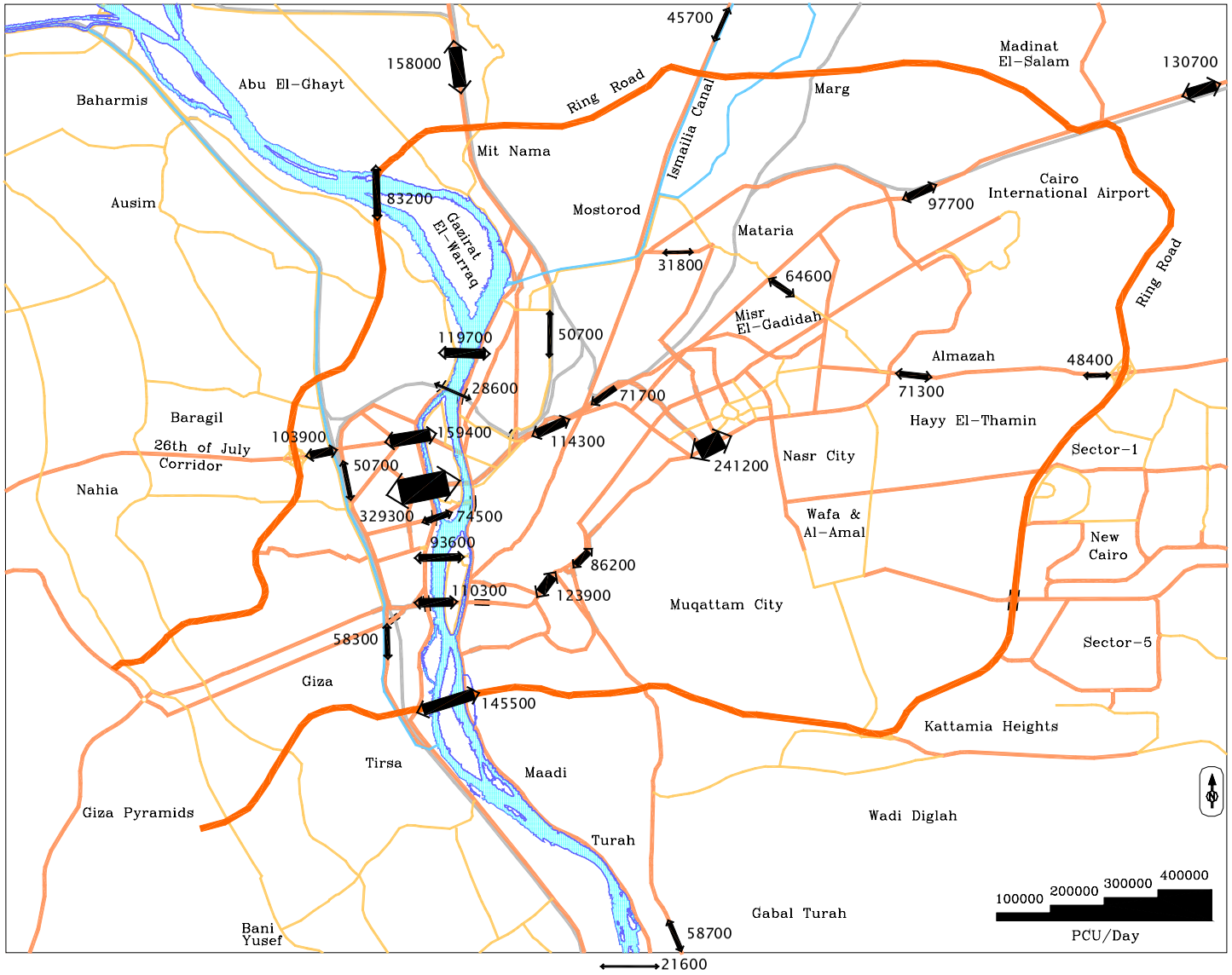
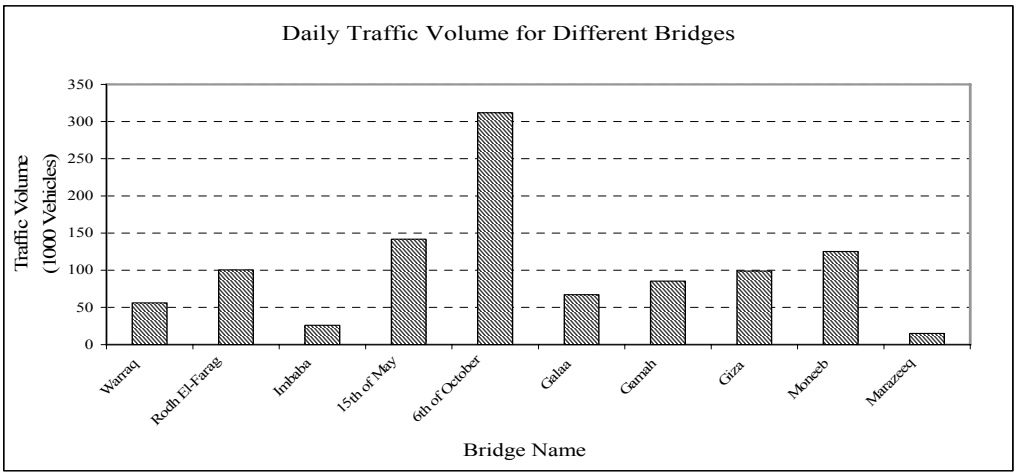
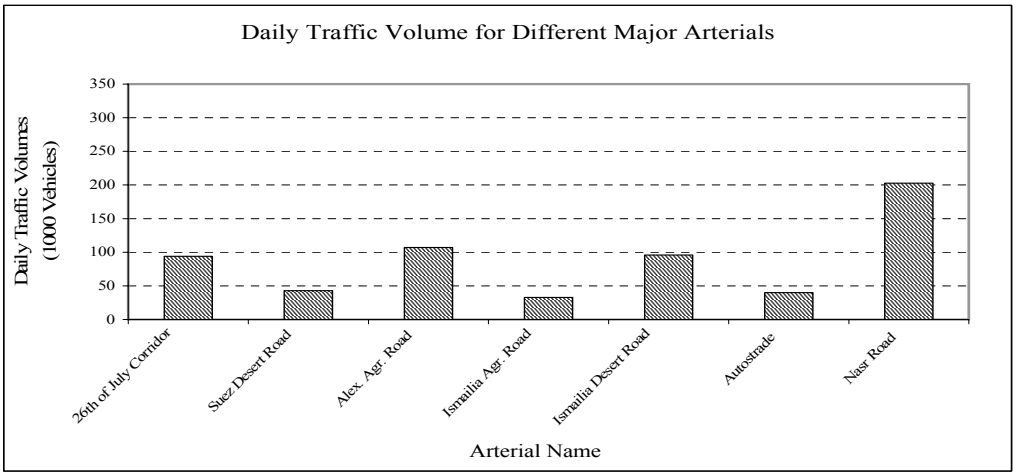


Figure 3.3-5 Daily Traffic Volume for Different Count Stations in 2005 (PCU)





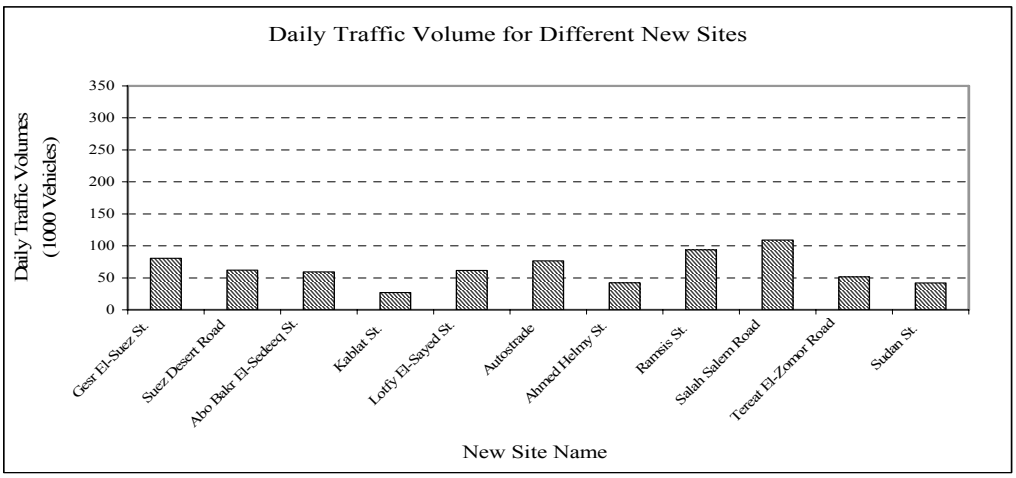


Figure 3.3-6 Daily Traffic Volume for Bridges, Arterials and New Sites in 2005 (Unit:1000 vehicles/day)

- Passenger cars account for 51%, 48% and 45% for Nile bridges, arterials and new sites, respectively, which is not far from the overall average of 48.5% for all count stations. Consequently, it can be concluded that passenger cars can be considered as the major vehicle type in the traffic flow in the study area.
- Taxi accounts for 22%, 10% and 21% for Nile bridges, arterials and new sites, respectively, with an overall average of 18.4% for all count stations.
- Despite shared taxi carries a considerable number of passengers, its share varied from 9% on Nile bridges to 14% on major arterials with an average of 11.8% for all count stations. This indicates the intensive existence of this mode in the traffic flow and the high frequency of this service to accommodate its observed transport demand.
- As for buses, they represent around 6% of the traffic flow compared with 7.6% for light trucks (pickup) and 5.4% for trucks.

Table 3.3-8 can be referred to if a detailed traffic composition for a specific count station is needed.

3.3.4 Peak Hour Factor, Directional Factor and K-Factor

Based on the aforementioned survey summaries, different factors describing the characteristics of traffic flow could be estimated. These factors include Peak Hour Factor (PHF), Directional factor (D) and percentage of peak hour volume as related to the daily traffic volume as shown in Table 3.3-9.

The peak hour factor (PHF) varies from 0.72 to 0.93 with an average of 0.84 for the Nile bridges compared with 0.81, 0.97 and 0.87 for major arterials, respectively. As for the new sites on the expressway corridors, PHF varies from 0.82 to 0.95 with 0.88 as an average. This implies that in some locations, the variation of traffic volumes within the peak hour can not be neglected. If the whole set of the count stations is considered, PHF reaches 0.86 as overall average within the study area.

The average value of distributional factor (D) accounts form 0.65, 0.62 and 0.67 for bridges, arterials and new sites, respectively with an overall average of 0.65. This indicates the traffic volume is not evenly balanced between the two directions of travel.

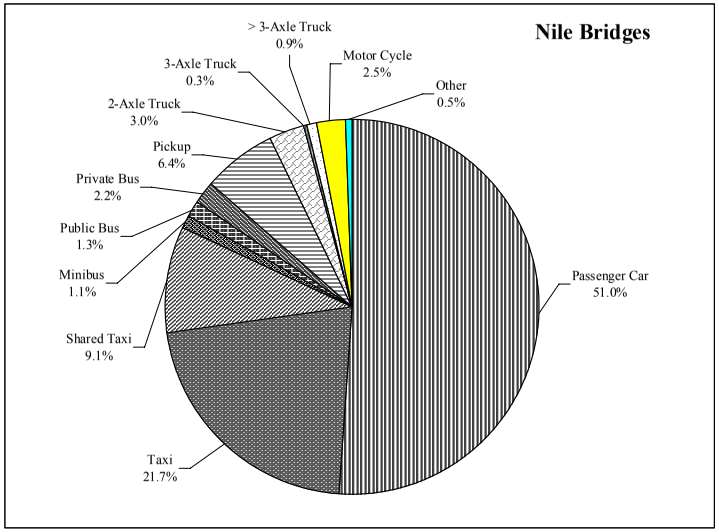
Similarly, the value of design traffic volume divided by daily traffic volume (K) is estimated. It can be observed that K-factor, which is estimated by dividing the peak hour volume by the observed/estimated daily traffic for each count station, varies from 6.1% to 10.3% with an average of 8.4% for Nile bridges compared with 6.6%, 8.4% and 7.8% for major arterials, respectively. As for the count stations located on the expressway corridors (new sites), the K-factor ranges from 6% to 12% with 8% as an average. A value of 8.1% for K-factor can be considered as an overall average for the study area.

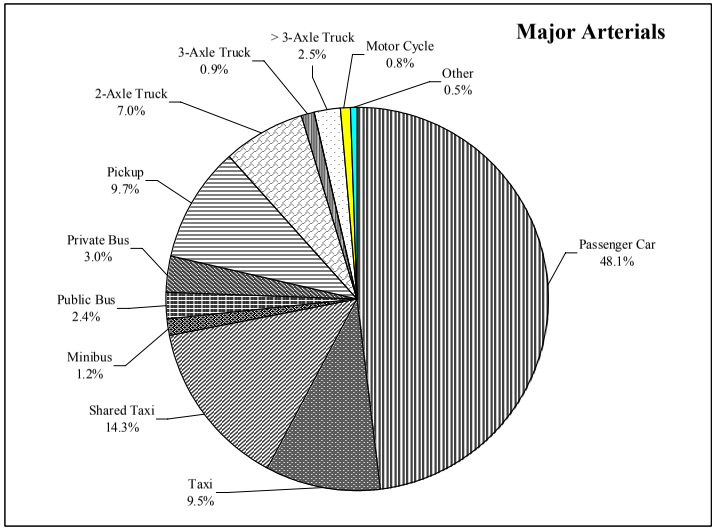
Table 3.3-7 Summary of Traffic Count Data for Different Count Stations in 2005 (veh/day)

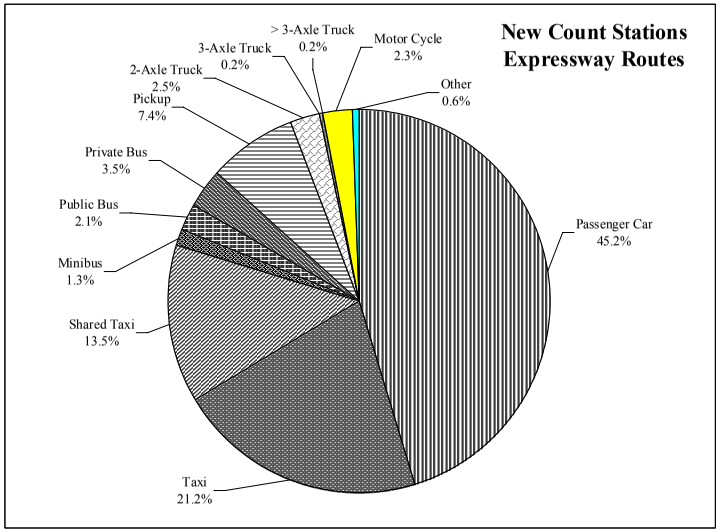
Site Code	Number of Vehicles												Total
			Bus				Truck						
	Car	Taxi	Shared Taxi	Mini	Public	Private	Pickup	2-Axle	3-Axle	>3 Axle	Motorcycle	Other	
B01	15,899	2,317	7,792	98	113	1,464	11,629	10,282	496	5,343	451	278	56,161
B02	28,892	27,286	18,660	633	2,003	2,536	10,710	4,473	545	412	3,406	822	100,379
B03	6,187	6,671	7,259	2	0	52	1,888	806	1	0	2,643	389	25,898
B04	66,135	36,644	15,092	5,711	1,354	4,004	6,321	1,381	81	10	4,928	187	141,847
B05	214,604	55,093	13,537	1,272	3,147	5,212	10,470	2,781	36	66	5,287	428	311,933
B06	30,988	23,109	3,018	1,405	2,915	1,209	1,901	267	9	21	2,102	174	67,118
B07	42,029	27,058	5,241	1,255	2,529	1,497	2,866	429	3	16	1,971	389	85,284
B08	42,363	28,321	12,112	616	1,409	2,320	5,639	1,983	94	73	3,052	985	98,967
B09	74,222	16,627	8,566	343	271	2,960	10,463	6,170	1,733	2,138	1,324	564	125,381
B10	3,000	129	2,674	22	85	983	4,047	2,408	124	819	147	551	14,989
Sub-Tot	**524,320**	**223,254**	**93,951**	**11,358**	**13,827**	**22,236**	**65,936**	**30,980**	**3,122**	**8,898**	**25,310**	**4,766**	**1,027,957**
A18	69,010	6,517	9,969	771	689	2,337	3,009	851	138	71	418	62	93,843
A21	32,455	920	2,486	26	207	2,056	2,498	948	110	462	181	512	42,861
A35	30,085	3,517	27,689	2,238	2,167	4,865	15,176	12,581	2,021	5,760	983	204	107,287
A36	6,596	2,047	6,108	229	1,192	580	7,933	5,170	257	1,220	970	360	32,662
A39	41,822	3,450	12,095	12	2,237	2,901	14,338	13,514	1,652	3,288	147	451	95,907
A42	15,490	2,598	6,272	8	95	673	3,950	5,774	892	3,882	154	196	39,984
AC20	100,799	39,599	23,544	4,359	8,226	5,315	12,596	4,529	287	430	1,871	1,318	202,874
Sub-Tot	**296,257**	**58,649**	**88,164**	**7,642**	**14,814**	**18,727**	**59,500**	**43,368**	**5,358**	**15,112**	**4,723**	**3,103**	**615,417**
NW01	33,369	13,875	10,626	363	2,071	2,816	10,144	4,388	527	545	1,364	654	80,741
NW02	38,483	7,265	4,605	972	627	2,532	4,107	1,663	498	253	645	382	62,032
NW03	30,294	17,076	3,258	598	1,450	1,314	3,084	333	90	57	1,576	253	59,382
NW04	8,126	8,087	3,513	18	820	1,382	2,692	876	75	63	1,045	293	26,991
NW05	32,502	9,611	9,512	976	921	3,195	2,919	595	17	4	970	216	61,437
NW06	42,707	11,314	7,593	502	537	1,459	7,305	3,221	196	189	1,114	349	76,486
NW07	13,488	9,873	11,663	209	731	1,206	3,011	585	59	49	1,084	369	42,328
NW08	34,091	26,670	11,316	3,881	4,551	4,080	4,569	1,520	62	77	2,360	477	93,653
NW09	53,822	20,542	15,391	367	2,025	1,948	9,583	2,791	95	66	1,943	462	109,037
NW10	16,489	13,445	13,129	119	373	818	2,897	579	36	21	2,935	716	51,556
NW11	15,485	11,700	4,495	924	796	4,154	2,113	795	31	67	1,378	216	42,151
Sub-Tot	**318,856**	**149,457**	**95,101**	**8,928**	**14,901**	**24,904**	**52,425**	**17,346**	**1,687**	**1,391**	**16,412**	**4,386**	**705,795**
Total	**1,139,433**	**431,360**	**277,215**	**27,928**	**43,542**	**65,867**	**177,861**	**91,694**	**10,166**	**25,401**	**46,446**	**12,255**	**2,349,169**

Table 3.3-8 Summary of Traffic Composition Data for Different Count Stations in 2005 (%)

Site Code	Traffic Composition (%)												Total
			Bus				Truck						
	Car	Taxi	Shared Taxi	Mini	Public	Private	Pickup	2-Axle	3-Axle	> 3 Axle	Motorcycle	Other	
B01	28.3	4.1	13.9	0.2	0.2	2.6	20.7	18.3	0.9	9.5	0.8	0.5	100.0
B02	28.8	27.2	18.6	0.6	2.0	2.5	10.7	4.5	0.5	0.4	3.4	0.8	100.0
B03	23.9	25.8	28.0	0.0	0.0	0.2	7.3	3.1	0.0	0.0	10.2	1.5	100.0
B04	46.6	25.8	10.6	4.0	1.0	2.8	4.5	1.0	0.1	0.0	3.5	0.1	100.0
B05	68.8	17.7	4.3	0.4	1.0	1.7	3.4	0.9	0.0	0.0	1.7	0.1	100.0
B06	46.2	34.4	4.5	2.1	4.3	1.8	2.8	0.4	0.0	0.0	3.1	0.3	100.0
B07	49.3	31.7	6.1	1.5	3.0	1.8	3.4	0.5	0.0	0.0	2.3	0.5	100.0
B08	42.8	28.6	12.2	0.6	1.4	2.3	5.7	2.0	0.1	0.1	3.1	1.0	100.0
B09	59.2	13.3	6.8	0.3	0.2	2.4	8.3	4.9	1.4	1.7	1.1	0.4	100.0
B10	20.0	0.9	17.8	0.1	0.6	6.6	27.0	16.1	0.8	5.5	1.0	3.7	100.0
Sub-Tot	51.0	21.7	9.1	1.1	1.3	2.2	6.4	3.0	0.3	0.9	2.5	0.5	100.0
A18	73.5	6.9	10.6	0.8	0.7	2.5	3.2	0.9	0.1	0.1	0.4	0.1	100.0
A21	75.7	2.1	5.8	0.1	0.5	4.8	5.8	2.2	0.3	1.1	0.4	1.2	100.0
A35	28.0	3.3	25.8	2.1	2.0	4.5	14.1	11.7	1.9	5.4	0.9	0.2	100.0
A36	20.2	6.3	18.7	0.7	3.6	1.8	24.3	15.8	0.8	3.7	3.0	1.1	100.0
A39	43.6	3.6	12.6	0.0	2.3	3.0	15.0	14.1	1.7	3.4	0.2	0.5	100.0
A42	38.7	6.5	15.7	0.0	0.2	1.7	9.9	14.4	2.2	9.7	0.4	0.5	100.0
AC20	49.7	19.5	11.6	2.1	4.1	2.6	6.2	2.2	0.1	0.2	0.9	0.6	100.0
Sub-Tot	48.1	9.5	14.3	1.2	2.4	3.0	9.7	7.0	0.9	2.5	0.8	0.5	100.0
NW01	41.3	17.2	13.2	0.4	2.6	3.5	12.6	5.4	0.7	0.7	1.7	0.8	100.0
NW02	62.0	11.7	7.4	1.6	1.0	4.1	6.6	2.7	0.8	0.4	1.0	0.6	100.0
NW03	51.0	28.8	5.5	1.0	2.4	2.2	5.2	0.6	0.2	0.1	2.7	0.4	100.0
NW04	30.1	30.0	13.0	0.1	3.0	5.1	10.0	3.2	0.3	0.2	3.9	1.1	100.0
NW05	52.9	15.6	15.5	1.6	1.5	5.2	4.8	1.0	0.0	0.0	1.6	0.4	100.0
NW06	55.8	14.8	9.9	0.7	0.7	1.9	9.6	4.2	0.3	0.2	1.5	0.5	100.0
NW07	31.9	23.3	27.6	0.5	1.7	2.9	7.1	1.4	0.1	0.1	2.6	0.9	100.0
NW08	36.4	28.5	12.1	4.1	4.9	4.4	4.9	1.6	0.1	0.1	2.5	0.5	100.0
NW09	49.4	18.8	14.1	0.3	1.9	1.8	8.8	2.6	0.1	0.1	1.8	0.4	100.0
NW10	32.0	26.1	25.5	0.2	0.7	1.6	5.6	1.1	0.1	0.0	5.7	1.4	100.0
NW11	36.7	27.8	10.7	2.2	1.9	9.9	5.0	1.9	0.1	0.2	3.3	0.5	100.0
Sub-Tot	**45.2**	**21.2**	**13.5**	**1.3**	**2.1**	**3.5**	**7.4**	**2.5**	**0.2**	**0.2**	**2.3**	**0.6**	**100.0**
Total	**48.5**	**18.4**	**11.8**	**1.2**	**1.9**	**2.8**	**7.6**	**3.9**	**0.4**	**1.1**	**2.0**	**0.5**	**100.0**







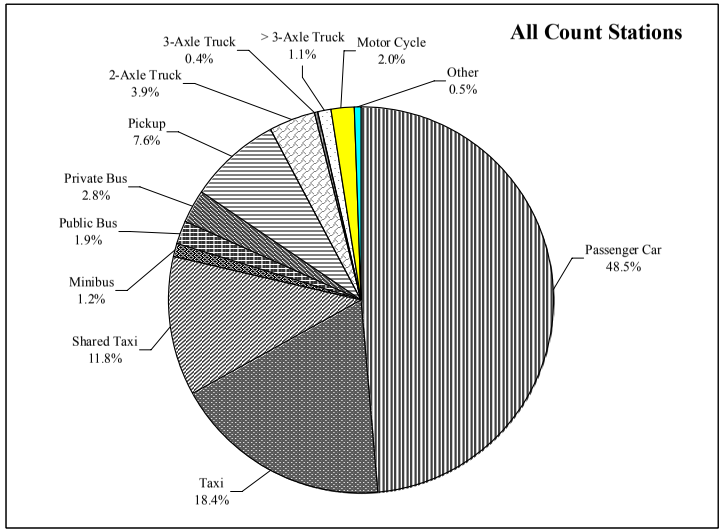


Figure 3.3-7 Traffic Composition for Nile Bridges, Arterials, New Sites and Average of All Count Stations in 2005

Table 3.3-9 Characteristics of Observed Traffic Volume at Different Count Stations in 2005

Site	No.	Code	Site Name	PHF	D	K
BRIDGES	1	B01	Warraq Bridge	0.72	0.59	9.2%
	2	B02	Rodh El-Farag Bridge	0.87	0.71	7.4%
	3	B03	Imbaba Bridge	0.86	0.72	8.9%
	4	B04	15th of May Bridge	0.78	0.60	10.3%
	5	B05	6th of October Bridge	0.78	0.67	8.2%
	6	B06	Galaa Bridge	0.88	0.60	8.4%
	7	B07	Gamah Bridge	0.82	0.67	8.2%
	8	B08	Giza Bridge	0.93	0.61	6.1%
	9	B09	Moneeb Bridge	0.85	0.68	8.6%
	10	B10	Marazeeq Bridge	0.89	0.63	8.4%
	Average of Nile Bridges			**0.84**	**0.65**	**8.4%**
ARTERIALS	11	A18	26th of July Corridor	0.84	0.65	8.2%
	12	A21	Suez Desert Road	0.90	0.57	8.4%
	13	A35	Alex. Agriculture Road	0.93	0.61	6.6%
	14	A36	Ismailia Agriculture Road	0.80	0.57	8.4%
	15	A39	Ismailia Desert Road	0.81	0.61	8.1%
	16	A42	Autostrade	0.88	0.70	8.2%
	17	AC20	Nasr Road	0.97	0.60	6.8%
	Average of Major Arterials			**0.87**	**0.62**	**7.8%**
EXPRESSWAY ROUTES	18	NW01	Gesr El-Suez St.	0.87	0.56	8.6%
	19	NW02	Suez Desert Road	0.86	0.67	6.4%
	20	NW03	Abo Bakr El-Sedeeq St.	0.88	0.60	8.8%
	21	NW04	Kablat St.	0.88	0.60	6.9%
	22	NW05	Lotfy El-Sayed St.	0.95	1.00	7.0%
	23	NW06	Autostrade	0.92	0.58	12.3%
	24	NW07	Ahmed Helmy St.	0.86	0.77	7.9%
	25	NW08	Ramsis St.	0.94	0.69	8.4%
	26	NW09	Salah Salem Road	0.82	0.66	6.4%
	27	NW10	Tereat El-Zomor Road	0.84	0.66	8.1%
	28	NW11	Sudan St.	0.91	0.59	6.7%
	Average of Expressway Corridors			**0.88**	**0.67**	**8.0%**
Overall Average				**0.86**	**0.65**	**8.1%**

3.4 GROWTH RATE OF TRAFFIC VOLUME

It is worth mentioning that most of traffic count stations were allocated on the same locations counted in CREATS Phase 1 in order to easily compare the results of the two traffic count surveys to estimate the growth rate in traffic volume during the last four years (2001 till 2005). The data summarized in Appendix 3.6 includes the daily traffic volume for different count stations in 2001 and 2005, which are abstracted in Table 3.4-1 for vehicles and Table 3.4-2 for PCU.

Table 3.4-1 Growth Rates of Traffic Volume from 2001 to 2005 (Vehicles)

Site	No.	Code	Site Name	Daily Traffic Volume		Ratio	Growth Rate
				2001	2005		
BRIDGES	1	B01	Warraq Bridge	44,579	56,161	1.26	5.9%
	2	B02	Rodh El-Farag Bridge	98,403	100,379	1.02	0.5%
	3	B03	Imbaba Bridge	22,452	25,898	1.15	3.6%
	4	B04	15th of May Bridge	135,297	141,847	1.05	1.2%
	5	B05	6th of October Bridge	247,939	311,933	1.26	5.9%
	6	B06	Galaa Bridge	64,392	67,118	1.04	1.0%
	7	B07	Gamah Bridge	74,499	85,284	1.14	3.4%
	8	B08	Giza Bridge	93,882	98,967	1.05	1.3%
	9	B09	Moneeb Bridge	68,790	125,381	1.82	16.2%
	10	B10	Marazeeq Bridge	14,815	14,989	1.01	0.3%
	Average of Nile Bridges			**867,049**	**1,029,962**	**1.19**	**4.4%**
ARTERIALS	11	A18	26th of July Corridor	93,548	93,843	1.00	0.1%
	12	A21	Suez Desert Road	25,750	42,861	1.66	13.6%
	13	A35	Alex. Agriculture Road	101,935	107,287	1.05	1.3%
	14	A36	Ismailia Agriculture Road	23,089	32,662	1.41	9.1%
	15	A39	Ismailia Desert Road	89,493	95,907	1.07	1.7%
	16	A42	Autostrade	38,356	39,984	1.04	1.0%
	17	AC20	Nasr Road	193,079	202,874	1.05	1.2%
	Average of Major Arterials			**565,251**	**615,418**	**1.09**	**2.1%**
Overall Average				**1,432,300**	**1,645,380**	**1.15**	**3.5%**

The following can be inferred from Table 3.4-1:

- The growth rate varies significantly from count station to another as can be observed in a range of 0.3% to 16.2% for Nile bridges and a range from 0.1% to 13.6% for the major arterials.
- Marazeeq Bridge records the lowest growth rate (0.3%), while Moneeb Bridge has the highest growth rate (16.2%) followed by both Warraq and 6th of October, which accounts for a growth rate of 5.9%.
- As for major arterials, 26th of July (A18) has the lowest growth rate (0.1%). On the other hand, the highest growth rate (13.6%) is observed at Suez Desert Road (A21) followed by Ismailia Agriculture Road (A36), which has a growth rate of 9.1%.
- The average growth rates for bridges and arterials are 4.4% and 2.1%, respectively, which imposes an overall average growth rate of 3.5% for all count stations.

Similarly, Table 3.4-2, which is based on PCU instead of vehicles, indicates the following:

Table 3.4-2 Growth Rates of Traffic Volume from 2001 to 2005 (PCU)

Site	No.	Code	Site Name	Daily Traffic Volume		Ratio	Growth Rate
				2001	2005		
BRIDGES	1	B01	Warraq Bridge	67,037	83,198	1.24	5.5%
	2	B02	Rodh El-Farag Bridge	112,853	119,716	1.06	1.5%
	3	B03	Imbaba Bridge	24,567	28,619	1.16	3.9%
	4	B04	15th of May Bridge	143,800	159,359	1.11	2.6%
	5	B05	6th of October Bridge	261,098	329,331	1.26	6.0%
	6	B06	Galaa Bridge	71,288	74,528	1.05	1.1%
	7	B07	Gamah Bridge	80,951	93,595	1.16	3.7%
	8	B08	Giza Bridge	104,318	110,297	1.06	1.4%
	9	B09	Moneeb Bridge	77,977	145,532	1.87	16.9%
	10	B10	Marazeeq Bridge	22,712	21,591	0.95	-1.3%
	Average of Nile Bridges			**968,601**	**1,167,771**	**1.21**	**4.8%**
ARTERIALS	11	A18	26th of July Corridor	111,386	103,891	0.93	-1.7%
	12	A21	Suez Desert Road	30,878	48,411	1.57	11.9%
	13	A35	Alex. Agriculture Road	153,921	157,960	1.03	0.6%
	14	A36	Ismailia Agriculture Road	31,079	45,657	1.47	10.1%
	15	A39	Ismailia Desert Road	125,632	130,693	1.04	1.0%
	16	A42	Autostrade	52,339	58,716	1.12	2.9%
	17	AC20	Nasr Road	213,870	241,226	1.13	3.1%
	Average of Major Arterials			719,107	**786,554**	**1.09**	**2.3%**
Overall Average				**1,687,708**	**1,954,325**	**1.16**	**3.7%**

- The average growth rates for bridges and arterials are 4.8% and 2.3%, respectively, which impose an overall average growth rate of 3.7% for all count stations.
- However, it seems that some count stations have less traffic volume in 2005 compared with the estimated PCU in 2001 such as Marazeeq Bridge (-1.3%) and 26th of July Corridor (-1.7%). This implies that the traffic volume of larger vehicles (buses and trucks) decreased due to the ban of trucks on such areas, while the traffic volume of small-size vehicles increased.

3.5 TRAFFIC VOLUMES AT URBAN EXPRESSWAY CORRIDORS

One major point of interest is to determine the existing traffic volumes and their characteristics along the potential corridors of the proposed expressway network. Therefore, the traffic survey policy considers this issue by allocating new count stations to fulfill this objective provided that other count stations from CREATS Phase 1 are already located on expressway corridors. It should be noted that 19 out of 28 count stations are positioned on expressway corridors including three (3) bridges and five (5) arterials from CREATS Phase 1 in addition to eleven (11) new count stations.

Based on the data presented in previous sub-sections, Table 3.5-1 summarizes the relevant information for the concerned expressways corridors, which include the following items:

- Site type, code, name and direction of travel.
- Peak hour volumes per direction. The maximum value was observed at 6th of October Bridge (13,440 vehicles per hour).
- Daily traffic volume expressed in vehicles and PCU. A total of 1.8 million vehicles were counted at different count stations, which are equivalent to 2.1 million PCU.
- Traffic flow characteristics such as:
  - Peak hour factor (PHF) of 0.88 as an average.
  - Directional Factor (D) of 0.65 as an average.
  - Percentage of design traffic volume to the daily traffic volume (K) of 7.9% as an average.

Table 3.5-1 Summary of Traffic Volume along Urban Expressway Corridors

Site	No.	Code	Site Name	Direction of Traffic Flow		Peak Hour Volume (Veh)		Daily Traffic Volume		Traffic Flow Characteristics		
				Dir 1: To	Dir 2: To	Dir 1	Dir 2	Vehicles	PCU	PHF	D	K
EXPRESSWAY CORRIDORS	BRIDGES	B04	15th of May Bridge	Cairo	Gaza	4,300	6,862	141,847	159,359	0.78	0.60	10.3%
		B05	6th of October Bridge	Cairo	Gaza	13,400	9,747	311,933	329,331	0.78	0.67	8.2%
		B08	Gaza Bridge	Cairo	Gaza	3,259	3,433	98,967	110,297	0.93	0.61	6.1%
		Sub-Total				NA	NA	552,747	598,987	0.83	0.63	8.2%
	ARTERIALS	A18	26th of July Corridor	Lebanon Sq.	6th of Oct. City	3,176	4,204	93,843	103,891	0.84	0.65	8.2%
		A21	Suez Desert Road	Suez	Cairo	1,692	1,851	42,861	48,411	0.90	0.57	8.4%
		A35	Alex. Agriculture Road	Alexandria	Cairo	3,975	3,780	107,287	157,960	0.93	0.61	6.6%
		A39	Ismailia Desert Road	Ismailia	Cairo	3,832	3,328	95,907	130,693	0.81	0.61	8.1%
		AC20	Nasr Road	Cairo Airport	Helwan	8,050	6,529	202,874	241,226	0.97	0.60	6.8%
		Sub-Total				NA	NA	542,771	682,181	0.89	0.61	7.6%
	NEW SITES	NW01	Gesr El-Suez St.	Ismailia	CBD	2,619	3,346	80,741	97,693	0.87	0.56	8.6%
		NW02	Suez Desert Road	Suez	Cairo	2,258	2,151	62,032	71,264	0.86	0.67	6.4%
		NW03	Abo Bakr El-Sedeeq St.	Orooba St.	Tagneed Sq.	2,753	2,458	59,382	64,624	0.88	0.60	8.8%
		NW04	Kablat St.	Mataria Sq.	Ismailia Canal	980	828	26,991	31,791	0.88	0.60	6.9%
		NW05	Lotfy El-Sayed St.**	Ramsis Sq.	**	4,078	**	61,437	71,725	0.95	1.00	7.0%
		NW06	Autostrade	Cairo Airport	Helwan	5,011	3,122	76,486	86,196	0.92	0.58	12.3%
		NW07	Ahmed Helmy St.	Qalyob	CBD	1,624	2,223	42,328	50,717	0.86	0.77	7.9%
		NW08	Ramsis St.	Abbassia Sq.	Ramsis Sq.	3,067	5,103	93,653	114,283	0.94	0.69	8.4%
		NW09	Salah Salem Road	Cairo Airport	Giza Sq.	3,719	3,804	109,037	123,850	0.82	0.66	6.4%
		NW10	Tereat El-Zomor Road	Haram St.	Ring Road	2,298	1,701	51,556	58,325	0.84	0.66	8.1%
		NW11	Sudan St.	Imbaba	Haram St.	1,281	1,514	42,151	50,721	0.91	0.59	6.7%
		Sub-Total				NA	NA	705,795	821,191	0.88	0.67	8.0%
TOTAL						NA	NA	1,801,314	2,102,359	0.88	0.65	7.9%

3.6 RESULTS OF WILLINGNESS-TO-PAY SURVEY

3.6.1 General

It is mentioned earlier that the Willingness-to-Pay (WTP) survey is divided into two different types including interviews with road users at different locations and interviews with the decision makers (owners or general managers) of some selected transport companies. This survey was conducted to collect the necessary information regarding the willingness of drivers, taxi passengers, and transport companies to pay a certain amount of money (toll) for a pre-specified reduction in travel time when using the proposed urban expressway.

The interview survey form with road users comprises the following data items:

- General information:
  - Sample ID
  - Survey Date (day and month)
  - Survey time (hour and minute)
  - Survey location code
  - Vehicle type
- Personal information:
  - Gender
  - Age
  - Car availability
  - Occupation
  - Monthly income
  - Monthly electricity bill
- Personal information:
  - Trip origin
  - Trip destination
  - Travel time
  - Trip frequency
  - Trip purpose
  - Amount of money the interviewee likes to pay for a certain travel time saving.

The last item can be considered as the most important item to be obtained and interpreted from this survey.

As for the interviews with the representatives of transport companies, the following information was obtained:

- Company type.
- Total number of staff and workers.
- Fleet size and data.
- Total transport volume.
- Vehicle routes.
- Amount of money the company likes to pay for a certain travel time saving.

3.6.2 Characteristics of Interviewed Road Users

1) Vehicle Type

The planned and actual sample size of each vehicle type is presented in Table 3.6-2. Figure 3.6-1 illustrates the distribution of actual interviewed sample, in which passenger car represents the majority of sample (55%) followed by taxi (20%) and light truck (13.6%).

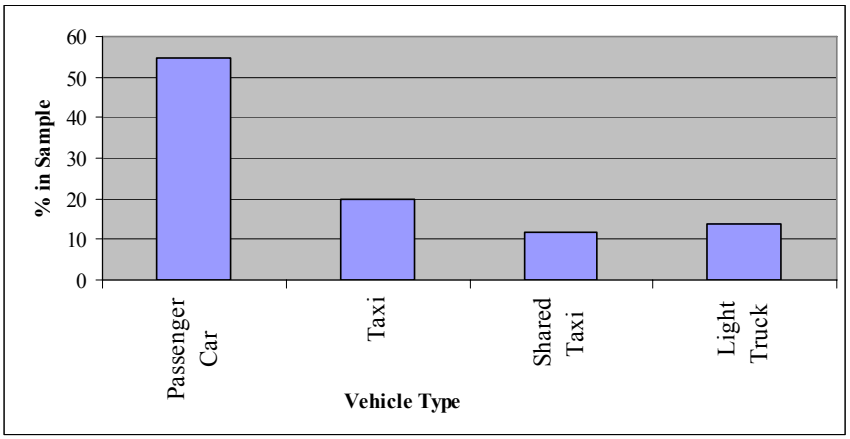


Figure 3.6-1 Distribution of Vehicle Type in Interviewed Sample

2) Gender

A total sample of 2,049 persons were interviewed, who are using different modes of transport. The total number of interviewed males is 1,737 persons, representing around 85% of the total sample size. On the other hand, the total number of interviewed females is 312 accounting for 15% of the total sample size.

3) Age

The age of the interviewed persons ranged between 20 years to more than 60 years. Figure 3.6-2 shows the distribution of age within the interviewed sample. Almost one third of the interviewed sample is in the range of 30 to 39 years old. The percentage of the interviewed sample of age interval of (20 to 29 years) represents 23.3%, (30 to 39 years) represents 33.4%, (40 to 49 years) represents 27%, (50 to 59 years) represents 13.4%, and more than 60 years represents 2.5% (the minimum age category).

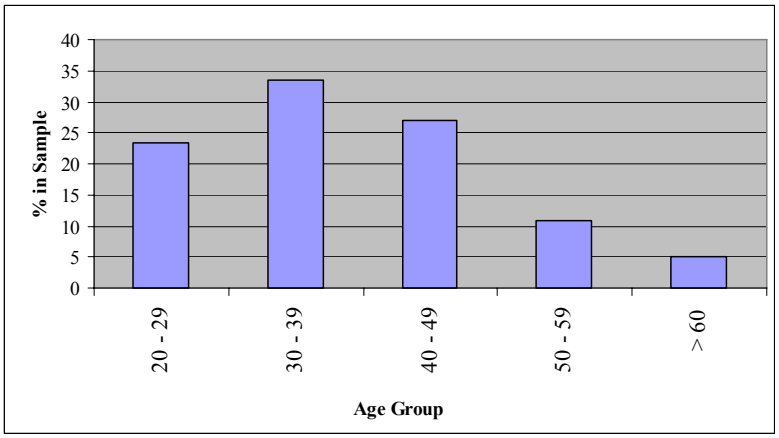


Figure 3.6-2 Distribution of Age in Interviewed Sample

4) Car Availability

The availability of car to the interviewed persons was categorized throughout 5 categories as follows:

- Always available
- Often available
- Occasionally available
- Seldom available
- Not available

Figure 3.6-3 depicts the distribution of these categories in the sample. The maximum sample percentage is 68% for the first category (i.e., always available). While the minimum sample percentage is 1% for category 5 (not available).

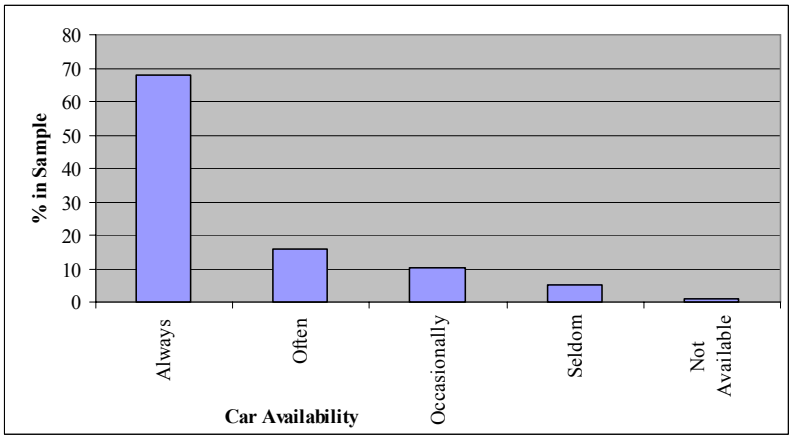


Figure 3.6-3 Distribution of Car Availability in Interviewed Sample

5) Occupation

Different 14 types of occupation were collected in road user interview as follows:

1. Legislature & Administrative
2. Professional Workers
3. Technicians and Assistants
4. Clerks and related Workers
5. Sale and Service Workers
6. Farmers, Fishers and Hunters
7. Craftsmen and related Workers
8. Production Workers and related Workers
9. Unskilled Workers
10. Student
11. Housewife
12. Retired
13. Jobless
14. Others

Figure 3.6-4 shows the shares of different occupation types in the interview sample size. The maximum occupation type found in the interviewed process is the craftsman with percentage of 31% of the total sample size, followed by professional workers (23%) and administration (9%). The minimum occupation type is the farmers and fishers with percentage of 0.3% of the total sample size which makes sense inside Greater Cairo Region.

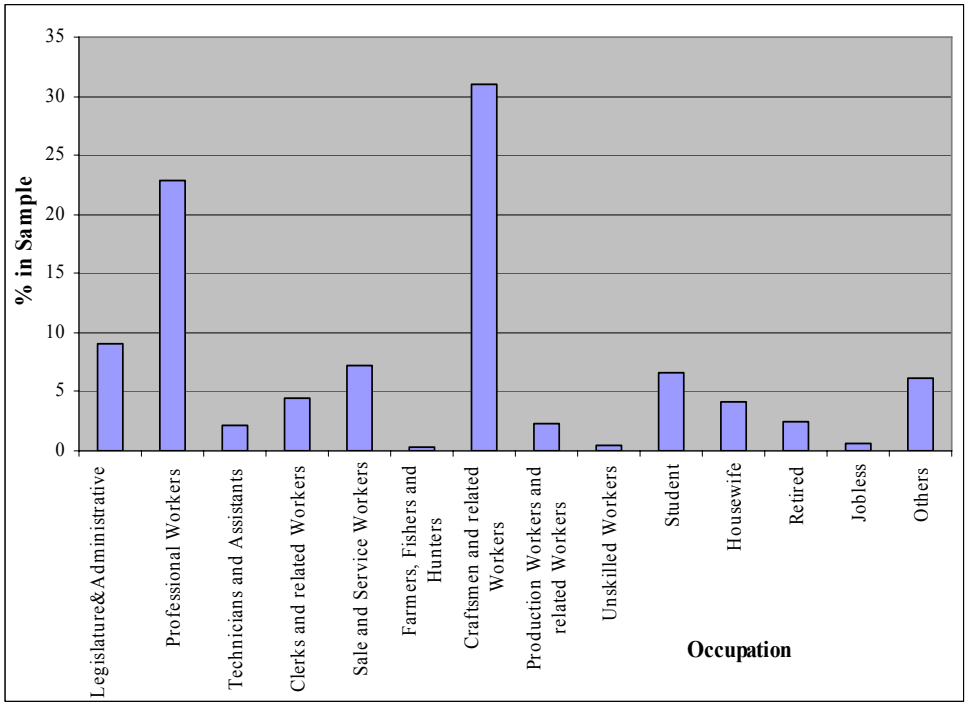


Figure 3.6-4 Distribution of Occupation in Interviewed Sample

6) Income

Figure 3.6-5 illustrates the distribution of different income classes within the interviewed sample. It is expected that most of the interviewed persons will refuse to report their real income class, which is not uncommon even in the developed countries. Therefore, the majority of interviewees (44.4%) refused to report their income. Some persons have no income such as students and jobless persons, which account for 9.5% of total sample size. The distribution of the first six bars of Figure 3.6-5 emphasizes a logical distribution of income levels among the interviewed sample, in which the categories of (501-1000 LE) and

(1001-2000 LE) represent 13.5% and 12.6%, respectively. The poor (3%) and rich (2%) categories are located at the two ends of the sample.

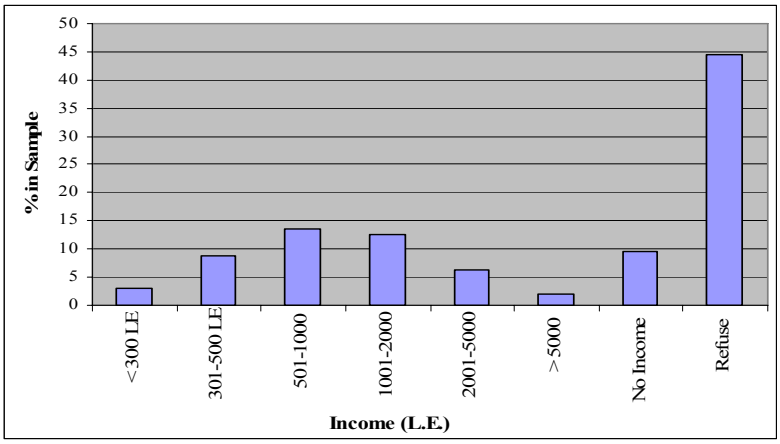


Figure 3.6-5 Distribution of Income Class in Interviewed Sample

7) Electricity Bill

Some proxy variables have to be selected to substitute the expected lack of income data. The monthly electricity bill is one of the reliable candidates of such kind of proxies based on previous experience of home interview survey of CREATS Phase 1. Figure 3.6-7 shows the distribution of monthly electricity bill value among the interviewed persons. Much less percentage of the interviewed persons (10%) refused to provide information compared with 44.4%, who refused to report their income class. It is obvious that half and two-third of interviewed sample still are used to pay up to 30 LE/month and 40 LE/month for electricity, respectively.

8) Travel Time

Figure 3.6-7 shows the distribution of travel time within the sample population. One quarter of the sample size has a travel time up to 20 minutes, while half the sample has a 30-minute travel time. The maximum sample percentage is 41.63% for travel times more than 30 minutes and less or equal to 60 minutes.

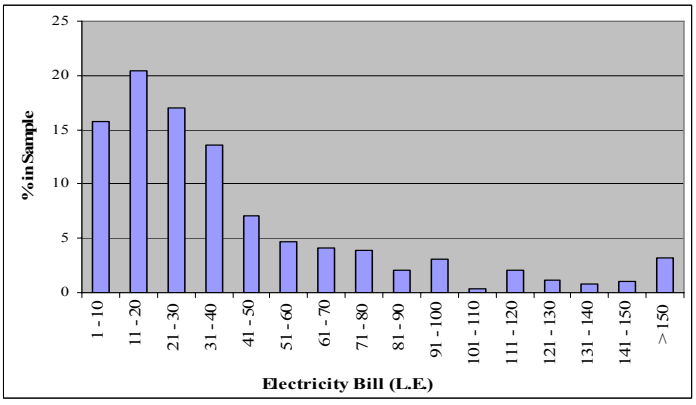


Figure 3.6-6 Distribution of Monthly Electricity Bill Value (LE)

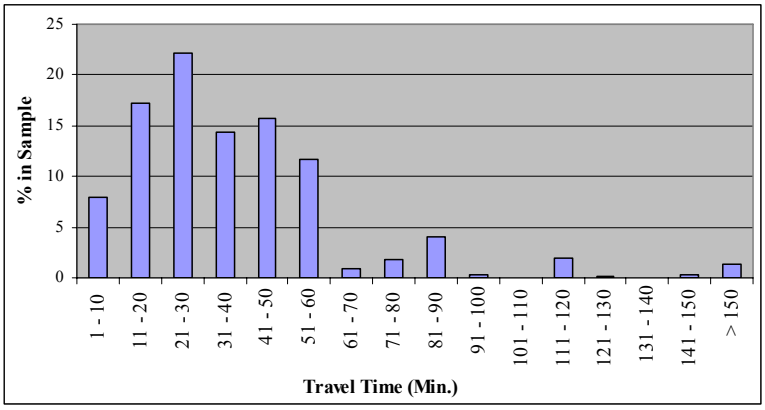


Figure 3.6-7 Distribution of Travel Time

9) Trip Frequency

Trip frequency is a measure of how frequent the road users are used to make the relevant trip, which might affects the frequency of using the proposed urban expressway network. Figure 3.6-8 presents the distribution of trip frequency made by interviewees. The majority of interviewees (41.4%) are used to make one or two trips per week. Around two-third the sample size are making up to 8 trips per week.

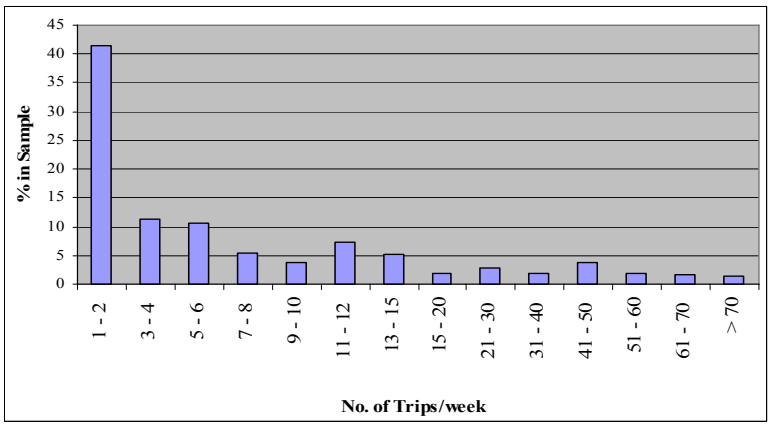


Figure 3.6-8 Distribution of Weekly Trip Frequency

10) Trip Purpose

Figure 3.6-9 illustrates the distribution of different trip purposes among the total interviewed sample. The “work trips” represents the highest share of 49% of the total sample while, the “return to work trips” represents the lowest value of 1.7% of the total sample size.

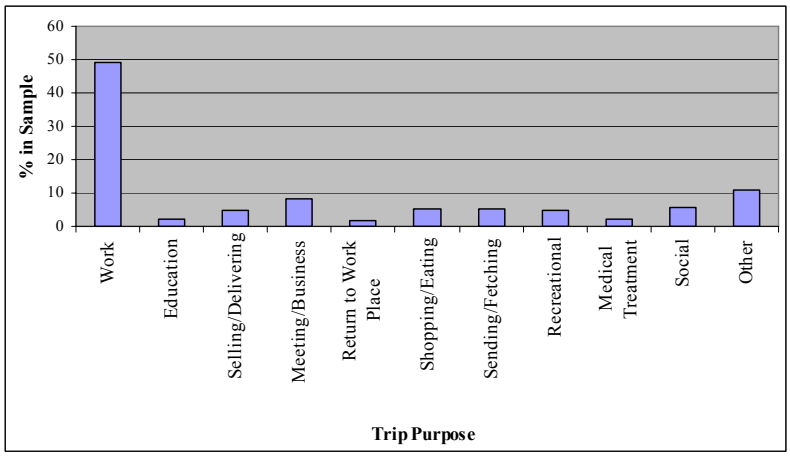


Figure 3.6-9 Distribution of Trip Purpose

3.6.3 Willingness-to-Pay for 25% Travel Time Reduction

The most obvious outcome of this survey is that the majority of sample (72.5%) refused to pay any amount of money regardless the expected benefit of introducing a better level of service as shown in Figure 3.6-10. This observation can be expected and inferred as a logical result for road users who are not familiar with this kind of service in addition to their resistance to pay additional cost for their trips. Consequently, it might be fair to say that this outcome is underestimated. On the other hand 17.7% and 5.3% of the total interviewed samples indicate that they would pay one pound and 2 pounds, respectively for a reduction of 25% of their travel time. Further investigation of road users who are willing to pay is outlined later.

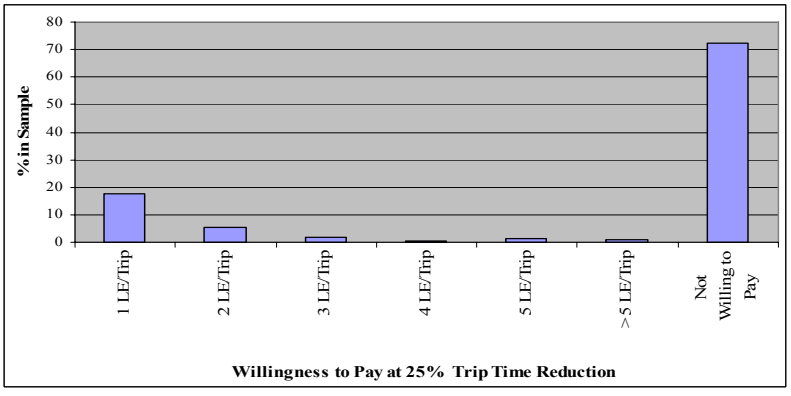


Figure 3.6-10 Distribution of WTP for 25 % Travel Time Reduction

3.6.4 Willingness-to-Pay for 50% Travel Time Reduction

Similar to a great extent to the response of 25% travel time saving, Figure 3.6-11 indicates that about 61% of the interviewed sample has no intention to pay money for a 50% reduction in travel time. Only 20% of the total interviewed sample may pay one pound for such a reduction. These two categories represent about 81% of the total sample size.

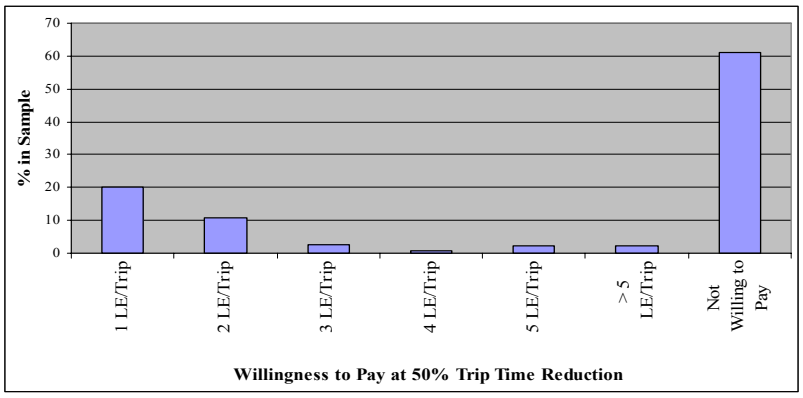


Figure 3.6-11 Distribution of WTP for 50 % Travel Time Reduction

Further investigation to clarify the relation between the toll value and different characteristics of the sample is outlined below.

3.6.5 Characteristics of WTP Individuals

Appendix 3.7 presents the cross-tabulation results of different toll levels as related to personal and trip characteristics, from which only three items, including vehicle type, trip purpose and income class, are presented below. Figures 3.6-12 through 3.6-17 show the detailed distribution of willingness to pay with vehicle type, trip purpose and monthly income class for the reduction of 25% and 50% in travel time.

1) Vehicle Type

Figures 3.6-12 and 3.6-13 illustrate the relationship between the vehicle type and toll level (amount) when the reductions of 25% and 50% in travel time are considered.

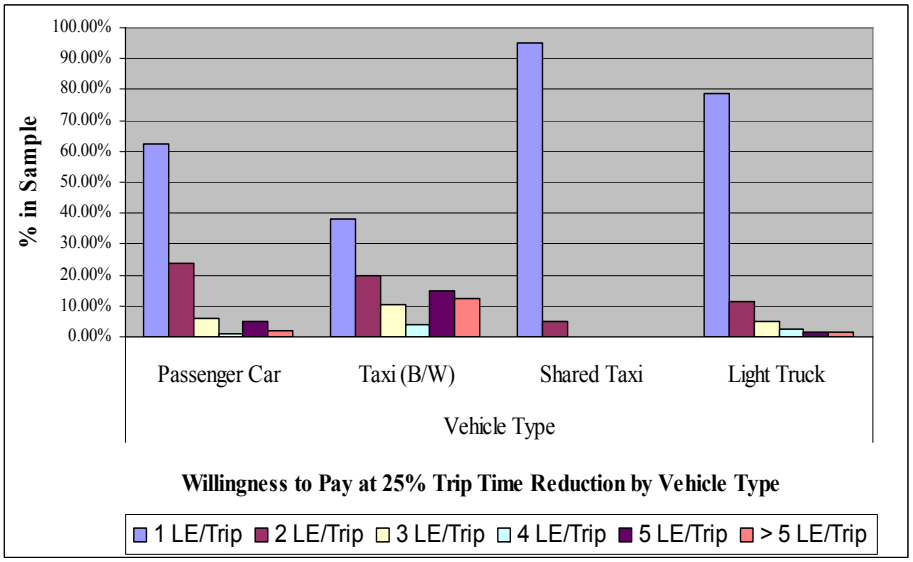


Figure 3.6-12 Distribution of WTP by Vehicle Type for 25% Travel Time Reduction

It can be inferred from Figure 3.6-12 that private mode users, passenger car and taxi, have more tendency to pay more money (2 L.E. or more). On the other hand, most of shared taxi and light truck users indicated that they could not afford paying much money for 25% travel time reduction for which, most responses are for 1 L.E. only. It can be also deduced that for any vehicle type, the percentage of responses within the samples size decreases when the toll increases.

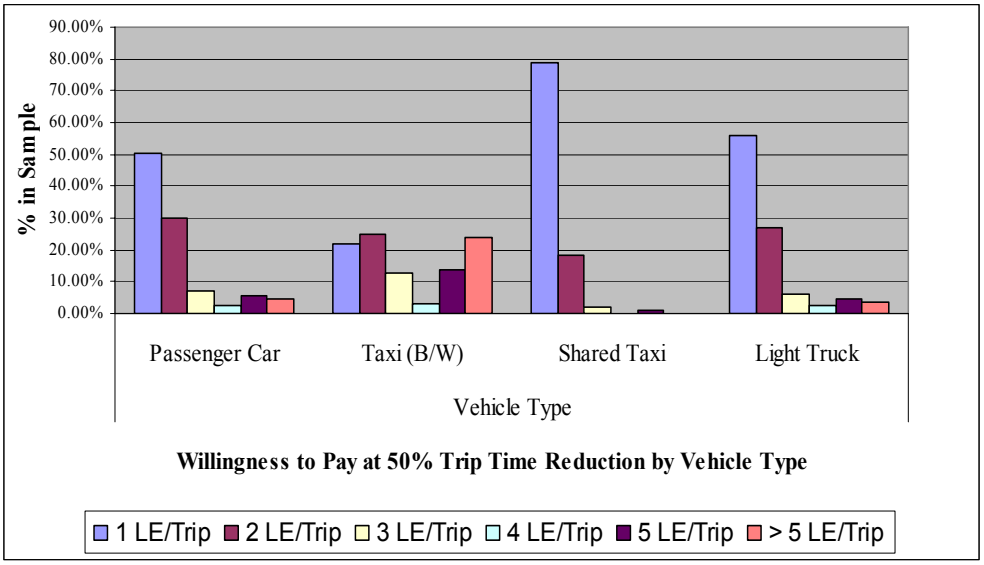


Figure 3.6-13 Distribution of WTP by Vehicle Type for 50% Travel Time Reduction

The conclusion drawn from Figure 3.6-12 can be once again drawn from Figure 3.6-13 regarding the tendency of private modes to pay more money. On the other hand a notable increase is obvious for the tendency of individuals to pay more for an increased travel time reduction. For example, passenger car users who indicated that they would pay 2 L.E. for 25% travel time reduction are 22% of the sample, but when 50 % reduction in travel time was introduced, 30% of the sample had an intention to pay more money which accounts for additional 8% of interviewees.

2) Trip Purpose

Figures 3.6-14 and 3.6-15 illustrate the relationship between the trip purpose and toll level (amount) when the reductions of 25% and 50% in travel time are considered.

For any purpose in the sample, all records yield the same result which indicates that the most interviewees, whatever the trip purpose is, will pay only 1 L.E. for their trip time reduction. No clear evidence that a certain trip purpose may reveal while considering willingness to pay.

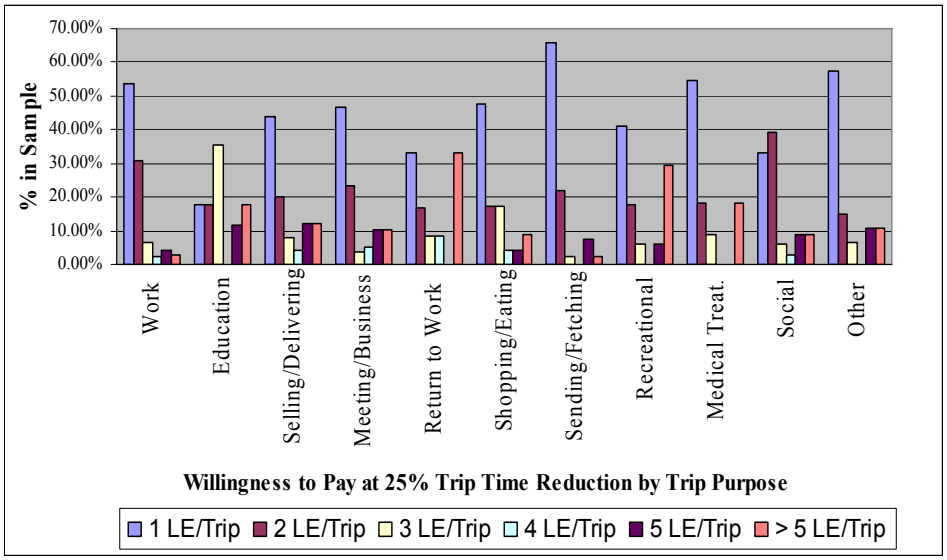


Figure 3.6-14 Distribution of WTP by Trip Purpose for 25% Travel Time Reduction

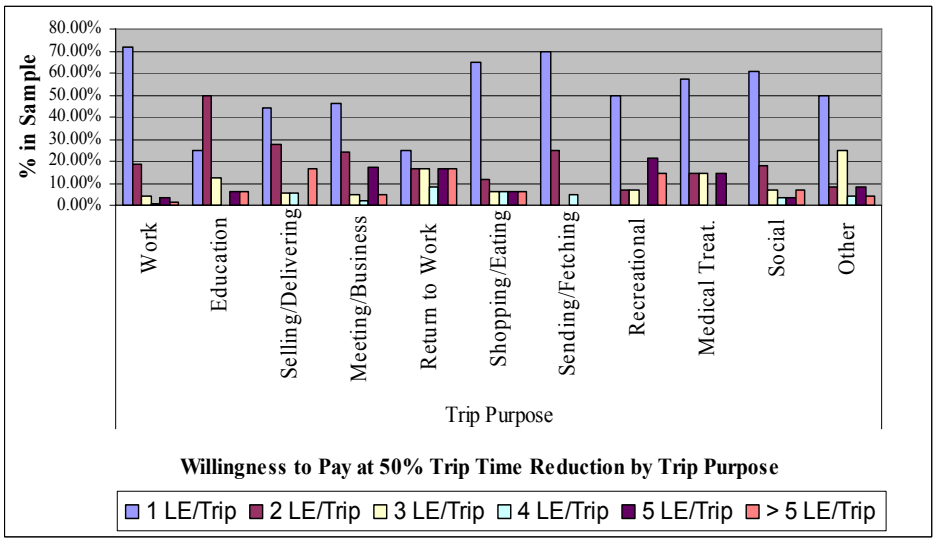


Figure 3.6-15 Distribution of WTP by Trip Purpose for 50% Travel Time Reduction

3) Income Class

It can be illustrated from Figure 3.6-16 that higher income classes have more tendencies to pay more when reducing their trip travel time. Regarding the 50% reduction in travel time, a great change takes place. More inclination toward paying more money appears for all income classes. Again the higher income classes have more willingness to pay for an increased travel time reduction as can be observed from Figure 3.6-17.

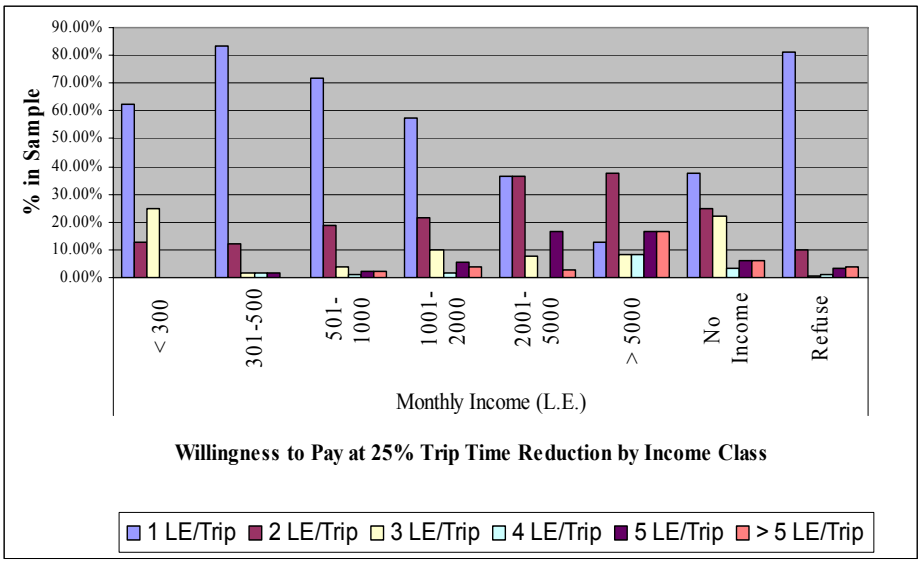


Figure 3.6-16 Distribution of WTP by Monthly Income for 25% Travel Time Reduction

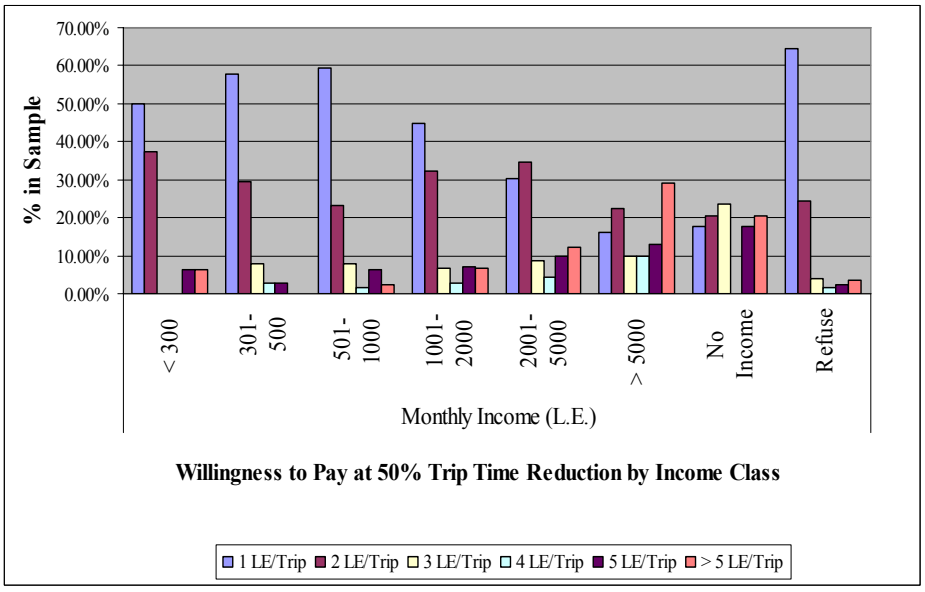


Figure 3.6-17 Distribution of WTP by Monthly Income for 50% Travel Time Reduction

3.6.6 Willingness-to-Pay against Specific Travel Time Reduction

One random case out of five different cases was introduced to each interviewee to determine his tendency to pay pre-specified amounts of toll for three different alternatives of travel time saving. These cases are presented in Table 3.6-1. It should be mentioned that options A, B and C have the same definitions among different cases.

Table 3.6-1 Definition of Different Cases and Options of WTP Survey

Case	Option	Toll Amount	Reducing Travel Time of Work Trip (Min)		Travel Time Saving
		(LE)	From	To	(Min)
Case 1	A	20	90	50	40
	B	15	60	30	30
	C	8	30	10	20
Case 2	A	15	90	50	40
	B	10	60	30	30
	C	8	30	10	20
Case 3	A	10	90	50	40
	B	8	60	30	30
	C	5	30	10	20
Case 4	A	8	90	50	40
	B	5	60	30	30
	C	3	30	10	20
Case 5	A	5	90	50	40
	B	2	60	30	30
	C	2	30	10	20

Tables 3.6-2 through 3.6-6 show the results of WTP against specific travel time reductions and proposed toll amount (LE) for work trips.

Table 3.6-2 Distribution of WTP for Travel Time Reduction in Work Trip (Case 1)

Case 1-A: 20 LE Toll for a Travel Time Reduction from 90 Min to 50 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1623	79.2	79.2	79.2
	Yes	6	0.3	0.3	79.5
	No	420	20.5	20.5	100.0
	Total	2049	100.0	100.0	

Case 1-B: 15 LE Toll for a Travel Time Reduction from 60 Min to 30 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1623	79.2	79.2	79.2
	Yes	8	0.4	0.4	79.6
	No	418	20.4	20.4	100.0
	Total	2049	100.0	100.0	

Case 1-C: 8 LE Toll for a Travel Time Reduction from 30 Min to 10 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1623	79.2	79.2	79.2
	Yes	14	0.7	0.7	79.9
	No	412	20.1	20.1	100.0
	Total	2049	100.0	100.0	

Table 3.6-3 Distribution of WTP for Travel Time Reduction in Work Trip (Case 2)

Case 2-A: 15 LE Toll for a Travel Time Reduction from 90 Min to 50 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1648	80.4	80.4	80.4
	Yes	5	0.2	0.2	80.7
	No	396	19.3	19.3	100.0
	Total	2049	100.0	100.0	

Case 2-B: 10 LE Toll for a Travel Time Reduction from 60 Min to 30 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1648	80.4	80.4	80.4
	Yes	9	0.4	0.4	80.9
	No	392	19.1	19.1	100.0
	Total	2049	100.0	100.0	

Case 2-C: 8 LE Toll for a Travel Time Reduction from 30 Min to 10 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1648	80.4	80.4	80.4
	Yes	10	0.5	0.5	80.9
	No	391	19.1	19.1	100.0
	Total	2049	100.0	100.0	

Table 3.6-4 Distribution of WTP for Travel Time Reduction in Work Trip (Case 3)

Case 3-A: 10 LE Toll for a Travel Time Reduction from 90 Min to 50 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1656	80.8	80.8	80.8
	Yes	8	0.4	0.4	81.2
	No	385	18.8	18.8	100.0
	Total	2049	100.0	100.0	

Case 3-B: 8 LE Toll for a Travel Time Reduction from 60 Min to 30 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1657	80.9	80.9	80.9
	Yes	12	0.6	0.6	81.5
	No	380	18.5	18.5	100.0
	Total	2049	100.0	100.0	

Case 3-C: 5 LE Toll for a Travel Time Reduction from 30 Min to 10 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1657	80.9	80.9	80.9
	Yes	24	1.2	1.2	82.0
	No	368	18.0	18.0	100.0
	Total	2049	100.0	100.0	

Table 3.6-5 Distribution of WTP for Travel Time Reduction in Work Trip (Case 4)

Case 4-A: 8 LE Toll for a Travel Time Reduction from 90 Min to 50 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1654	80.7	80.7	80.7
	Yes	19	0.9	0.9	81.6
	No	376	18.4	18.4	100.0
	Total	2049	100.0	100.0	

Case 4-B: 5 LE Toll for a Travel Time Reduction from 60 Min to 30 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1654	80.7	80.7	80.7
	Yes	31	1.5	1.5	82.2
	No	364	17.8	17.8	100.0
	Total	2049	100.0	100.0	

Case 4-C: 3 LE Toll for a Travel Time Reduction from 30 Min to 10 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1654	80.7	80.7	80.7
	Yes	42	2.0	2.0	82.8
	No	353	17.2	17.2	100.0
	Total	2049	100.0	100.0	

Table 3.6-6 Distribution of WTP for Travel Time Reduction in Work Trip (Case 5)

Case 5-A: 5 LE Toll for a Travel Time Reduction from 90 Min to 50 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1667	81.4	81.4	81.4
	Yes	40	2.0	2.0	83.3
	No	342	16.7	16.7	100.0
	Total	2049	100.0	100.0	

Case 5-B: 2 LE Toll for a Travel Time Reduction from 60 Min to 30 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1659	81.0	81.0	81.0
	Yes	90	4.4	4.4	85.4
	No	300	14.6	14.6	100.0
	Total	2049	100.0	100.0	

Case 5-C: 2 LE Toll for a Travel Time Reduction from 30 Min to 10 Min

Item		Freq.	%	Valid %	Cum. %
Valid	Not Interviewed	1659	81.0	81.0	81.0
	Yes	86	4.2	4.2	85.2
	No	304	14.8	14.8	100.0
	Total	2049	100.0	100.0	

The results drawn from the previous tables can be summarized as follows:

- The analysis indicates that almost 60% of the interviewed persons will not pay money at any level of travel time reduction.
- People's responses demonstrate almost no intention to pay large amount of money (8 L.E. or more) for any travel time reduction (Case 1-A, 1-B, 1-C, 2-A, 2-B, 2-C, 3-A, 3-B, and 4-A)
- More willingness to pay appeared when the toll introduced (5 L.E.) balanced with a travel time reduction (Case 3-C, 4-B and 5-A)
- Increasing travel time reduction together with reducing tolls have a great influence on increasing people's willingness to pay (Case 4-C).
- The lowest tolls (2 L.E.) have the highest response regarding willingness to pay (Case 5-B, and 5-C).

3.6.7 Results of Companies' Willingness-to-Pay Interview

Data from nine (9) passenger/freight transport companies was collected regarding their willingness to pay for travel time reduction. The interviewed companies are classified into three categories (passenger, tourism and freight) as shown in Table 3.6-7. The first category is represented by three public transport companies coded as 1 to 3. The second category comprises two tourism companies, which are coded as 4 and 5. The last category includes four freight companies as shown in the last four rows of Table 3.6-7. The number of workers, fleet size and transport volume are also presented in Table 3.6-7. The fleet size of the interviewed companies consists of 1040 vehicles, of which 260 vehicles belong to the public transit companies, 110 vehicles belong to the tourist service and 670 trucks belong to the freight transport companies.

Table 3.6-7 Characteristics of Interviewed Transport Companies

Type	No	Company Name	Labor Size	Fleet Size	Transport Volume	Unit
Passenger	1	Lebanon for Passenger Transport	350	51	30,000	Pass/Day
	2	Transport Facilities Industry for Passenger Transport	360	109	35,000	Pass/Day
	3	SOOT Company for Passenger Transport	300	100	60,000	Pass/Day
Tourism	4	EASTMAR Tourist	100	60	5,000	Pass/Day
	5	National Travel Service	400	50	4,000	Pass/Day
Freight	6	Nile for Direct Transport	1300	317	1,260,000	Ton/Year
	7	Nile for Freight Transport	1100	340	1,000,000	Ton/Year
	8	Alexandria for Furniture Transport	25	8	2,200	Cargo/Year
	9	El-Mustafa for Furniture Transport	17	5	1,600	Cargo/Year

The key persons (owners or general managers) of these companies were interviewed based on the schedule shown in Table 3.6-4. The results of willingness to pay survey are summarized in Table 3.6-7. The service type appears in the first column, followed the number of the transport company. The toll amount for the reductions of 25% and 50% of travel time are shown in the third and fourth columns, respectively. The remaining columns of Table 3.6-7 include the responses for the pre-defined five cases (see Table 3.6-1). Only the positive responses are shown in monetary values, while negative responses are denoted as "N".

Table 3.6-8 Results of WTP Survey for Different Companies

Service	Number	Toll Value (L.E)		Case 1			Case 2			Case 3			Case 4			Case 5		
		25% Time Saving	50% Time Saving	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
				Toll Value (LE) for Different Cases and Options														
				20	15	8	15	10	8	10	8	5	8	5	3	5	2	2
Passenger	1	0.0	0.0	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	2	0.0	0.0	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	3	0.0	0.0	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Tourist	4	5.0	8.0	N	N	N	N	N	N	N	N	N	**8.0**	**5.0**	**3.0**	**5.0**	**2.0**	**2.0**
	5	3.0	5.0	N	N	N	N	N	N	N	N	N	**8.0**	**5.0**	**3.0**	**5.0**	**2.0**	**2.0**
Freight	6	1.5	2.0	N	N	N	N	N	N	N	N	N	N	N	**3.0**	**5.0**	**2.0**	**2.0**
	7	2.0	3.0	N	N	N	N	N	N	N	N	N	N	N	**3.0**	N	**2.0**	**2.0**
	8	1.5	3.0	N	N	N	N	N	N	N	N	N	N	N	**3.0**	N	**2.0**	**2.0**
	9	1.5	3.0	N	N	N	N	N	N	N	N	N	N	N	**3.0**	N	**2.0**	**2.0**

The following can be inferred from this survey:

- Public transit companies refuse the concept of paying a toll for reducing the travel time as can be observed from the first 3 rows in Table 3.6-8.
- Freight transport companies reveal some flexibility and understanding by accepting the concept of paying reasonable amount of money within the range of 1.5 to 2.0 pounds for 25% of travel time saving. As the time saving increases to 50%, their willingness to pay gets higher to reach rang from 2.0 to 3.0 pounds. Moreover, one freight company (Nile for Direct Transport) has the willingness to pay 5.0 LE for a travel time saving of 40 minutes.

- More flexibility and willingness to pay a toll are exhibited by tourism companies, who can afford up to 5.0 LE for 25% of travel time saving and up to 8.0 LE for 50% reduction in travel time or to reduce travel time from 90 minutes to 50 minutes.

3.6.8 Disaggregate Model Development

The WTP Survey conducted on four vehicle types with the number of responding samples as presented in Table 3.6-9. The questions include: (i) basic information on the trip and trip-maker; (ii) the preference of interviewee (ordinary road or expressway) given travel time savings and toll fee.

Table 3.6-9 Respondents of WTP Survey

Vehicle Type	Interviewee	Respondent
Passenger Car	Driver	1,112
Taxi	Trip maker	408
Microbus	Trip maker	241
Truck	Driver/Operator	278
Total		2,049

The model form adopted is the Logit model. This model is theoretically sound and is well accepted and widely used. It has the following general form:

$$\text{prob}(a) = \frac{\exp[U_a]}{\sum_A \exp[U_x]}$$

Where,

Prob(a): probability that an individual will choose alternative, a among other alternatives form choice set A. For this study a binary choice set – expressway or ordinary road – is used.

U_x: Utility of alternative, with x; as a function of its attributes

The form and parameters of the utility function is determined based on the results of the WTP survey. The linear utility function is used for simplicity without necessarily compromising the model fitness; and it has the following form.

$$U = \beta_{xway} XWAY + \beta_{tt} TT + \beta_{tf} TF$$

Where,

TT: Travel time in minutes

TF: Toll Fee L.E.

XWAY Express bonus (XWAY =1 if expressway; otherwise 0)

$\beta_{xway}, \beta_{tt}, \beta_{tf}$ Parameters

To estimate the parameters the Maximum Likelihood Estimation method is applied. It should be noticed that in other studies, an “expressway bonus”; i.e., a positive constant is added to the utility of the expressway. The parameters of the utility function for each vehicle type are summarized in Table 3.6-10.

Table 3.6-10 Result of Stated Preference Analysis per Vehicle Type

LOS Variables		Passenger Car	Taxi	Microbus	Truck
1	Travel Time	(-2.159) -0.02194	(-0.560) -0.00808	(-0.149) -0.00554	(-2.155) -0.04899
2	Toll	(-11.713) -0.33833	(-4.658) -0.13240	(-2.756) -0.26350	(-5.810) -0.40113
Constant		(-4.504) -1.20390	(-4.205) -1.59760	(-2.387) -2.30710	(-3.126) -1.91400
Nuber of Samples		3,261	1,188	708	819
Hit Ratio		93.16%	91.08%	97.74%	94.51%
chi-square		3,123.96	960.61	841.33	844.28
ρ^2		0.6907	0.5822	0.8566	0.7427

The results of developed model are considered enough by reaching more than 90%. The ρ^2 are also very high. However, t-values of the coefficients of the travel time parameters of taxi and microbus are not sufficient. The results of developed models, as presented in Table 3.6-11, are over 90%. The ρ^2 are also very high, but T-values of coefficients are sufficient but the results can be generally accepted to establish the diversion rate charts on the expressway, as shown in Figure 3.6-18, to be applied in the toll setting analysis.

Table 3.6-11 Result of Stated Preference Analysis (All Vehicles)

LOS Variables		All
1	Travel Time	(-2.562) -0.01930
2	Toll	(-13.798) -0.26599
Constant		(-7.569) -1.52230
Nuber of Samples		5976
Hit Ratio		93.47%
chi-square		5,696.93
ρ^2		0.6875

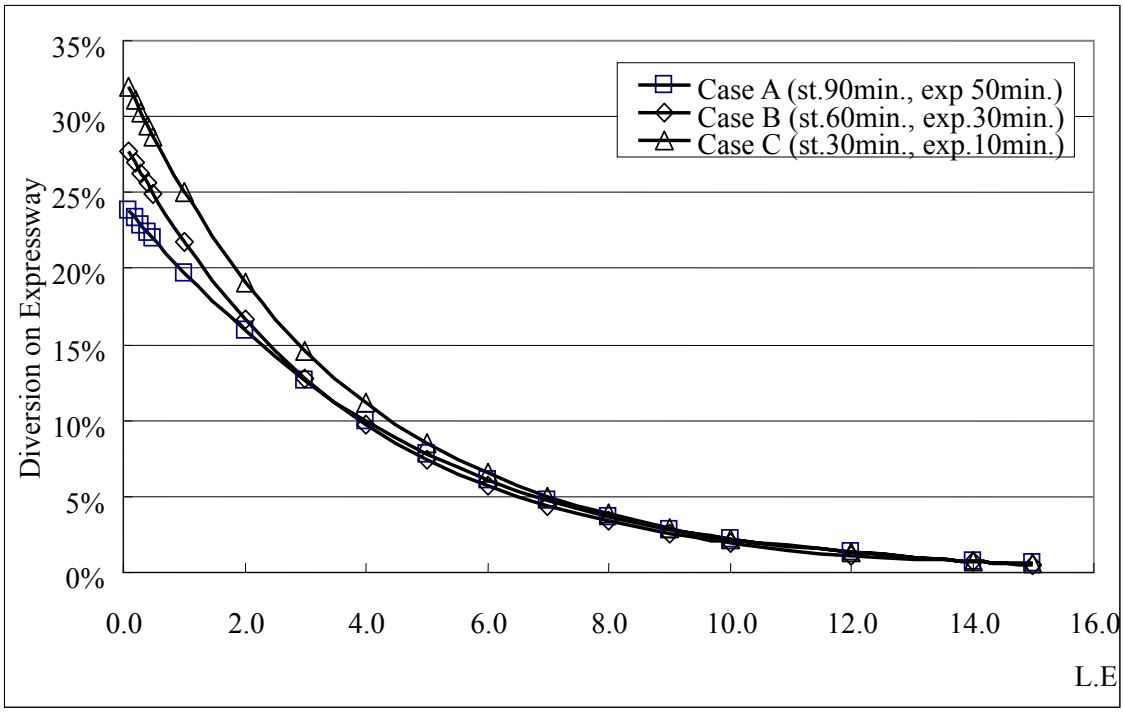


Figure 3.6-18 Diversion Rate on Expressway based on SP Analysis

CHAPTER 4

SOCIOECONOMIC FRAMEWORK

CHAPTER 4

SOCIOECONOMIC FRAMEWORK

4.1 GENERAL

This chapter describes a review of the socioeconomic characteristics and framework. The main objective is to verify the future socioeconomic framework applied in CREATS Master Plan through comparative process with the up dated socioeconomic data from 2001 to 2004. Another objective is to collect and analyze the updated socioeconomic data for toll setting.

In CREATS Master Plan, in order to predict traffic transport patterns for future years within the study forecast period (years 2007, 2012, 2022), key growth factors i.e. economic and population growth factors were estimated. On the basis of these estimated factors, the variables (population, employment, students and household income) for each traffic zone were forecasted. Based on the analysis results, it is concluded that future socioeconomic framework applied in CREATS Master Plan fit the present conditions and it is not necessary to change the socio economic framework at this stage.

4.2 ADMINISTRATIVE DIVISIONS

The Study Area is the same as the area of CREATS Master Plan illustrated in Figure 4.2-1. It covers the Greater Cairo Region (GCR) and a number of specifically mentioned new towns located outside the GCR, for example, the new urban communities of 6th of October and 10th of Ramadan.

Table 4.2-1 provides summary data on the geographical coverage and administrative units contained within the Study Area. In this table, the Governorate of Sharqiyah is not included as only the 10th of Ramadan city is located in the Sharqiyah Governorate.

The table indicates that the Study Area covers a high percentage (96 %) of the total population of the three main Governorates covered by the Study. This implies that any analysis of socioeconomic characteristics studied at the Governorate level will be fully represent the entire Study Area. The main advantage of this geographic feature is obvious: a number of statistical data are only available at Governorate level; for some analysis the use of statistics on Governorate level would simplify work procedures. It should be noted that there are some discrepancies between official data sources, e.g. the population of Cairo Governorate is given as 6.79 million from some sources whilst from

CAPMAS the calculated figure is 6.80 million. However, it must be considered that these differences are nominal.

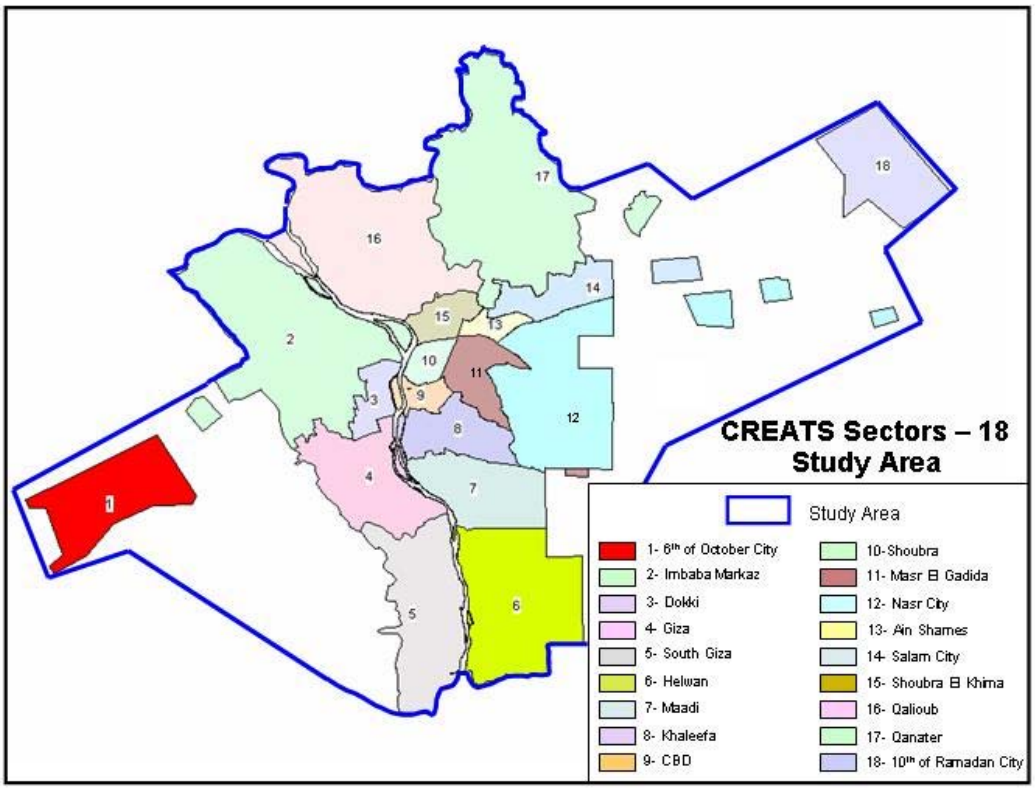


Figure 4.2-1 CREATS Master Plan Study Area

Table 4.2-1 Study Area and Coverage of Administrative Units

	Cairo	Giza	Kalyobeya	Total
Population in 1996 census ('000s), Greater Cairo Region	6,790	4,779	2,081	13,650
Study Area				
Population in 1996 census ('000s)	6,801	3,975	2,328	13,103
% of each Govern.	100%	83%	87%	96%
No of qism / markaz	38	14	7	59
No. of shiakhas village	292	144	94	530
Total Population in 1996 census including 10th of Ramadan (Governorate of Sharqiyah)				13,151 (96%)

Source: CREATS Master Plan

4.3 DEMOGRAPHY

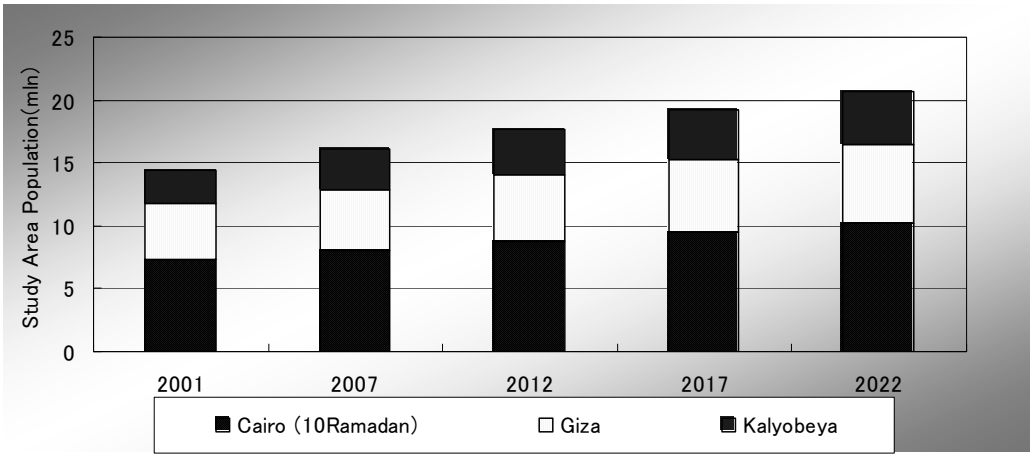
4.3.1 Demography Composition

Based on the forecasts of Cairo Demographic Center (CDC), CREATS prepared the projected population data for the traffic model forecast years shown in Table 4.3-1 and in Figure 4.3-1 taking into account the Study Area boundaries.

Table 4.3-1 Forecast Population, 2007-2022

Forecast Population					
Govenorate	2001	2007	2012	2017	2022
Cairo	7,364	8082	8,730	9,452	10,241
Giza	4,385	4,766	5,276	5,753	6,189
Kalyobeya	2,642	3,294	3,652	3,973	4,274
Total	14,391	16,142	17,658	19,178	20704
Annual Growth Rates					
Govenorate	2001-07	2007-12	2012-17	2017-22	2001-22
Cairo	1.56%	1.55%	1.60%	1.62%	1.58%
Giza	1.40%	2.05%	1.75%	1.47%	1.65%
Kalyobeya	3.74%	2.08%	1.70%	1.47%	2.32%
Total	1.93%	1.81%	1.67%	1.54%	1.75%

Source: CREATS Master Plan

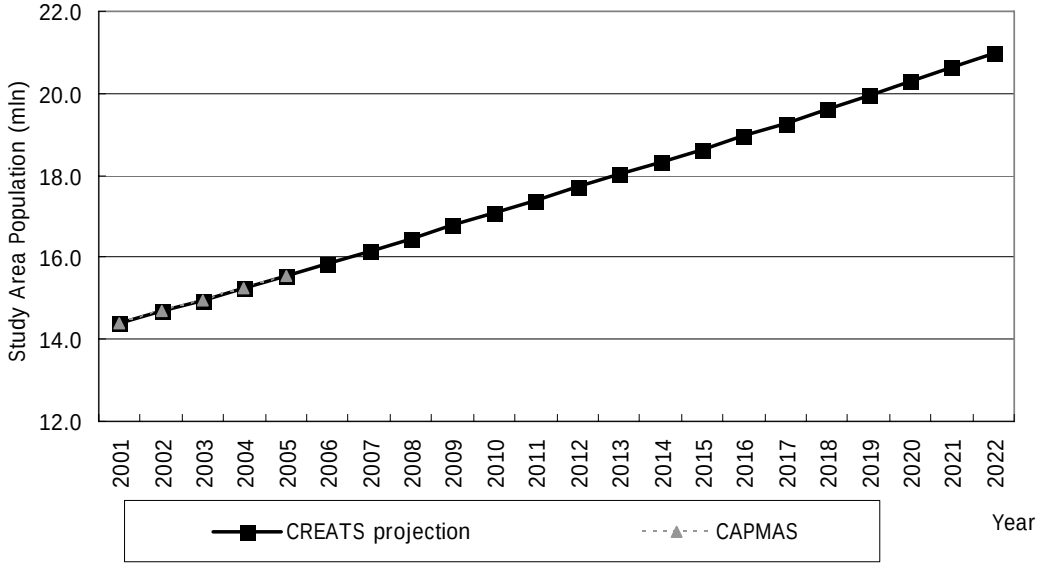


Source: CREATS Master Plan

Figure 4.3-1 Forecast Population, 2007-2022

To verify the CREATS projected population data, it is compared with estimated population data in CAPMAS Year 2001- 2005 statistics, as the latest population census was conducted in 1996 and next population census will be conducted in 2006. The estimated population data in CAPMAS Year 2001 - 2005 statistics are applied for comparison and verification purposes.

As shown in Figure 4.3-2, CREATS study area population projection in 2001 – 2005 fit the estimated CAPMAS statistical data.



Data Source: CAPMAS Year book 2001-2004, CAPMAS data 2005, and CREATS Master Plan

Figure 4.3-2 Forecast Population of CREATS and CAPMAS

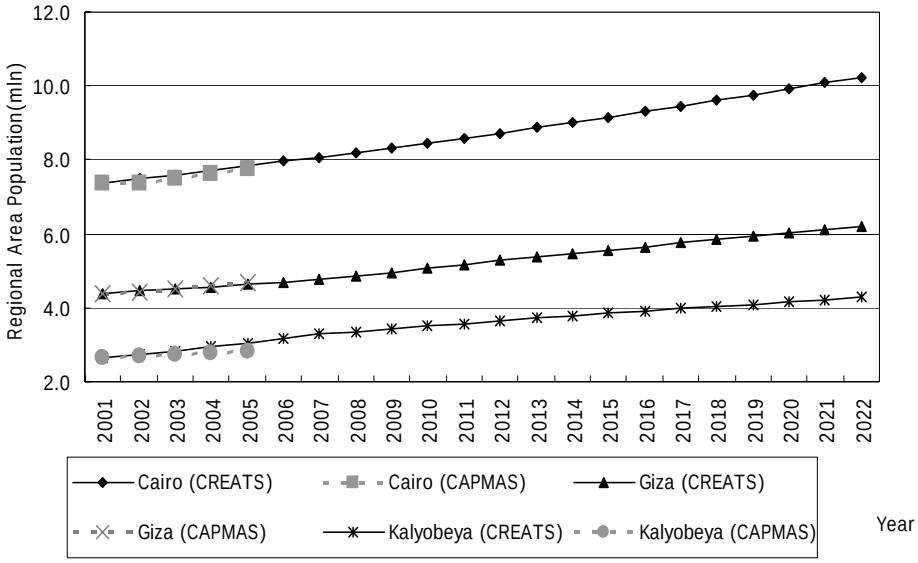
Regional (Cairo, Giza, Qalyobeya) population data shown in Figure 4.3-3, population projection in Cairo and Giza fit the estimated CAPMAS statistical data. Though CREATS projection data in Qalyobeya is a little higher than CAPMAS data, it is no significant difference.

Based on this analysis, population growth factor in the future forecasted by CREATS, follows the present conditions and it is not necessary to modify the population framework now.

4.3.2 Population Distribution

Table 4.3-2 shows the population, annual growth rate and density of zones in the Study Area. In addition, Figures 4.3-4 and 4.3-5 show population maps in 2001 and 2022 in which it is clear that high population areas will extend from center to the suburbs in the east and west. It can be noticed that:

- The cities of high population growth rate are 6th of October City, Nasr City and 10th of Ramadan City. Especially, it was formulated by CREATS that new communities as 6th of October City, 10th of Ramadan City will drastically be developed.



Data Source: CAPMAS Year book of 2001-2004, CAPMAS data 2005, and CREATS Master Plan

Figure 4.3-3 Regional Forecast Population, CREATS Master Plan, and CAPMAS Population Data

- The cities of high population density are Ain Shams, Shobra and Shobra El-Kheima, which are located in north areas of CBD. Doqy beside River Nile is very high density area too.

Table 4.3-2 Study Area Population Forecast 2007-2022

No.	Sector	Population ('000)				Average Annual Growth Rate			Population Density per km2			
		2001	2007	2012	2022	2001-07	2007-12	2013-22	2001	2007	2012	2022
1	6th of Octorber City	200	332	512	1,165	8.8%	9.1%	8.6%	2,300	3,800	5,800	13,200
2	Imbaba Markaz	1,295	1,387	1,503	1,656	1.1%	1.6%	1.0%	4,500	4,800	5,200	5,800
3	Doqy	1,202	1,262	1,336	1,434	0.8%	1.2%	0.7%	45,300	47,500	50,300	54,000
4	Giza	1,245	1,327	1,423	1,554	1.1%	1.4%	0.9%	11,800	12,600	13,500	14,700
5	South Giza	443	477	519	575	1.2%	1.7%	1.0%	3,200	3,500	3,800	4,200
6	Helwan	739	832	918	1,134	2.0%	2.0%	2.1%	4,300	4,800	5,300	6,600
7	Maadi	869	910	941	995	0.8%	0.7%	0.6%	10,000	10,500	10,800	11,400
8	Khaleefa	733	779	814	877	1.0%	0.9%	0.7%	12,600	13,400	14,000	15,100
9	CBD	401	433	456	498	1.3%	1.0%	0.9%	23,600	25,500	26,800	29,300
10	Shobra	1,072	1,121	1,153	1,218	0.7%	0.6%	0.6%	59,600	62,300	64,000	67,700
11	Masr El Gedeeda	862	922	968	1,052	1.1%	1.0%	0.8%	18,300	19,600	20,600	22,400
12	Nasr City	724	861	1,117	1,914	2.9%	5.3%	5.5%	3,600	4,300	5,500	9,500
13	Ain Shams	992	1,027	1,054	1,104	0.6%	0.5%	0.5%	66,100	68,500	70,200	73,600
14	Salam City	777	843	895	991	1.4%	1.2%	1.0%	14,900	16,200	17,200	19,100
15	Shobra El-Kheima	939	1,159	1,264	1,262	3.6%	1.8%	0.0%	33,500	41,400	45,200	45,100
16	Qalyob	760	938	1,024	1,116	3.6%	1.8%	0.9%	3,400	4,200	4,600	5,000
17	Qanater	943	1,212	1,379	1,601	4.3%	2.6%	1.5%	3,400	4,400	5,000	5,800
18	10th of Ramadan City	196	278	373	576	6.0%	6.0%	4.4%	5,200	7,300	9,800	15,200
Total		14,391	16,142	17,658	20,794	1.9%	1.8%	1.6%	7,700	8,600	9,400	11,100

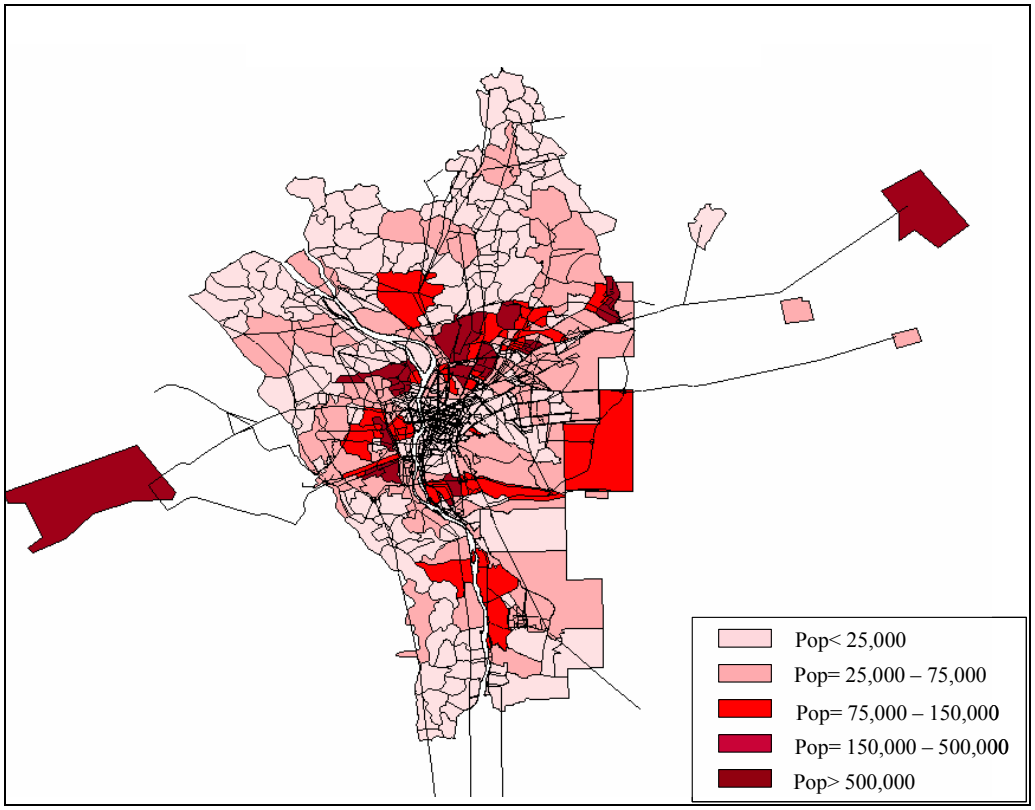


Figure 4.3-4 Population Density Map (pop/km^2) – Year 2001

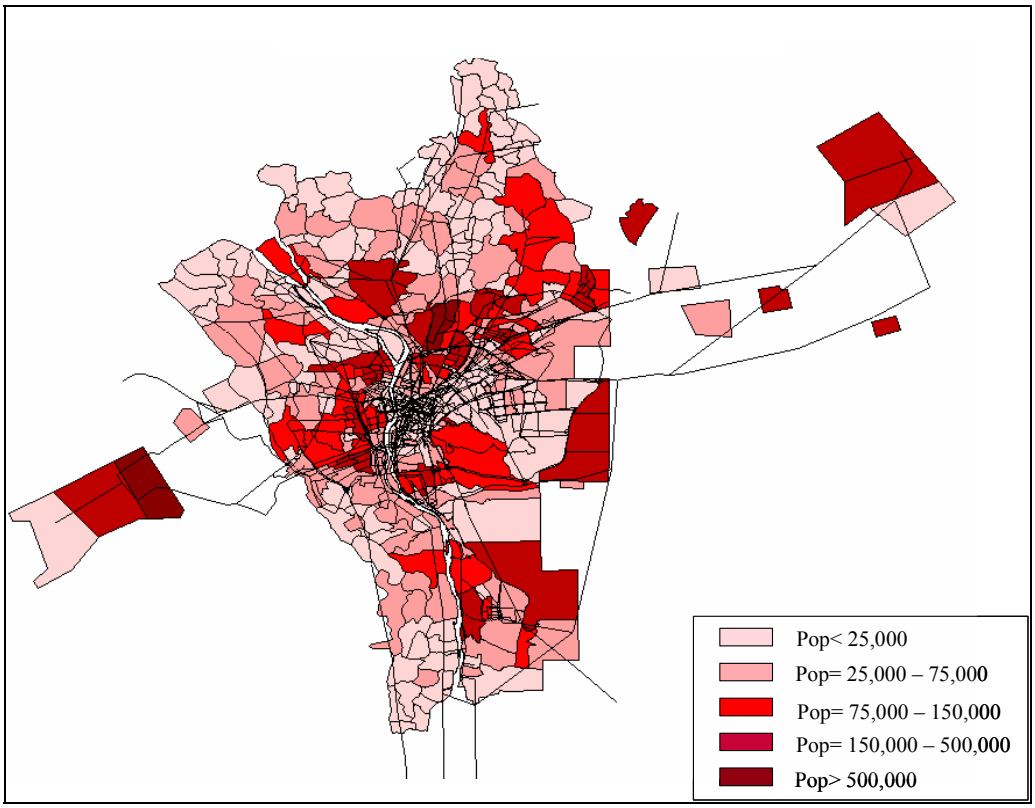


Figure 4.3-5 Population Density Map (pop/km^2) – Year 2022

4.4 GROSS DOMESTIC PRODUCTS

CREATS prepared three economic growth scenarios: high, medium and low due to the uncertainties regarding the long-term growth (Table 4.4-1 and Table 4.4-2). CREATS finally applied the Medium Economic Growth Scenario then forecasted the future transport demand.

The real growth of GDP, IMF projection was compared with CREATS projection in the period 2001 – 2009, as illustrated in Figure 4.4-1.

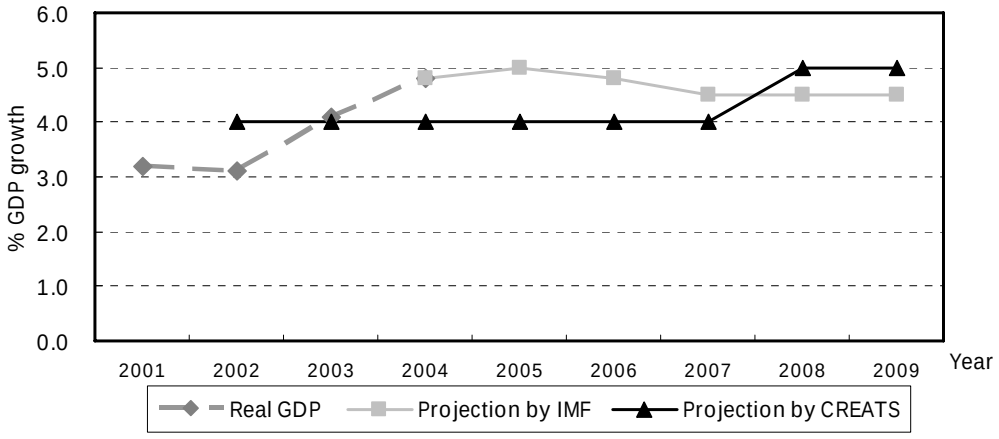
- Though real GDP in 2002 was 3.1 %, lower than projection GDP by CREATS, it became 4.1 % in 2003, the same level with CREATS projection.
- Annual GDP growth rate projected by IMF ranges between 4.5 % and 5.0 % from 2003 to 2009. This is about the same with that of CREATS projection in 2002- 07.
- Based on the 1996/97 prices, the real GDP, IMF projection and CREATS projection for the period 1999 – 2009 are illustrated in Figure 4.4-2.
- Projection GDP by CREATS fits the real GDP and projection GDP by IMF.

Based on these analyses, not only population growth factor but also economic growth factor in the future forecasted by CREATS follows the present conditions and it is not necessary to modify the socioeconomic framework proposed by CREATS.

Table 4.4-1 GDP Growth Rates, Economic Growth Scenarios, 2002-2022

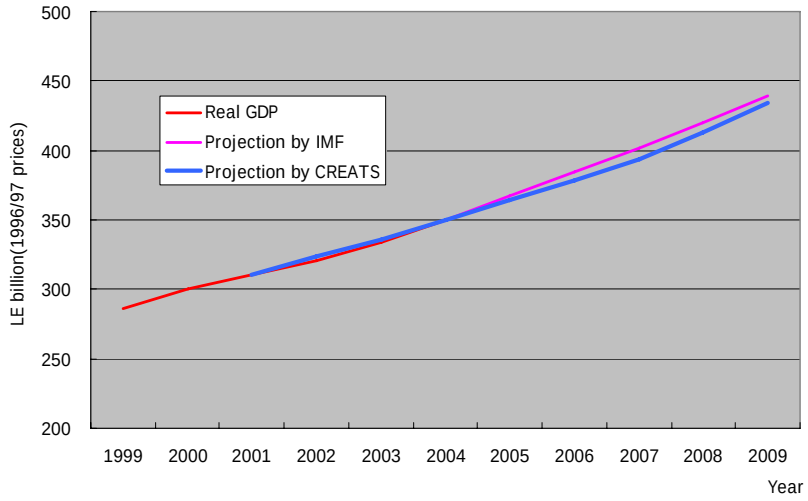
Growth scenario	2002-07	2008-12	2013-17	2018-22	2002-2022
High	4.6%	6.1%	6.5%	7.0%	6.1%
Medium	4.0%	5.0%	4.5%	4.5%	4.6%
Low	3.5%	4.0%	3.5%	3.5%	3.7%

Source: CREATS Master Plan



Data Source: CREATS Master Plan, International Monetary Fund

Figure 4.4-1 GDP Growth Rates, 2001-2009



Data Source: CREATS Master Plan, International Monetary Fund

Figure 4.4-2 GDP at Current (1996/97) Prices, 1999-2009

The three scenarios can be summarized as follows:

1) High Economic Growth Scenario

The high economic growth scenario is assumed on the basis of the government's vision for the period until 2017 as presented in Table 4.4-2. This required growth rates of 6.8% during the period 1997-2002, and 7.6% during the years 2003-17 shown in the below table. These are very high rates and difficult to sustain over a period of 20 years. No country has achieved this in recent history although both China and India have recorded some impressive performance. This target is unlikely to be met for the year ending 2002. It is, however, important to retain this growth strategy as one of the scenarios, particularly because the investment strategy of the government will be based on trying to achieve these high growth figures. However, and in order to reflect recent past performance and the still unstable world economy, it is proposed that growth would be less over the period 2002-12, rising from 4.6% in the first part to 6.1% in the years leading up to 2012. Thereafter, higher 5 year annual growth rates are postulated, 6.5% and 7% respectively.

This scenario would require both high public and private sector spending, a stable exchange rate regime and no major world economic downturns. The overall growth rate over the period would be a highly respectable 6.1% per annum.

Table 4.4-2 Main Indicators & Targets of Egyptian Government's Vision 2017

Items	1996 (actual)	Egypt Long Term Targets (2017)	
		In 2017	Assumptions
1. Inhabited area:	5.5% of total area or 55,000km^2	25% of total area or 250,000km^2	
2. Population:	59 million	80 million	Growth rate: Annual average 1.5%
3. GDP growth GDP growth rate	LE 256 billion 4.8% during the last 15 years	LE 1,100 billion Average 7.6 % per years	
4. Employment	15.8 million	27 million	500,000 new jobs per year
5. International tourism: Arrivals: No. of rooms required:	 4 million 76,000	 27 million 600,000	Growth rate: 10% per year

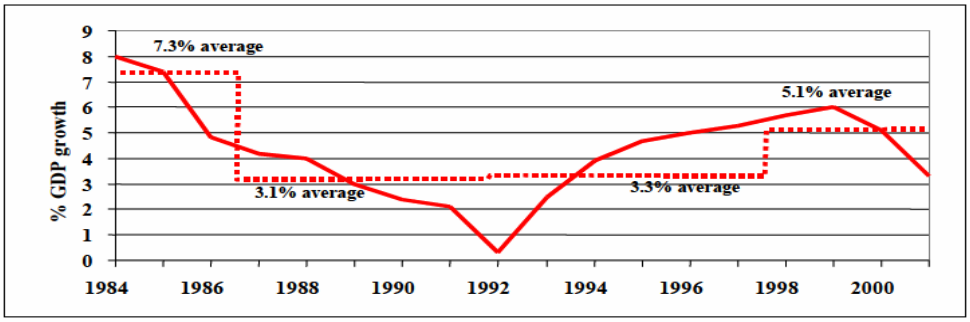
Source: Egypt and 21st Century, Cabinet 1997. Statistical Yearbook for actual data.

2) Medium Economic Growth Scenario

The medium economic growth scenario is assumed lower growth over the next couple of years but also assumed that the effects of the privatization program will form the foundation of further economic growth for later years. Because the privatization program is not so dramatic in Egypt, it is assumed that this slowing economic growth will take place at a later date. Therefore five year growth rates of 4%, 5%, 4.5% and 4.5% respectively are assumed by CREATS. Nevertheless, economic growth over the entire forecast period is still a reasonable 4.6% and is only just lower than growth seen in the last five years, because of the events of September 11th, particularly on foreign travel and tourism.

3) Low Economic Growth Scenario

This growth scenario is taken the assumptions that recovery will come later and that the privatization program, and its effects, will be much less significant. It is also assumed that these effects will decrease over time. This leads to growth rates of 3.5%, 4%, 3.5% and 3.5%. The overall growth rate is 3.7%. These are just above the growth rates seen between the mid 1980's and 90's.



Annual GDP Growth Rate of National Economy, 1984-2001

4.5 HOUSEHOLD INCOME

Based on the economic growth rate and the forecast population, the average monthly household income can be estimated. As projected, these factors by CREATS will not change in this study. The future household income estimation for this study is shown in Table 4.5-1.

Table 4.5-1 Future Average Household Income in Constant 2001 Prices

	2001	2007	2012	2017	2022
Average household income (LE per month)	672	754	879	1,006	1,176
Factor increase on year 2001	*1.00*	*1.13*	*1.31*	*1.50*	*1.73*

Source: CREATS Master Plan

The monthly household income distribution maps in 2001 and 2022 are illustrated in Figures 4.5-1 and 4.5-2. The forecast shows that higher income area will spread around the area from Giza to Masr El Gedeeda, Ain shams and Salam City.

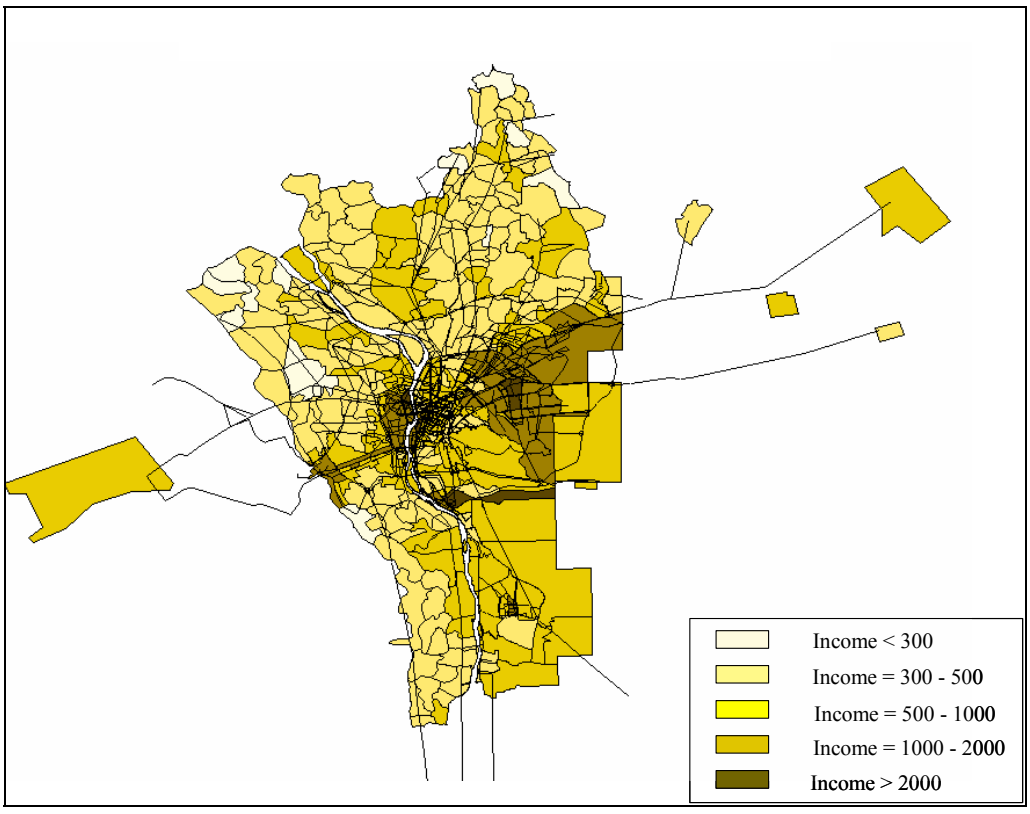


Figure 4.5-1 Monthly Household Income Distribution Map – Year 2001

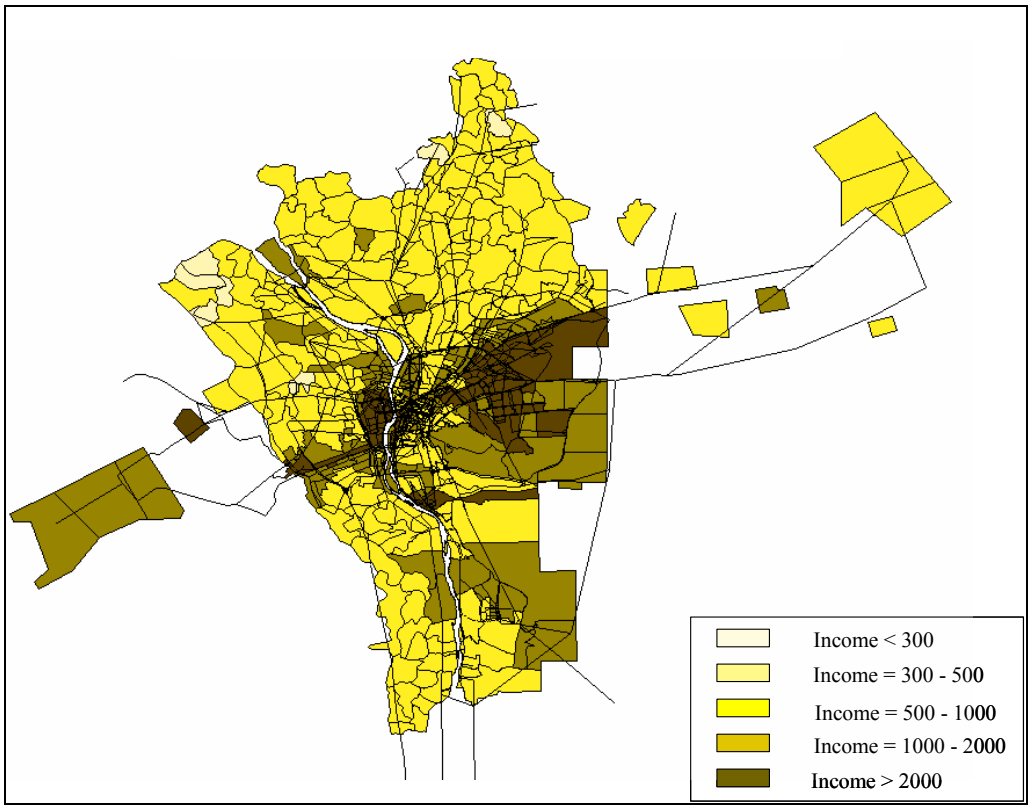
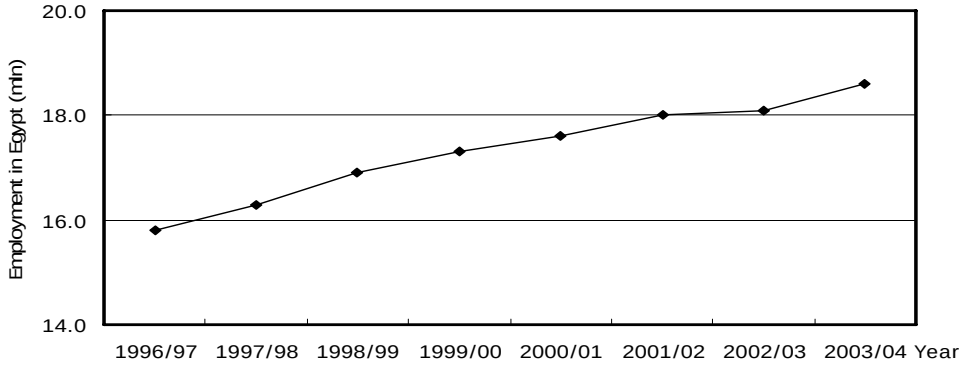


Figure 4.5-2 Monthly Household Income Distribution Map – Year 2022

4.6 EMPLOYMENT

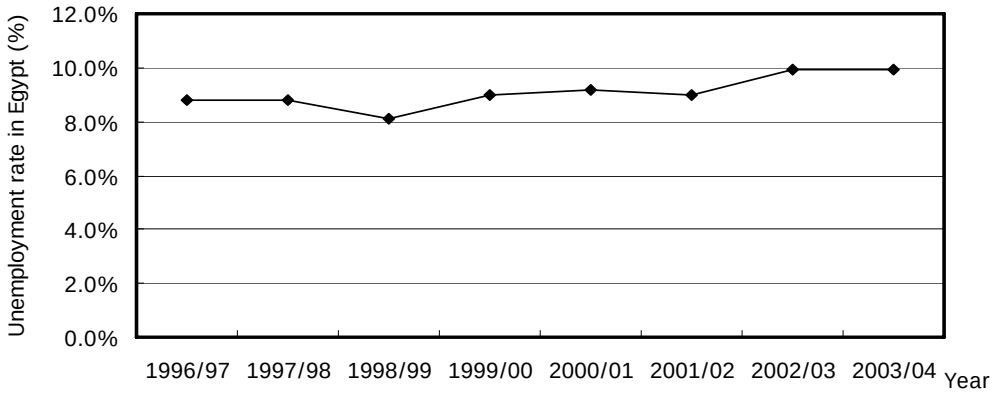
1) Employment in Egypt

Annual employment in Egypt is illustrated in Figure 4.6-1. In Year 2003/04, total employment is 18.6 millions and annual average growth rate (1996/97- 2003/04) is 2.4%. Unemployment rate keeps higher than 8.0% during 1996/07 and 2003/04 illustrated in Figure 4.6-2.



Source: Quarterly Economic Digest January – March 2005

Figure 4.6-1 Number of Employment in Egypt



Source: Quarterly Economic Digest January – March 2005

Figure 4.6-2 Unemployment Rate in Egypt

2) Employment in Study Area

Under the medium economic growth scenario, the average annual employment growth rates, by sector, are anticipated to be as follows;

GDP growth (medium growth scenario)	4.6%
Primary sector, average annual employment growth	0.5%
Secondary sector, average annual employment growth	2.7%
Tertiary sector, average annual employment growth	2.8%
Total, all sectors, average annual employment growth	2.7%

Based on these growth percentages, employment by sector, for the traffic model target years, are shown in Table 4.6-1.

Table 4.6-1 Employment, 2007-2022, Medium Economic Growth Rates

	2001	2007	2012	2022
Total population	14,391,987	16,097,798	17,649,144	20,721,173
Primary employed	154,762	159,463	163,490	171,851
Secondary employed	1,382,324	1621932	1,853,040	2,418,741
Tertiary employed	2,449,890	2,891,381	3,319,486	4,375,241
Total employed	3,986,976	4,672,776	5,336,016	6,965,833

Source: CREATS Master Plan

Working place employment density in 2001 and 2022 are illustrated in Figures 4.6-3 and 4.6-4. The figures show that employment density will concentrate in the central of Cairo more than now.

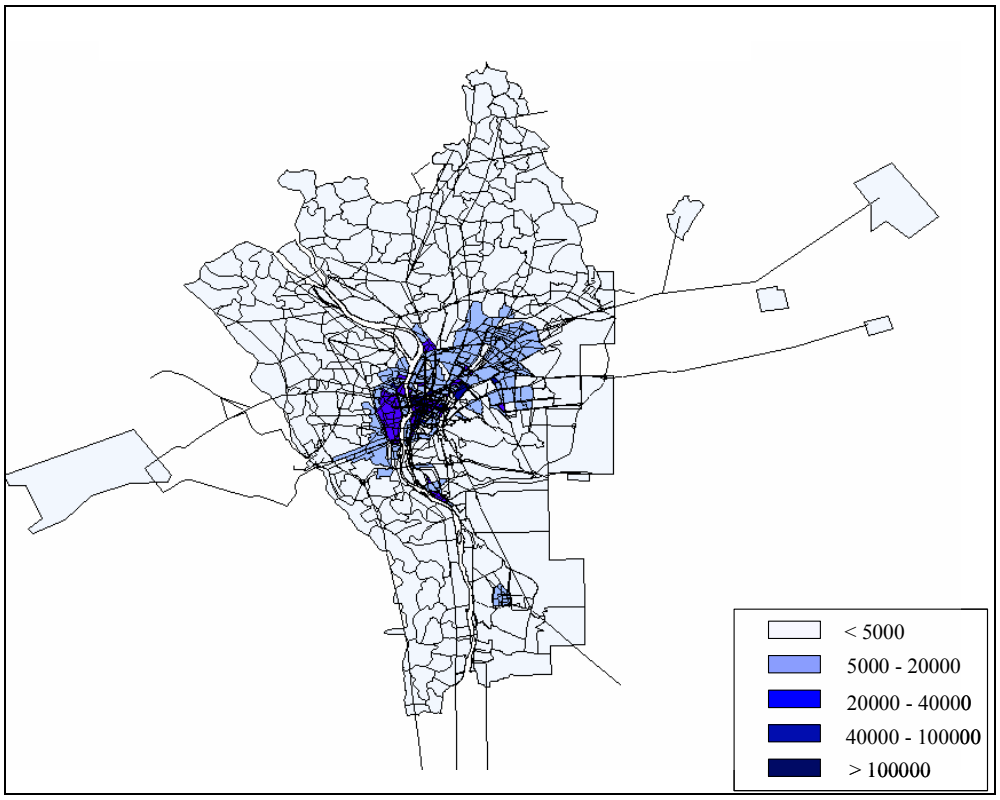


Figure 4.6-3 Working Place Employment Density Map -2001-

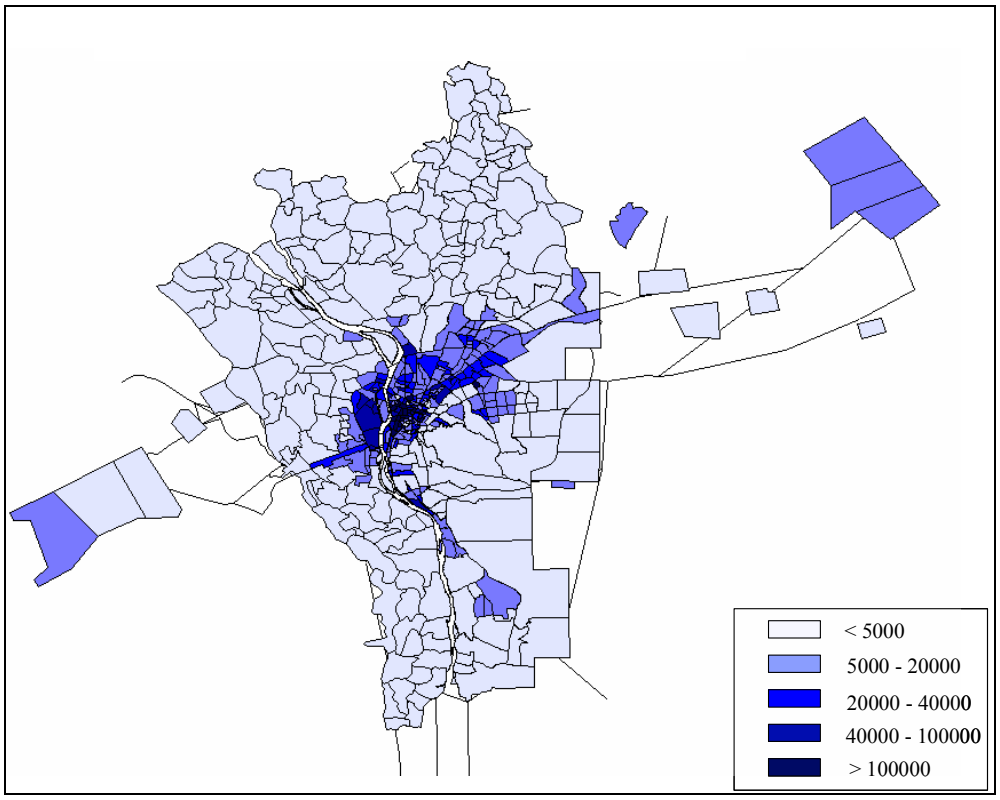


Figure 4.6-4 Working Place Employment Density Map -2022-

4.7 LAND USE

4.7.1 General

There is no updated land use plan for the Study Area since CREATS Master Plan, and this section is a review for the present planning. Appendix 2.1 provides some information on the previous urban plans of Greater Cairo Region.

4.7.2 Physical Planning Law No. 3/1982

The General Organization for Physical Planning (GOPP) was established under the Ministry of Housing, Utilities and Communities in 1973 as the national entity responsible for physical planning in Egypt at the regional, provincial, urban and rural levels. The GOPP has a key mission to propose physical and urban development policies and supervise the implementation in coordination with all relevant authorities at the national, regional and local levels. The GOPP is also mandated to establish norms and standards for industrial and urban agglomerations and develop sustained technical advice, training and human resource management to local governments.

As a legislative framework for the regional development planning in Egypt, the Physical Planning Law No. 3/1982 was established to stipulate the contents, presentation procedures and accreditation of general and detailed plans, land subdivisions and district renewals, as well as expropriations and penalties for violations. Based on the legal framework, the GOPP has launched a number of regional development plans such as: 1) Development Map of Egypt 2017; 2) Development Strategy of Sinai 2017; 3) Delta Region Development Plan; 4) Development Strategy of Upper Egypt Region; 5) Suez Canal Regional Development Plan; 6) Development Strategy of Assiut Region; 7) Establishment of a National Hazardous Waste Management System; and 8) Greater Cairo Master Plan.

Needless to say, the Greater Cairo Master Plan (GCMP), as shown in Figure 4.7-1, is relevant to this study. Nowadays, the up-dated GCMP was revised in 1997, and highlights some key elements to structure the Greater Cairo Region, viewing a wider spatial framework.

4.7.3 General Policy Directions of GCR Master Plan

Towards a sustainable economic growth and improvement of the living conditions, the GCMP articulates five (5) key objectives:

- Protect arable land, while providing a better industrial location strategy;
- Improve public transportation, while facilitating infrastructure network;
- Protect historical heritage, controlling informal urban expansion;
- Provide alternatives to informal settlements, encouraging de-concentration of Greater Cairo Region; and
- Protect water resources with controlling pollution and noise resources.

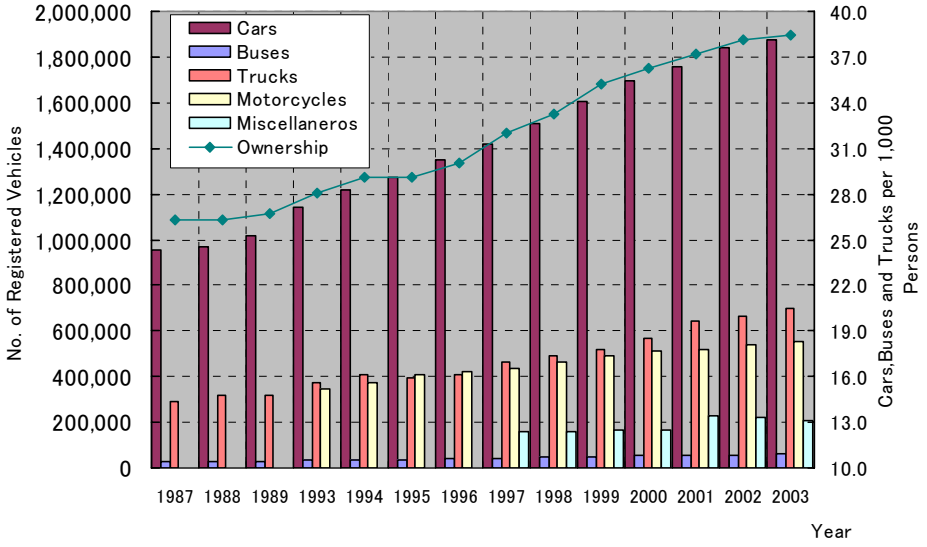
For delineation of area-wise development strategies, the GCMP has applied a unique planning concept of “Homogenous Sectors” that is regarded as an area-wise planning Homogeneous Sectors, each of which accommodates about 1 to 2 million inhabitants and plans to be self-sustainable or autonomous unit in terms of urban services and job opportunities. A population decentralization policy has been guided for these Homogenous Sectors. The GCMP aims to decentralize the inner sectors towards the new settlement areas outside the ring road. Although the Homogeneous Sectors of the central Cairo areas have been actually decreasing the population, the surrounding urban areas even within the ring road still show an increasing trend in the population.

4.8 VEHICLE OWNERSHIP

This section describes the recent trends and patterns related to vehicle ownership in Egypt as well as in Greater Cairo Region.

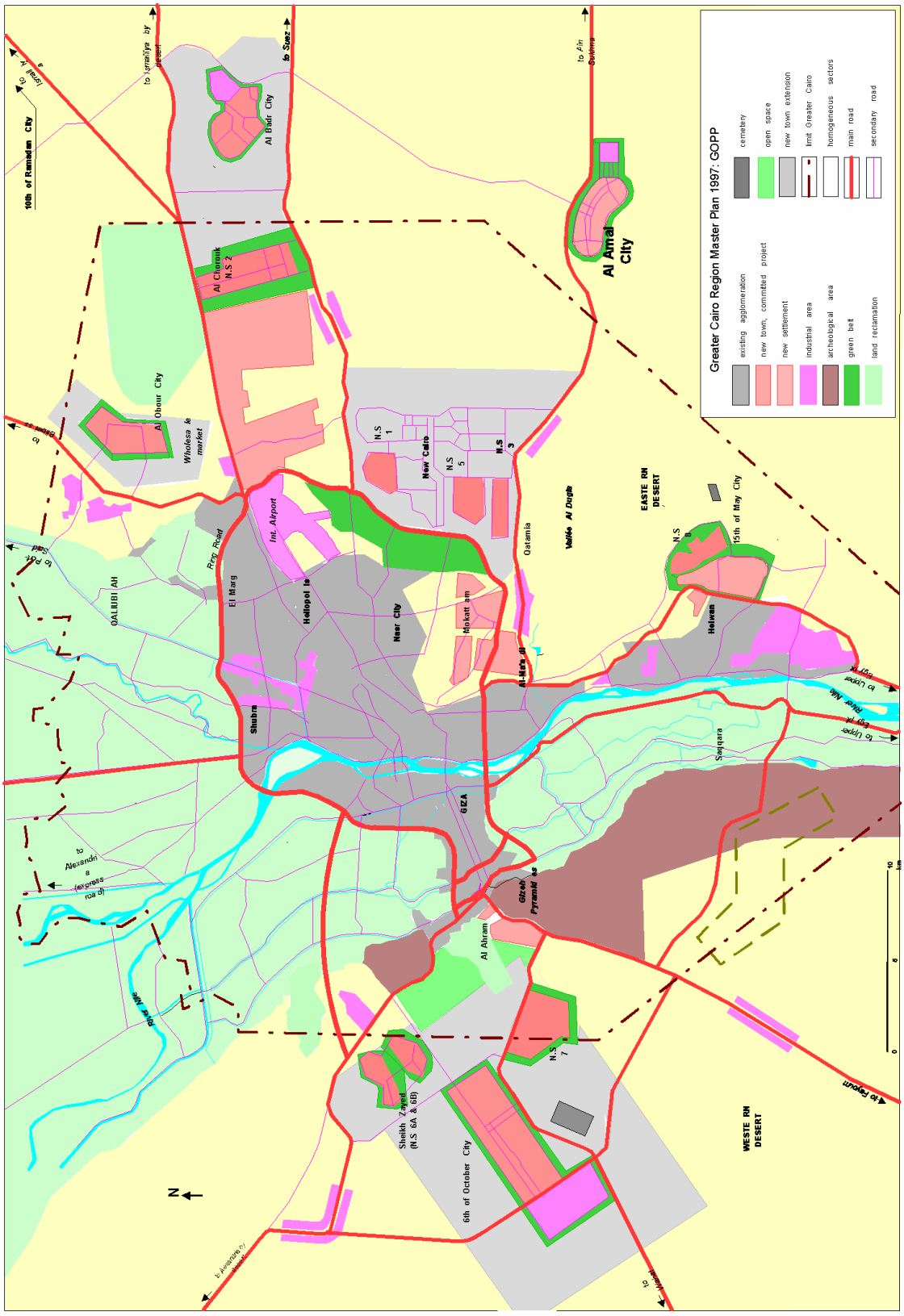
4.8.1 National Trends

Vehicle ownership in Egypt grew from 1.29 million vehicles in the year 1987 to an estimated 2.8 million cars, buses and trucks in year 2003. During that period, car ownership has dominated, averaging some three-quarters of car, bus and truck registrations. Trucks account for almost all remaining registrations, with buses only contributing to some of two percent toward the registered fleet. Over the same period, unit ownership of cars, buses and trucks increased from 26.4 vehicles per 1,000 persons to 38.5 vehicles per 1,000 persons (Figure 4.8-1).



Data Source: The World Bank, International Road Federation and the Statistical Yearbook between 1992 and 2004, Government of Arab Republic of Egypt, annual publications.

Figure 4.8-1 Recent Vehicle Ownership Trends in Egypt



Source: GOPP

Figure 4.7-1 Greater Cairo Region Master Plan 1997 by GOPP

4.8.2 Regional Trends

The number of four categories of vehicles in Cairo, Giza and Qalyobeya reaches 1.3 millions in 2003. Almost a half of Egyptian vehicles are registered in Cairo, Giza and Qalyobeya Governorates. But the average annual growth rate of 2.9% for cars in Cairo is not high compared with that of Egypt (Table 4.8-1).

Table 4.8-1 Comparison of Year 1999 and 2003 Regional Vehicle Ownership (Vehicles)

	Governorate	Cars	Buses	Trucks	Misc.	Total	M.cycles
Year 1999 No. of Vehicle Ownership	Cairo	650,051	17,425	105,314	59,052	*831,842*	103,867
	Giza	239,023	4,246	45,562	10,141	*298,972*	44,203
	Kalyobeya	34,320	2,247	20,360	3,945	*60,872*	34,500
	Subtotal	**923,394**	**23,918**	**171,236**	**73,138**	**1,191,686**	**182,570**
	Alexandria	263,923	9,604	66,394	17,319	*357,240*	17,301
	Rest of Egypt	417,685	13,902	292,266	73,132	*796,985*	285,428
	Total	**1,605,002**	**47,424**	**529,896**	**163,589**	**2,345,911**	**485,299**
Year 2003 No. of Vehicle Ownership	Cairo	729,332	23,733	91,465	65,675	*910,205*	111,223
	Giza	266,234	7,413	60,108	13,023	*346,778*	50,932
	Kalyobeya	44,185	3,427	30,047	3,897	*81,556*	42,831
	Subtotal	**1,039,751**	**34,573**	**181,620**	**82,595**	**1,338,539**	**204,986**
	Alexandria	319,557	10,143	85,997	30,727	*446,424*	17,929
	Rest of Egypt	518,080	17,402	433,438	92,789	*1,061,709*	330,195
	Total	**1,877,388**	**62,118**	**701,055**	**206,111**	**2,846,672**	**553,110**
Annual Average Growth Rate of vehicle Ownership (1999-03)	Cairo	2.9%	8.0%	-3.5%	2.7%	*2.3%*	1.7%
	Giza	2.7%	14.9%	7.2%	6.5%	*3.8%*	3.6%
	Kalyobeya	6.5%	11.1%	10.2%	-0.3%	*7.6%*	5.6%
	Subtotal	**3.0%**	**9.6%**	**1.5%**	**3.1%**	***2.9%***	**2.9%**
	Alexandria	4.9%	1.4%	6.7%	15.4%	*5.7%*	0.9%
	Rest of Egypt	5.5%	5.8%	10.4%	6.1%	*7.4%*	3.7%
	Total	**4.0%**	**7.0%**	**7.2%**	**5.9%**	***5.0%***	**3.3%**

Source: The Statistical Yearbook
Note: The Study Area of Greater Cairo does not include all the Governorates of Giza and Kalyobeya.

Table 4.8-2 shows the unit vehicles ownership in region base in the years 1999 and 2003

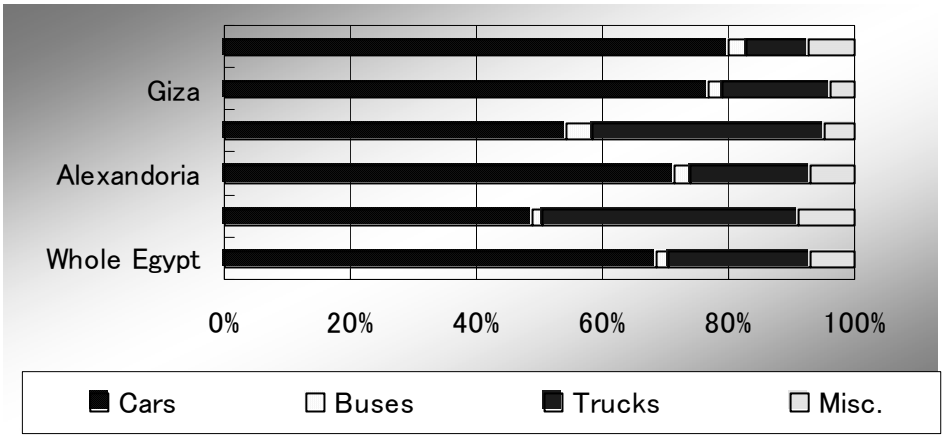
- Though unit ownership in Cairo is very high, averaging 95.6 cars per 1,000 persons, that in the rest of Egypt is quite low, averaging only 10.8 cars per 1,000 persons in the year 2003.
- Unit ownership in Egypt is 27.3 cars per 1,000 persons, 41.5 vehicles in total per 1,000 persons, and 8.1 motorcycles per 1,000 persons in the year 2003.

Table 4.8-2 Comparison of Year 1999 and 2003 Regional Unit Vehicle Ownership
(Vehicles per 1,000 Persons)

	Governorate	Cars	Buses	Trucks	Total	M.cycles
Year 1999 Unit Vehicle Ownership	Cairo	91.1	2.4	14.8	*108.3*	14.6
	Giza	47.4	0.8	9.0	*57.2*	8.8
	Kalyobeya	10.0	0.6	5.8	*16.4*	9.9
	Subtotal	**59.0**	**1.5**	**10.9**	***71.4***	**11.7**
	Alexandria	75.0	2.7	18.9	*96.6*	4.9
	Rest of Egypt	9.6	0.3	6.7	*16.6*	6.6
	Total	**25.7**	**0.8**	**8.5**	***35.0***	**7.8**
Year 2003 Unit Vehicle Ownership	Cairo	95.6	3.1	12.0	*110.7*	14.6
	Giza	48.1	1.3	10.9	*60.3*	9.2
	Kalyobeya	11.6	0.9	7.9	*20.4*	11.3
	Subtotal	**61.3**	**2.0**	**10.7**	***74.0***	**12.1**
	Alexandria	85.1	2.7	22.9	*110.7*	4.8
	Rest of Egypt	10.8	0.4	9.0	*20.2*	6.9
	Total	**27.3**	**0.9**	**10.2**	***38.5***	**8.1**

Vehicle compositions of ownership in region base are illustrated in Figure 4.8-2.

- The ratio of cars in Cairo and Giza are very high, each 80% and 77%.
- In Qalyobeya, the ratio of trucks is 37%, higher than that of Cairo and Giza.



Source: The Statistical Yearbook, 2004

Figure 4.8-2 Comparison of Regional Vehicle Ownership – 2003

4.9 FUTURE SOCIOECONOMIC FRAMEWORK

4.9.1 Characteristics of Socioeconomic Profile

(1) Demography

- The population in CREATS Study Area is 14.9 millions in 2001 and 20.7 millions in 2022. The average annual growth rate for 2001 - 2022 is 1.75%.
- The projected populations in CREATS Study Area in 2001 – 2005 fit the estimated CAPMAS statistical data. (See Figure 4.3-2)
- Regional population projections in Cairo and Giza fit the estimated CAPMAS statistical data. Though CREATS projection data in Qalyobeya is a little higher than CAPMAS data, the difference is not significant. (See Figure 4.3-3)
- There are no major changes that affected zonal population, especially in the new cities.
- Future population estimation process in both CREATS and CAMPAS is based on the census of 1996, with the next census in 2006.

(2) Gross Domestic Products

- CREATS prepared three economic growth scenarios, then finally applied the Medium Economic Growth Scenario, in which the growth rate is estimated at 4.0 % (2001-2007), 5.0 % (2008-2012) and 4.5 % (2013-2022).
- GDP growth rate projected by CREATS fits with real GDP (2002-2004)

- GDP growth rate projected by IMF for 2004 - 2009 is between 4.5 - 5.0%. It is approximately the same with that of CREATS projection 2004-2009. (See Figure 4.4-1)
- GDP projected by CREATS fits the real GDP and GDP projected by IMF (See Figure 4.4-2).

(3) Household Income

- Based on the forecast economic growth rate and the population, the average monthly household income was estimated by CREATS.
- The average monthly household income is 672LE in 2001 and 1,176LE in 2022.

(4) Employment

- Annual average growth rate of employment in Egypt (1996/97 – 2003/04) is 2.4%. Unemployment rate in Egypt during 1996/67 – 2003/04 remains above 8%. These two indicators have not substantially changed in the last ten years.
- Under the medium economic growth scenario of CREATS, annual average employment growth rate is 2.7%. Total employment is 4.0 millions in 2001 and 7.0 millions in 2022.

(5) Land Use

- There is no updated land use plan for the Study Area since CREATS Master Plan. The latest one is the up-dated Greater Cairo Mater Plan, which was revised in 1997,

(6) Vehicle Ownership Growth

- The growth rate of vehicle ownership (1999 -2003) in three governorates (Cairo, Giza and Qalyobeya) is 2.9 %. This value is lower than that in whole Egypt (5.0%).
- Unit ownership of Cairo is very high, averaging 95.6 cars per 1,000 persons, compared with that of whole Egypt, which is 27.3 cars per 1,000 persons.

Based on the analysis results, it is concluded that the future socioeconomic framework applied in CREATS Master Plan fits with the present conditions and it is not necessary to change the socio economic framework at this stage, which may affect the composition and schedule of CREATS M/P.

4.9.2 Future Socioeconomic Framework

Based on the findings presented above, this study follows the future socio-economic framework developed in CREATS, as well as the applied method of demand forecast as presented in Table 4.9-1. The future socioeconomic profile can be summarized as:

- Population of the study area is 14.4 millions in 2001 and expected to reach 20.7

millions in 2022.

- CREATS prepared three economic growth scenarios and adopted the medium economic growth scenario whose growth rate is 4.0% in 2001-2007, 5.0% in 2008-2012 and 4.5% in 2013-2022 as presented in Table 4.4-1.
- The average household monthly income is LE 672 in 2001 and LE 1,176 in 2022.
- Under the medium economic growth scenario of CREATS, the annual average employment growth rate is 2.7%. Total employment is 4.0 millions in 2001 and 7.0 millions in 2022.

Table 4.9-1 Future Socioeconomic Framework (Thousand)

Indicators	2001	2005	2007	2012	2022
1.Population					
(1) Cairo*	7,364	7,785	8,005	8,688	10,359
(2) Giza	4,385	4,646	4,783	5,294	6,384
(3) Qalyobeyya	2,642	3,070	3,309	3,667	3,978
(4) Study Area	14,391	15,501	16,098	17,649	20,721
2.Employment at Work place					
(1) Cairo*	2,533	2,811	2,961	3,367	4,350
(2) Giza	1,027	1,149	1,215	1,401	1,882
(3) Qalyobeyya	427	472	496	568	734
(4) Study Area	3,987	4,431	4,672	5,336	6,966
3.Student at School place					
(1) Cairo*	2,669	2,652	2,643	2,681	2,815
(2) Giza	1,548	1,632	1,682	1,715	1,859
(3) Qalyobeyya	796	870	817	855	904
(4) Study Area	5,013	5,098	5,142	5,251	5,588
4.Average Household Income (LE per month)	672	726	754	879	1,176

Note: *includes 10th of Ramadan City.

CHAPTER 5

FUTURE DEMAND FORECAST

CHAPTER 5

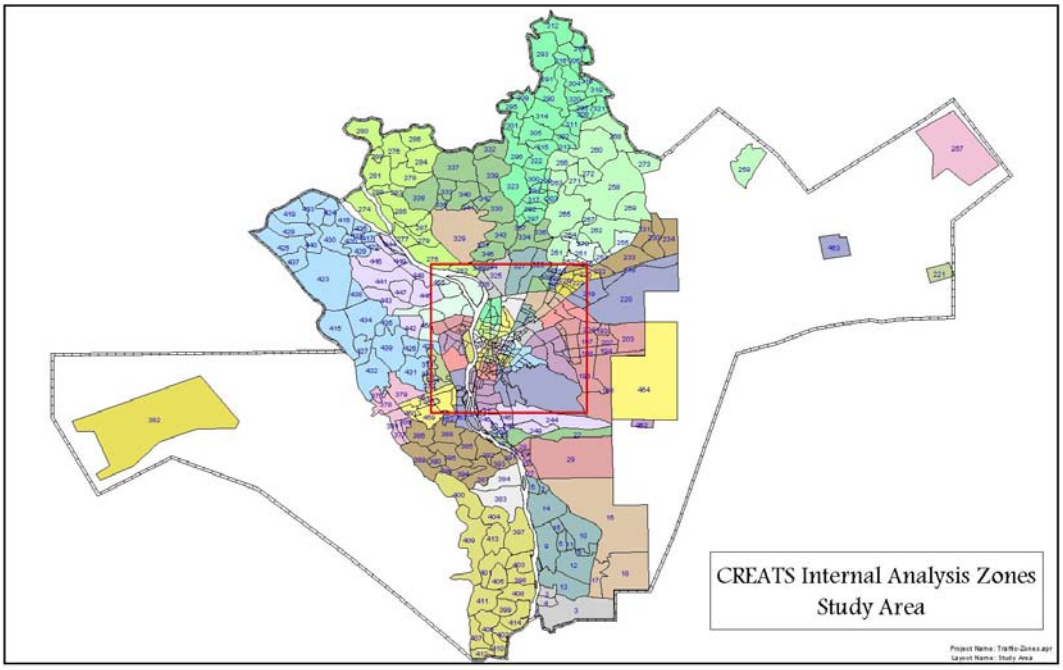
FUTURE DEMAND FORECAST

5.1 GENERAL

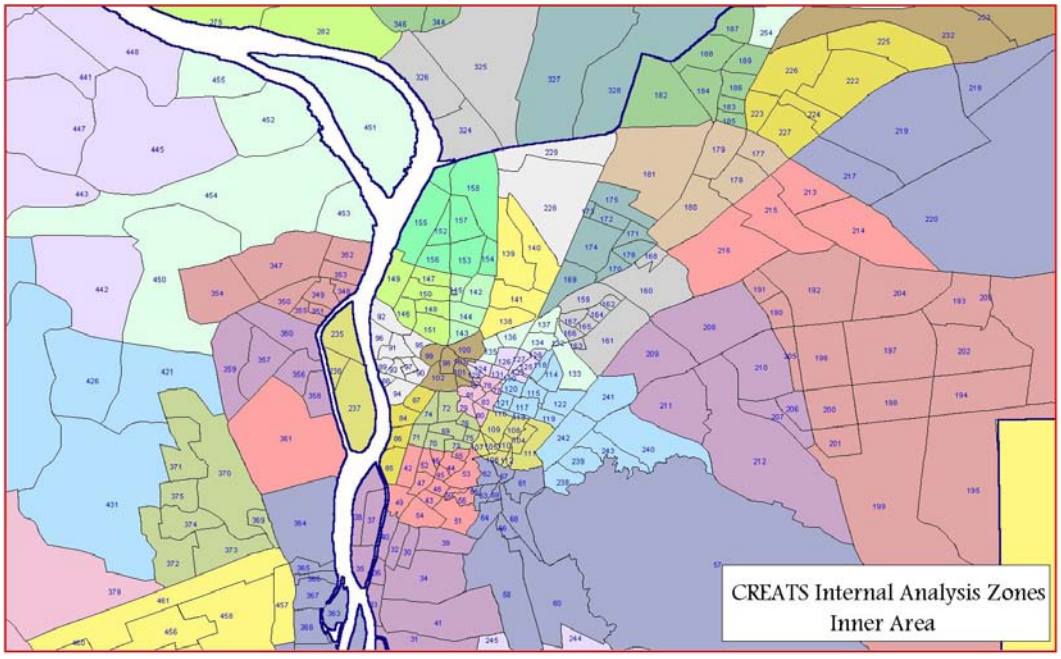
To estimate the traffic volumes on the planned expressway network, traffic count and willingness-to-pay interview surveys in Cairo Metropolitan area are conducted. Traffic count data are used to analyze the present traffic characteristics and to establish present OD tables by vehicle category. Willingness-to-pay interview data are used to conclude the diversion parameters of traffic assignment model on the expressways. Then, the forecasted person trips basic matrices of CREATS are converted as Future OD tables for the target years of 2012 and 2022 of vehicle category basis based on the results of traffic composition surveys. The major purpose of the comprehensive OD studies is to obtain information on existing movements of vehicles so that they can be modeled which can serve as vital information to the formulation of strategic plans and policies.

Traffic volumes are assigned first on the existing and future road networks without the proposed expressway network, which is "Without Project" case. Next, volume of traffic which will be handled on the expressway network in the future are determined, which is "With Project" case.

In this study, the traffic zone system established in CREATS, comprises part of the Governorates of Cairo, Giza, Qalyobeyya and Sharqiyah. Basically, there are 503 traffic zones, of which 464 are internal traffic zones, 10 are special generators, 19 are external stations and 10 are reserved for future development. In the future years of 2012 and 2022, there are 525 traffic zones because some of these reserved traffic zones have deployed special generators along the corridors linking the 6th of October and 10th of Ramadan cities. The zoning system is presented in Figure 5.1-1 (a and b) and in Appendix 5-1. For presentation purposes, the total numbers of zones are integrated into 18 larger zones (sectors).



a. Traffic Zoning in the Study Area



b. Traffic Zoning in the Inner Area

Figure 5.1-1 Traffic Zoning System

5.2 ESTABLISHMENT OF PRESENT AND FUTURE OD MATRIX

As described in Chapter 4, it is concluded that future socio-economic framework of CREATS Master Plan fits the present conditions (2001-2004) based on socio-economic review and it is not necessary to change the framework.

CREATS forecasted the traffic demand based on the Transport Model Framework presented in Figure 5.2-1. This method is commonly known as four-step model which has been widely-used and found to be highly reliable in many cities in the world. In this Study, the procedure as CREATS is applied to estimate the future OD matrix.

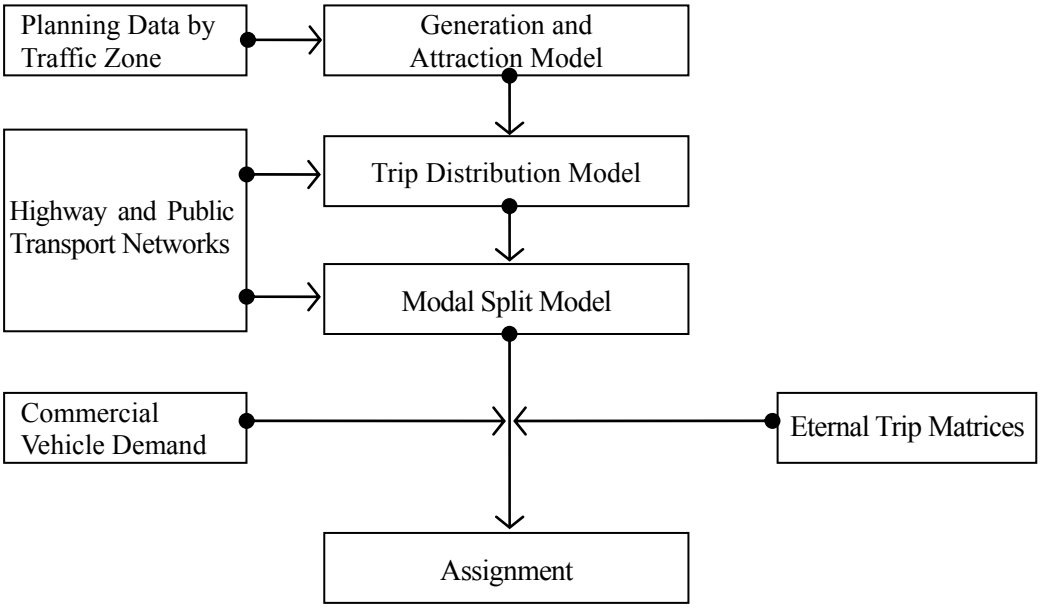


Figure 5.2-1 CREATS Transport Model Framework

CREATS OD matrices are person-trip base while vehicle base daily OD matrices are prepared under this Study in order to estimate the traffic demand on the expressways by vehicle category.

The established tables for vehicle daily OD trips have 4 types: Passenger Car, Taxi, Special Bus (Company Bus, School Bus) and Truck. Since Public Transport (including informal shared taxi) uses the specified ordinary route, public transport volumes are initially assigned for each link before highway transport assignment. The present daily OD matrix is prepared for the year 2005. This OD matrix is intermediate of 2001 OD matrix and 2007 OD matrix. Future OD matrices are prepared for the years 2012 and 2022. The estimated total numbers of trips for each of the 4 vehicle types are presented in Table 5.2-1, and graphically in Figure 5.2-2 for the years 2005, 2012 and 2022.

Table 5.2-1 Total Daily Trips by Vehicle Type (Thousand)

Year	Passenger Car	Taxi	S-Bus	Truck	Total
2005	2,367	675	78	364	3,484
2012	3,310	883	95	492	4,780
2022	5,146	1,223	122	659	7,150
Annual average growth rate (2005-2012)	4.9%	3.9%	2.8%	4.4%	4.6%
Annual average growth rate (2012-2022)	4.5%	3.3%	2.5%	3.0%	4.1%

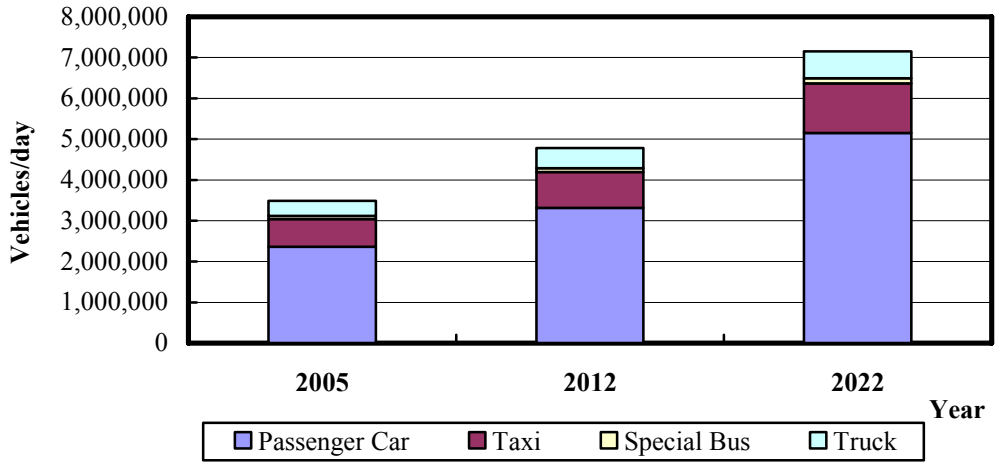


Figure 5.2-2 Total Vehicle Trips

5.3 PRESENT AND FUTURE TRIP PATTERN

To summarize the results of OD data, a graphical representation is prepared by desire line chart which show a number of trips routed directly between each zone centroid and all others, without taking any account of the routes taken by drivers.

5.3.1 Present OD Tables and Desire Line Charts

The zoning system is composed of small zones, medium zones and large zones. Small zones are grouped to produce the medium zones while the grouped medium zones made-up the large zones (See Appendix 5-1). Large zone is referred as Sector in this section of the report which corresponds to a certain place in the Study Area. The idea behind the grouping is to present the vehicle flows in simple way. The total number of large zones is 18.

The OD matrix for all vehicles as well as for individual mode in 2005, 2012, and 2022 is available in Appendix 5-2. On the other hand, Figure 5.3-1 and Figure 5.3-2 depict the

desire line chart in 2005 and 2022 respectively. One notable observation aside from the natural increase of trips within the city center (Sector No. 9, 11, 12, and others) is the sudden increase of trips from/to 6th of October City, and followed by 10th of Ramadan City (Sector No. 1). A jump from 19,994 to 119,593 trips in both directions is observed that would put tremendous pressure on the road network.

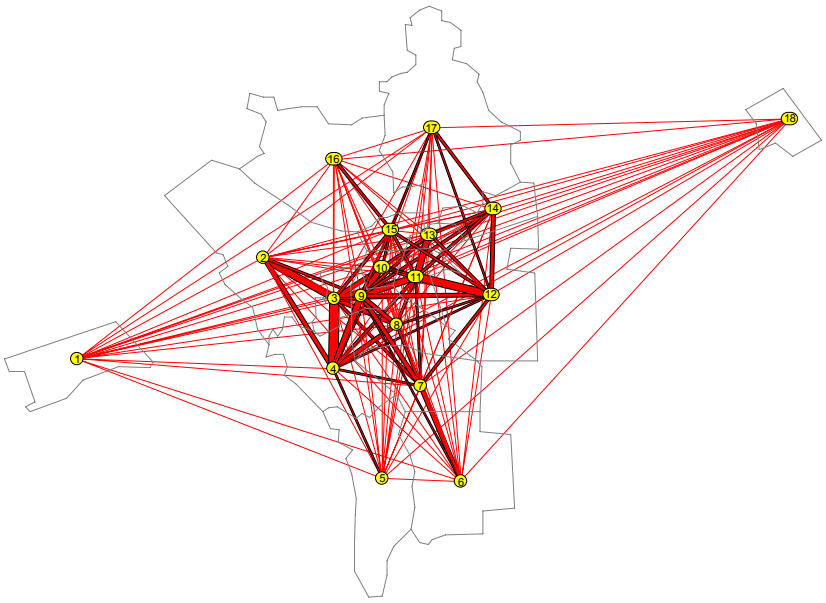


Figure 5.3-1 Present Desire Line Chart (2005)

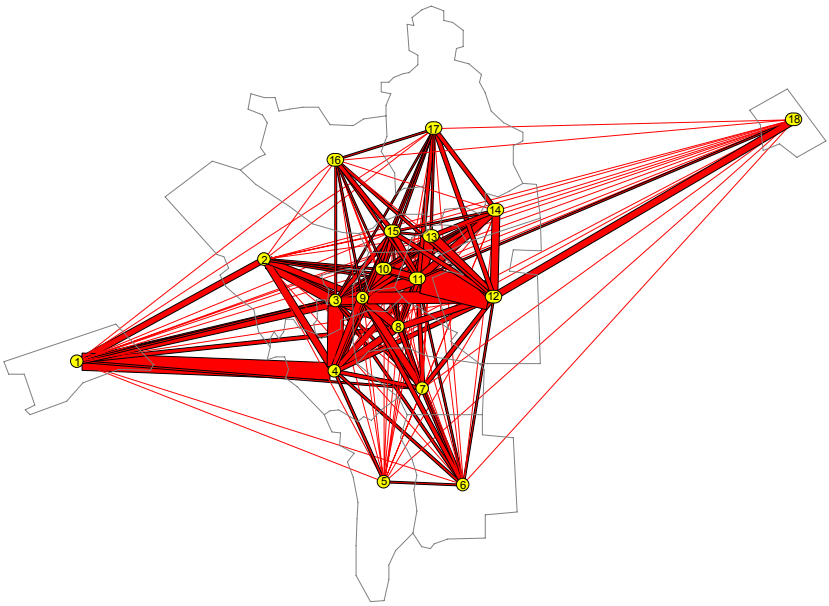


Figure 5.3-2 Future Desire Line Chart (2022)

5.3.2 Growth of Trip Generation and Attraction

Comparative analysis between the present and future OD trip tables are carried out to estimate the expected growth rates in the different trip generation. Results of these analyses give indications on the expected growth in different trips during the next twenty years.

1) Sector Trips

Present and future trip-generation on large-zone basis are shown in Figure 5.3-3. Growth rates of trip-generation on the sectors level are presented in Appendix 5-3 for all vehicles categories. Figures in this appendix gave an indication for the sector growth in which 6th of October and 10th of Ramadan have the highest growth rates for the all vehicle categories.

2) Regional Trips

The growth of trip-generation presented in Figure 5.3-4 shows that Cairo will be close to 6 million trips in 2012 and around 8 million trips in 2020. Meanwhile, trip-generation in Giza in 2020 will grow as high as the present trip-generation of Cairo while that of Qalyobeyya will get close to the present number of Giza.

3) Growth in Trips by Vehicle Category

Transition of trip-generation by vehicle category in trip-generation per day for year 2005, 2012, and 2022 is shown in Figure 5.3-5. The passenger car has the highest share of trips until 2022 followed distantly by taxi.

5.4 ASSIGNED TRAFFIC VOLUME

The objective of the traffic assignment procedure is to allocate the trip matrices to the road network in order to reproduce traffic flows between zones (i.e. each origin and destination pair) on the actual links of the present and future road networks. This is done by fitting traffic on routes from each zone to all other zones, (all inter-zonal movement from the trip matrices are aggregated) to generate reasonable representation of traffic flow.

5.4.1 Methodology

The overall flow diagram of the methodology applied in forecasting the traffic volumes on the toll expressway network, which includes the present and future road network with two scenarios (i.e. “Without Project” and ”With Project”) is shown in Figure 5.4-1.

In the case of “With Project”, a diversion model is applied to assign traffic volumes on the future road network and a tentative toll expressway networks.

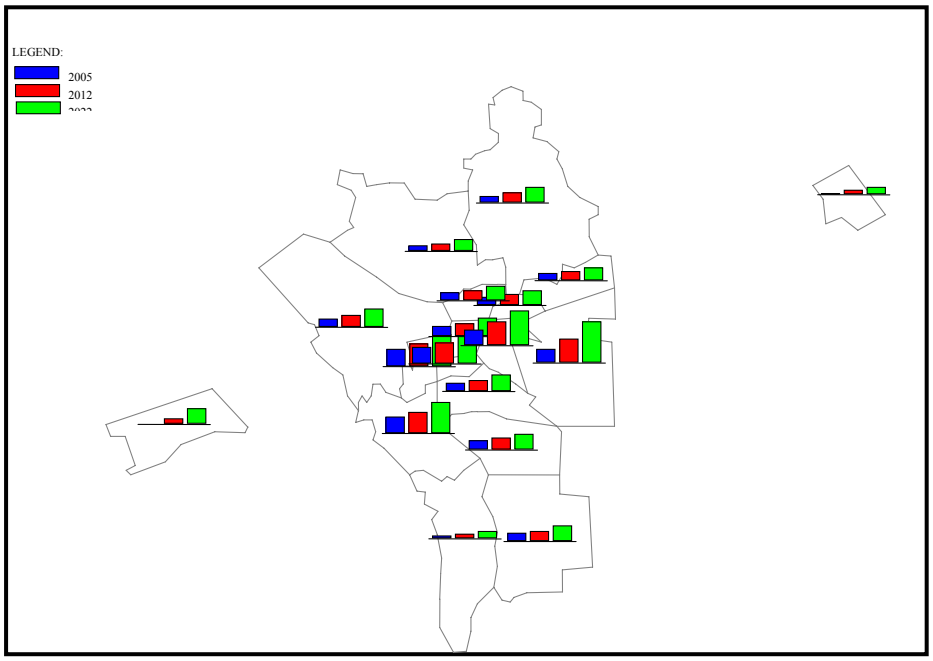


Figure 5.3-3 Present and Future Trip-Generation (vehicle/day)

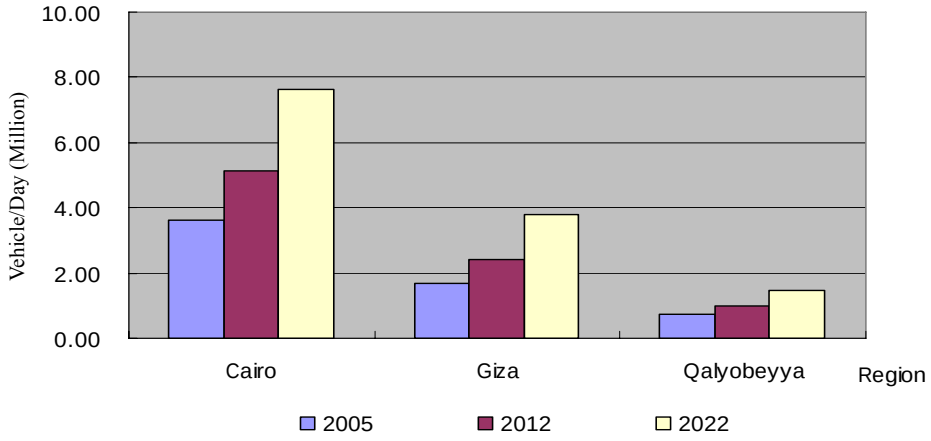


Figure 5.3-4 Transition of Regional Trip-Generation

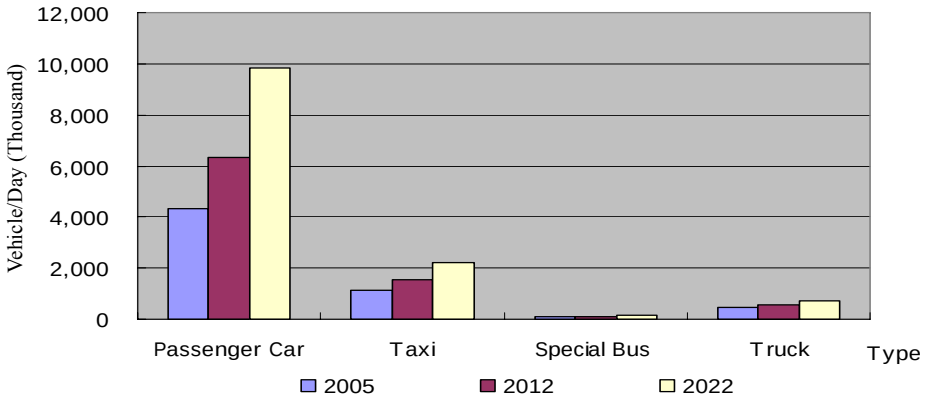


Figure 5.3-5 Transition of Trip-Generation by Vehicle Category

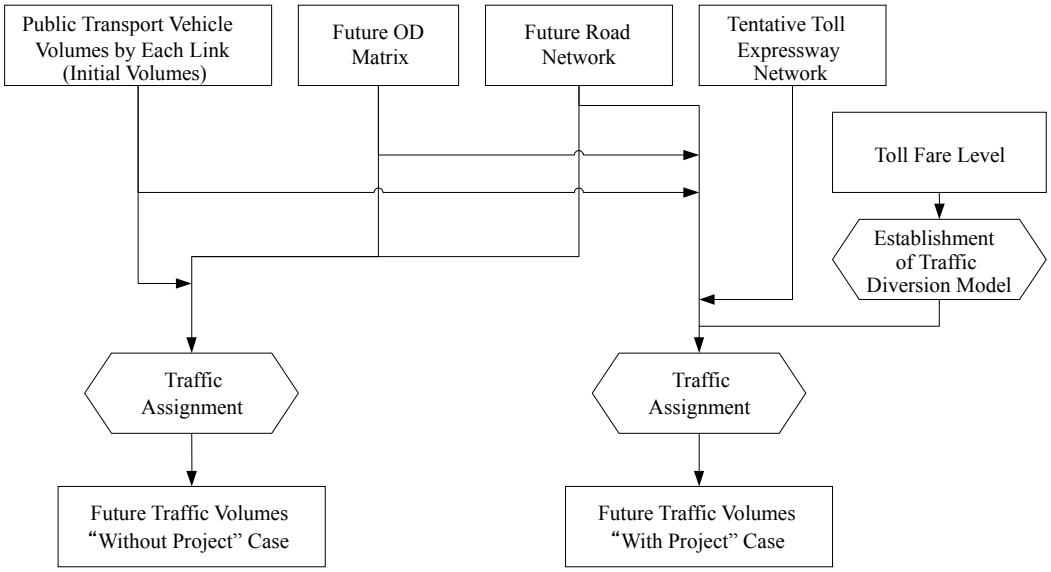


Figure 5.4-1 Forecast of Traffic Volumes on Road and Toll Expressway Networks

To carry out the traffic assignment, several items have to be defined and estimated first. Following is the description of the assignment technique utilized as well as the other items required for the application procedure.

1) Traffic Assignment Procedure

Various assignment techniques are used ranging from manual methods for simple problems to complex iterative procedures by computer programs. In this study, the method utilized was the capacity restraint assignment which is the most straightforward tecnique in network models, and the most efficient one, particularly where the number of zones in the trip matrix is large. This assignment technique is based on the speed – flow relationship.

In this assignment technique, and by calculating the required travel time for each link according to its travel speed and road conditions, the program determines the fastest routes between each origin and destination by evaluating the travel time on links, and assigns the trips between the given origin and destination to these routes starting at the destination and working back to the origins. As congestion increases to a certain level as traffic volume increases, alternative routes are introduced to handle the unassigned traffic. Zone-to-zone routing is built, which is the fastest path from each zone to any other, and all trips are assigned to these optimum routes.

Since the link-travel time varies with the traffic volume of vehicles using that link, which can be explained as a degree of link congestion, the OD tables are divided to apply an

iteration procedure on five stages. At each iteration, and depending upon the current link loadings, the flows are divided between all the shortest routes generated and a new travel time is computed for the average assigned link flow at each pass. The iteration continues to re-estimate the speed on that links considering the assigned traffic on links, and to produce alternative routes so that more accurate allocation can be achieved. The accumulated assigned traffic volume from each OD pair on the links composes the total assigned traffic volumes per direction for the network.

The traffic assignment procedure for the road networks is shown in Figure 5.4-2. In the "without project" case, daily OD trips are assigned based on the link speed and shortest route between each two zones to get traffic volumes on each link. In the "with project" case, there are two networks, at-grade and expressways. Here the diversion between the two networks is done based on the difference in all costs, including time, VOC and toll.

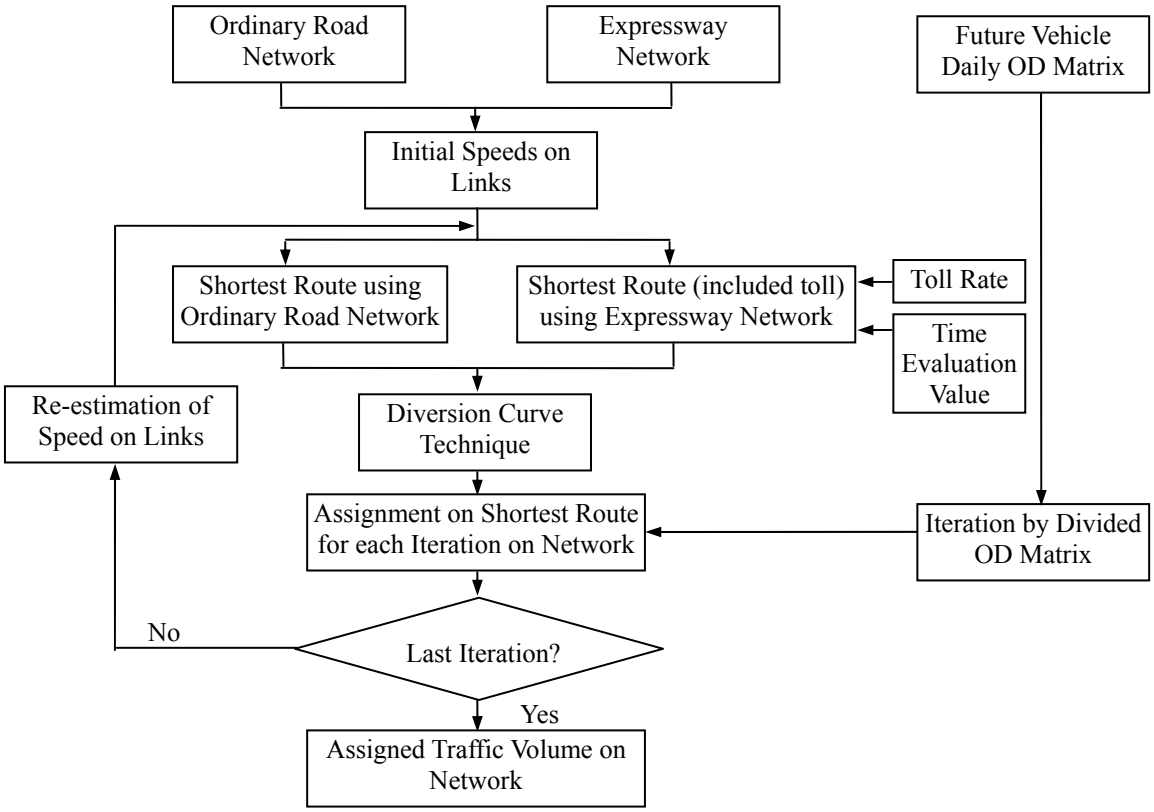


Figure 5.4-2 Traffic Assignment for Cairo Metropolitan Road Network

The JICA STRADA (System for Traffic Demand Analysis) is used to estimate the traffic volumes. This software has all the necessary tools for transportation planning. It is developed to experience relative ease while analyzing transportation problems, modeling demand forecast and developing project proposals.

2) Speed – Flow Relationship

The speed – flow relationship used in the traffic assignment procedure is shown in Figure 5.4-3. This approximate relationship is based on the CREATS data. When the traffic volumes are over the maximum capacity Qmax, it is assumed that vehicle speed drastically decreases.

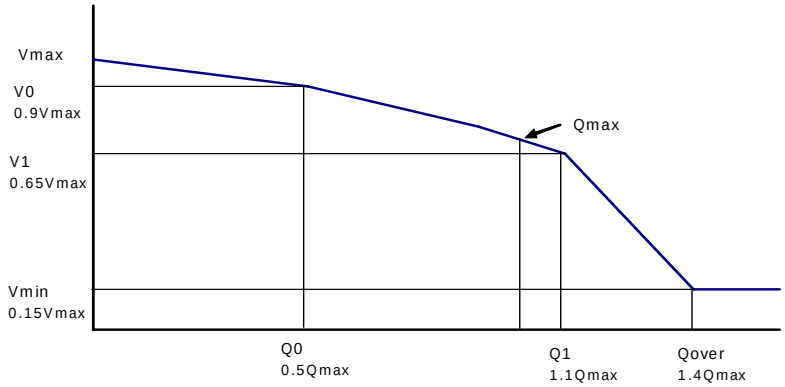


Figure 5.4-3 Speed –Flow Relationship

3) Time Evaluation Value

The time evaluation value (TEV) method is applied to evaluate the travel time on links of toll expressways in use for persons, either passengers or assistants in trucks, in all vehicle categories. The procedure applied to estimate the average TEV is based on values of the annual GDP per Capita for the present and future target years, the average number of working hours, and the occupancy rate data for passenger cars. The estimated TEV results are presented in Table 5.4-1 as the average time value in LE per hour.

Table 5.4-1 Time Evaluation Value by Type of Vehicle

Unit: LE per hour

Vehicle Type	Year 2005	Year 2012	Year 2022
Passenger Car	6.5	8.6	11.5
Taxi	8.6	11.3	12.9
Company Bus, School Bus	41.8	54.6	73.2

4) Diversion Curve Technique

This technique is applied to estimate the proportion of traffic volumes diverted from the future road network to the new toll expressway network. The factors having the greatest influence on the routes taken by drivers are the comparative travel time and distance. Two formulas are applied to develop the diversion curves in estimating the traffic volumes on both networks.

In Japan, two types of the diversion model are applied to estimate the expressway traffic volume.

The first, which is applied by Japan Highway Public Corporation, was developed specially for toll inter-urban expressway, and calibrated and upgraded continuously. In this formula, the diversion rate is determined by toll-fee and travel time.

The second is being applied by Tokyo Metropolitan Expressway Public Corporation. Many Urban Expressway in Japan such as Hanshin Expressway, Nagoya Expressway and Fukuoka-Kita-Kyushu Urban Expressway are also using the same model for toll urban expressway. This formula is based on the AASHTO's one, which is widely applied for freeways in the United States.

a) Formula of Japan Highway Public Corporation

$$p = \left\{ \frac{1}{1 + \alpha(C/T * S)^{\beta} / T^{\gamma}} \right\}$$

Where p: Diversion Rate

C: Trip Fare in Yen (to be converted to LE)

T: Time Difference in Minutes (TH - TG)

TH: Inter-zonal time distance using toll motorway in minutes (including fare resistance calculated by time evaluation time)

TG: Inter-zonal time distance using ordinary road in minute

S: Shift Factor

α, β, γ: Parameters, which have the values presented in Table 5.4-2.

Table 5.4-2 Parameters of Diversion Curve

Vehicle Type	α	β	γ
Passenger Car	0.0857	1.121	0.583
Small Truck	0.2000	0.936	0.529
Truck(Medium &Heavy)	0.0230	1.245	0.151

Note: parameters are determined based on that established by Japan Highway Corporation

b) Formula of AASHTO (Tokyo Metropolitan Expressway and Hanshin Expressway)

$$p = \{(\frac{1}{1+\alpha X^{\beta}})\gamma - \delta\} * a$$

Where, p: Diversion Rate

X: Time Difference (TH / TG)

TH: Inter-zonal time distance using toll motorway in minutes (including fare resistance calculated by time evaluation time)

TG: Inter-zonal time distance using ordinary road in minute

α, β, γ, δ, a: Parameters, which have the values presented in Table 5.4-3.

Table 5.4-3 Parameters of Diversion Curve (Formula of AASHTO Model)

	α	β	γ	δ	a
AASHTO	1.0	6.0	1.0	0.05	1.0
Tokyo Metropolitan Expressway	1.0	6.0	1.0	0.05	$0.047x_1+0.2696$ (x_1:zone-distance)
Hanshin Expressway	1.0	4.0	1.0	0.05	1.0

This formula is adjusted to be applied for the Cairo Expressway based on the result of the willingness-to-pay survey. Parameter γ is settled by the growth rate of economy. Higher values of α for Cairo Expressway means higher sensitivity to paying toll. Table 5.4-4 presented the adjusted parameters while Figure 5.4-4 shows a comparison for both cases.

$$p = \left(\frac{1}{1 + \alpha X^{\beta}} \right) \gamma$$

Table 5.4-4 Parameters of Diversion Curve for Cairo Expressway

Year	α	β	γ
2005	3.0	6.0	0.57
2012	3.0	6.0	0.75
2022	3.0	6.0	1.00

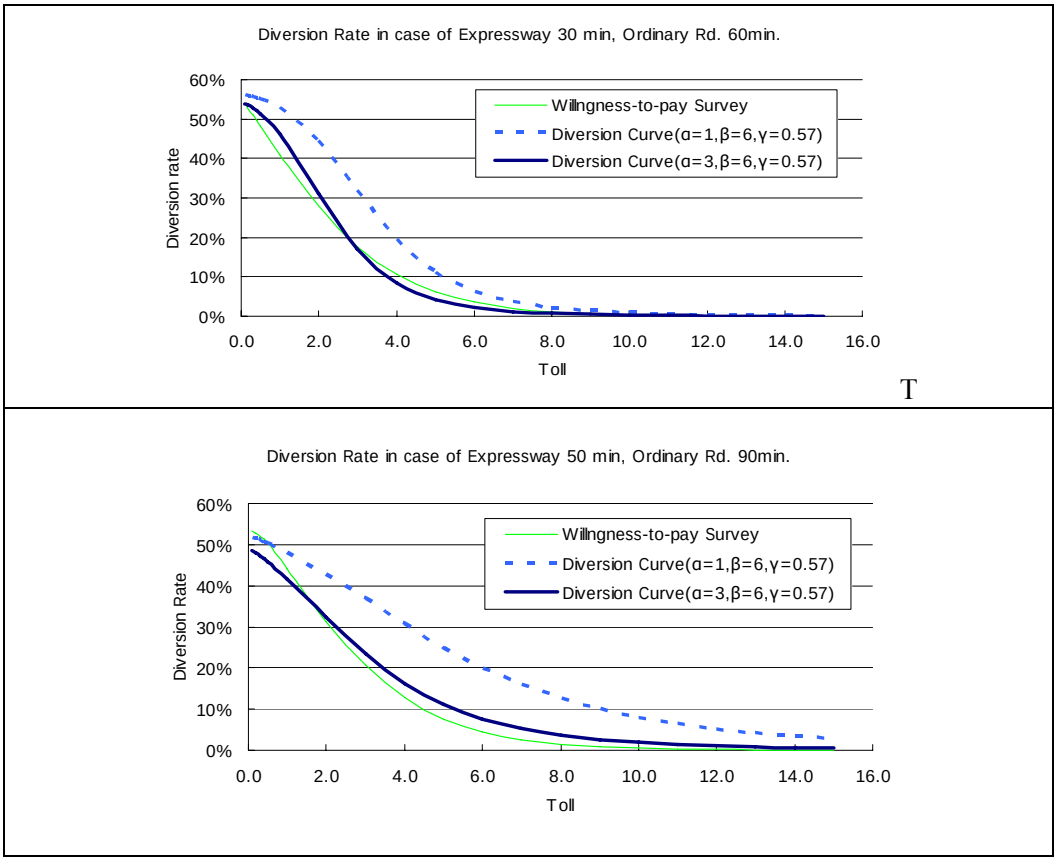


Figure 5.4-4 Disaggregate Model for Adjusted Diversion Curve and WTP Survey Results

5) Assignment Cases

Traffic assignments are carried out for different cases and purposes. First, assignment carried out for the present road networks ("Do Nothing Case"). Second, traffic volumes are assigned on the future road network without new expressway ("Without Project Case"). Third, assignment is done for the tentative new expressway based on the CREATS Master Plan as "With Project Case". A summary of the assignment results is shown in Table 5.4-5.

Table 5.4-5 Assignment Cases

	Case	Road Network	OD Matrix
D/N	Case A-1 Case A-2 Case A-3	2005 2005 2005	2005 2012 2022
W/O Project	Case B-3	2022 (W/O Expressway)	2022
With Project	Case C-3	2022 (With Expressway)	2022

6) Assignment Validation

In general, trips between individual pairs of zones are uncertainly estimated by aggregation of the trip matrix cells and the allocated through assignment techniques to routes cover large number of zones pairs. Therefore, it is necessary to examine the result of the assignment to ensure that trips are assigned in a realistic pattern which will match the actual situation.

To check the assignment's validity, all vehicle types in the form of passenger car units (PCU) across the Nile River screen-line and the ring road cordon-line are checked as shown in Figure 5.4-5. The difference between the observed trips and the assigned crossing the in Nile River is just 6% while 9% in the Ring Road. The reliability of the model therefore is quite high.

In addition a comparison between the observed and individual traffic count at 28 observed stations shown in Figure 5.4-6. This comparison between observed traffic count and assigned traffic flow at individual sites is done via the Mean Absolute Difference (MAD)[1] Ratio. For daily traffic counts, the value of the MAD ratio is 0.13 which is considered to reflect a good calibration. By all indicators the assignment has accurately replicated year 2005.

[1] MAD Ratio is defined by the following formula: MAD Ratio $= \sum \left| \frac{count - assignment}{assignmet} \right| / n$

where n is the number of observations.

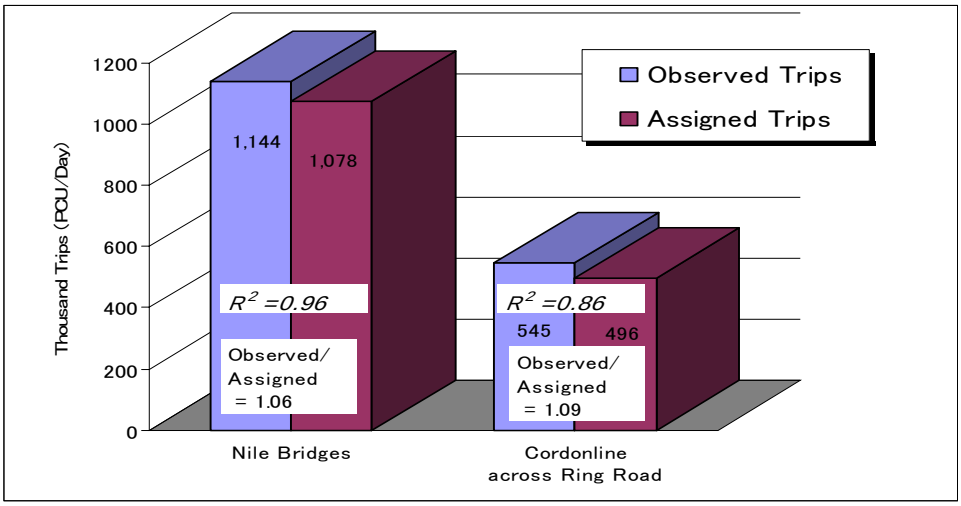


Figure 5.4-5 Comparison between Observed and Assigned Traffic in 2005

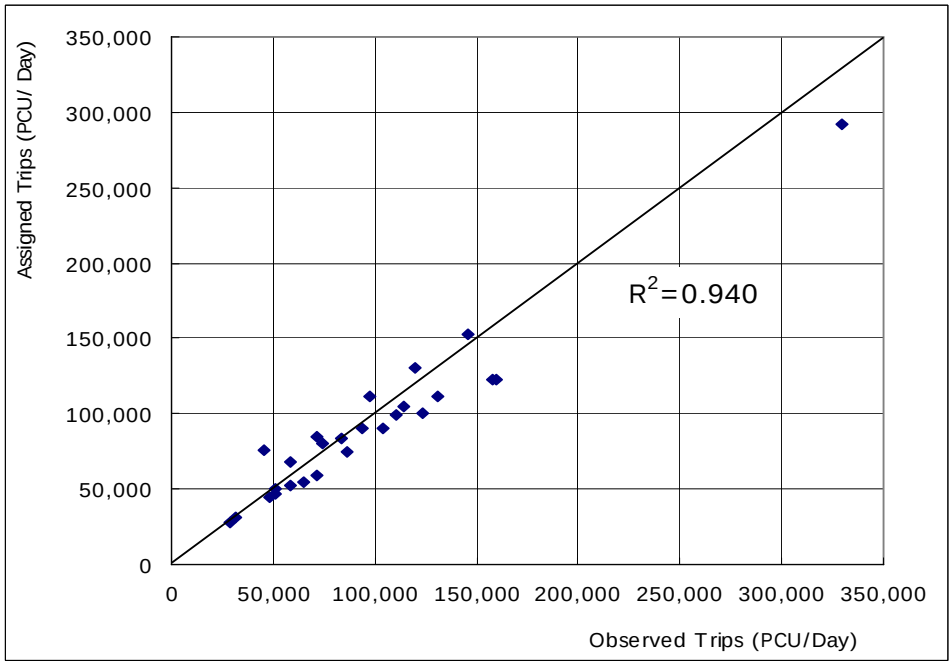


Figure 5.4-6 Comparison between Observed and Assigned Traffic at Individual Sites

5.4.2 Traffic Volumes on Expressway Network (Without Project Case)

Present and future OD tables are respectively assigned here on the existing road network (Do Nothing Case), after adding future plans of CREATS for the year 2022 to compose the future networks without taking into consideration the project of the expressway networks Without Project.

1) Do Nothing Case

The assigned traffic volumes on the present road network are illustrated in Figure 5.4-7 for year 2005. Table 5.4-6 gives the result of assigned traffic volumes per day in year 2005, 2012 and 2022. Assigned traffic volumes for the year 2012 and 2022 are shown in Figure 5.4-8 and Figure 5.4-9 for case of "Do Nothing".

a) Traffic Indicator

- Annual traffic indicators of vehicular trips are evaluated from the view points of changes in vehicular trips, pcu-hr, pcu-km and average speed.
- The vehicular trips are forecast to increase from 66.98 million trips in 2005 to 149.07 million in 2022 with a growth of about 2.23 times. In addition, the indicators of pcu-hr and pcu-km are also increasing, especially the pcu-hr that increases from 3.91 million pcu-hr in 2005 to 14.09 million in 2022 with a growth of about 3.60 times.
- As a result, the average travel speed is decreased from 17.1 km/hr in 2005 to 10.6 km/hr in 2022, which means that the level of service on the road network will face a severe situation from the economic and environmental points of view.

b) Traffic Congestion

- Results of analyzing the volume to capacity ratio V/C to investigate the road congestion in 2005 show desirable ratio of 0.84.
- Results of the year 2025 show unacceptable level of traffic congestion with an average value of 1.88.

Table 5.4-6 Result of Assigned Traffic Volumes for Do Nothing Case

Case		Case A-1	Case A-2	Case A-3	Ratio	
Year		2005	2012	2022	2012/2005	2022/2005
Whole Network	PCU-km	66,979,850	98,694,863	149,074,207	1.47	2.23
	PCU-hour	3,913,048	7,738,570	14,087,879	1.98	3.60
	Ave. Speed (km/h)	17.1	12.8	10.6	0.75	0.62
	V/C	0.84	1.24	1.88	1.48	2.24
E1+E2	PCU-km	1,709,037	2,107,352	3,469,869	1.23	2.03
	PCU-hour	85,952	128,952	232,598	1.50	2.71
	Ave. Speed (km/h)	19.9	16.3	14.9	0.82	0.75
	V/C	1.29	1.59	2.62	1.23	2.03

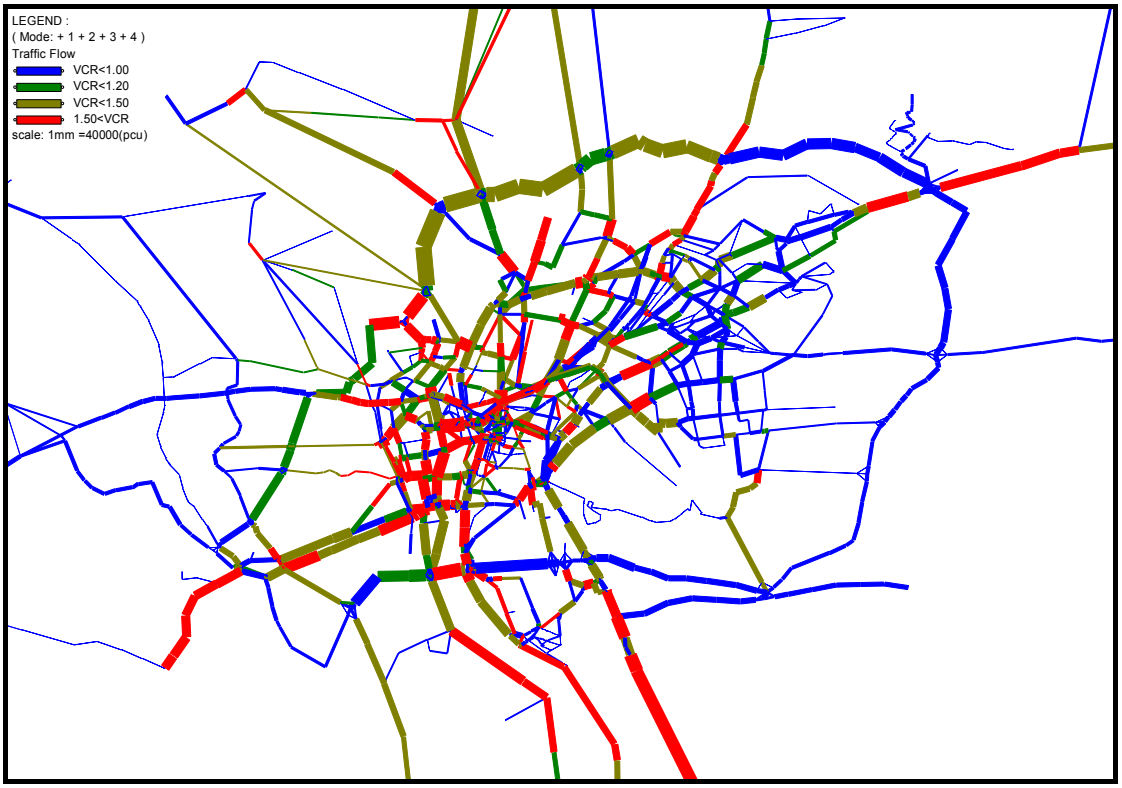


Figure 5.4-7 Assigned Traffic Volumes – 2005

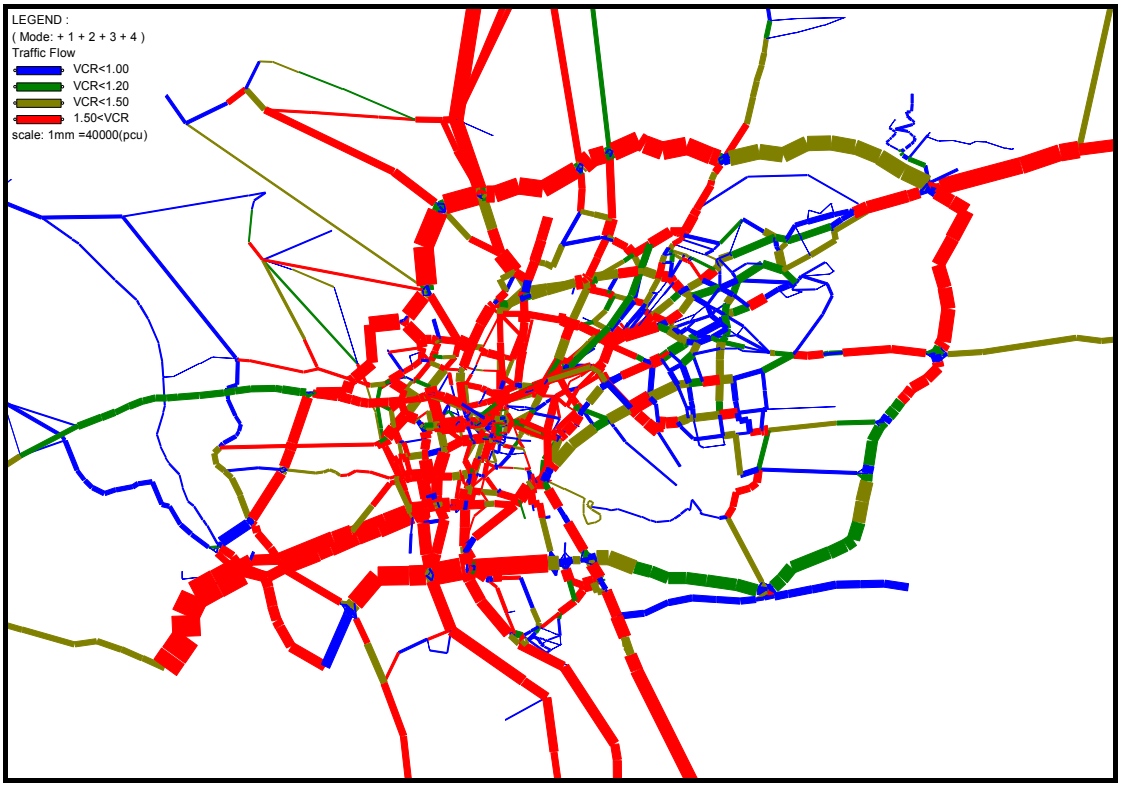


Figure 5.4-8 Assigned Traffic Volumes (Do Nothing Case – 2012)

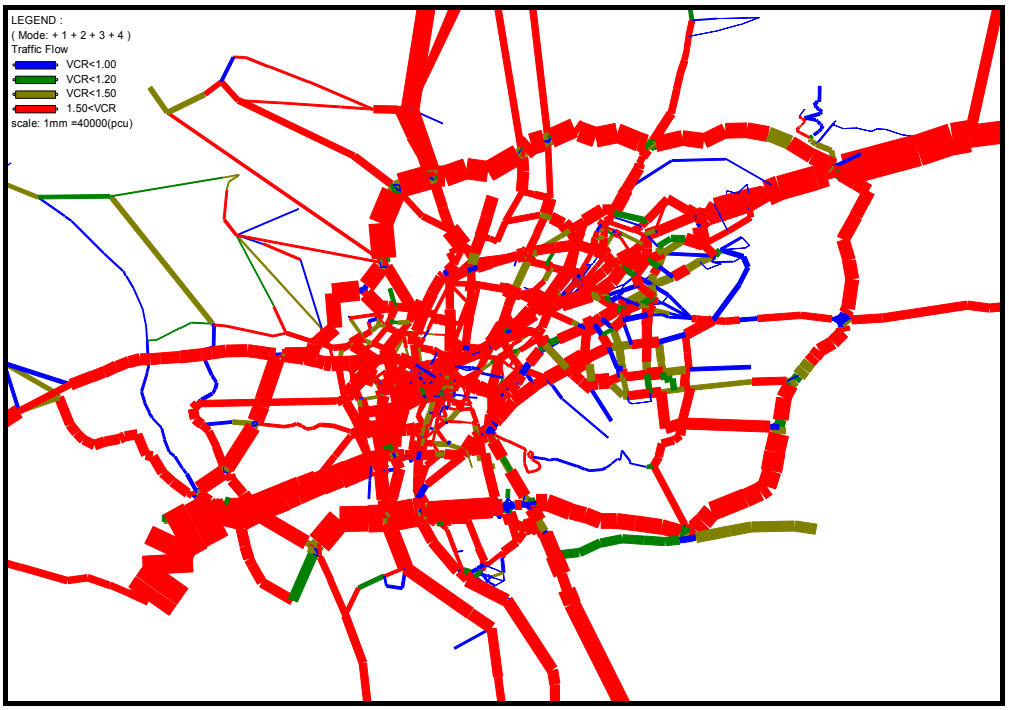


Figure 5.4-9 Assigned Traffic Volumes (Do Nothing Case – 2022)

2) Without Project Case

In this "Without Project" case, traffic volumes are assigned on the future road network without the toll expressway network (see Figure 5.4-10).

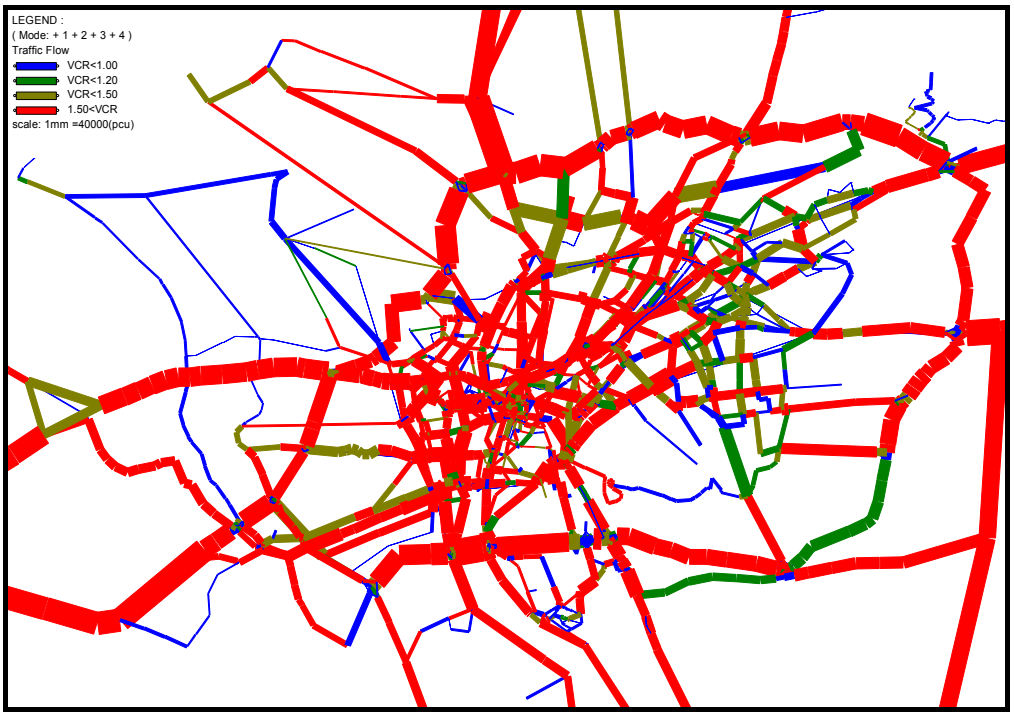


Figure 5.4-10 Assigned Traffic Volumes – 2022 (Without Project)

5.4.3 Traffic Volumes on Future Expressway Network (With Project Case)

In this "With Project" case, traffic is assigned on both future road network and expressway network together for each assignment case. Other assignments are done in later stage for cases of different alternative of priority routes or sections to be used in the implementation plan of the expressway network (see Chapter 9 for Economic and Financial Analysis). Results of assigned traffic volumes, on ordinary road network and expressway network are shown in Figure 5.4-11 and 5.4-12 for the basic case before applying diversion rates.

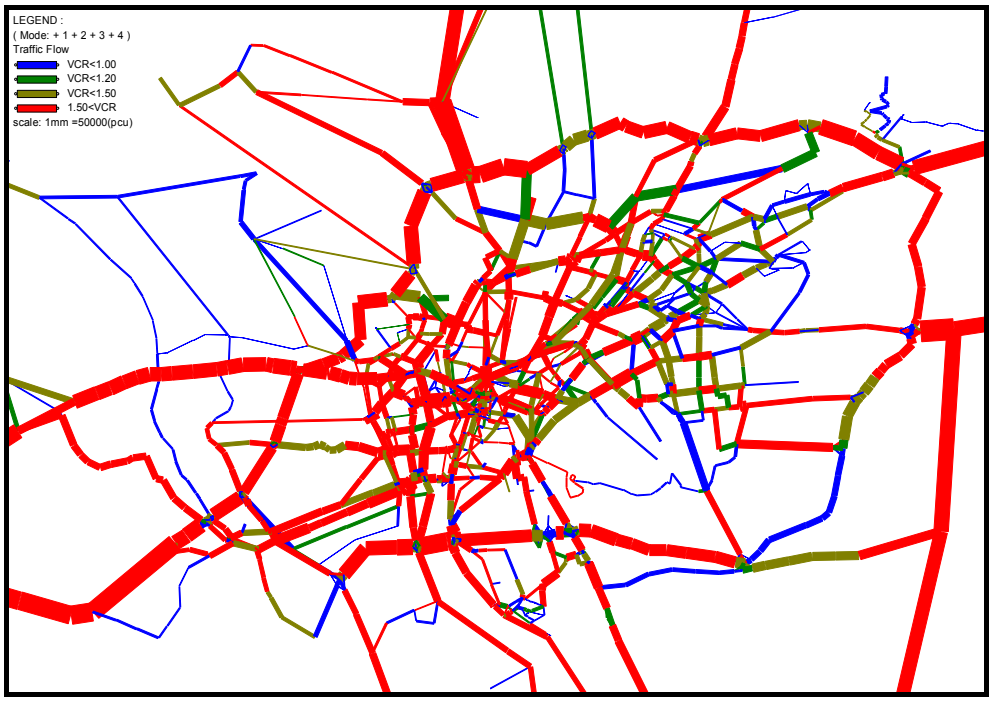


Figure 5.4-11 Assigned Traffic Volumes – 2022 (With Project - Basic Case)

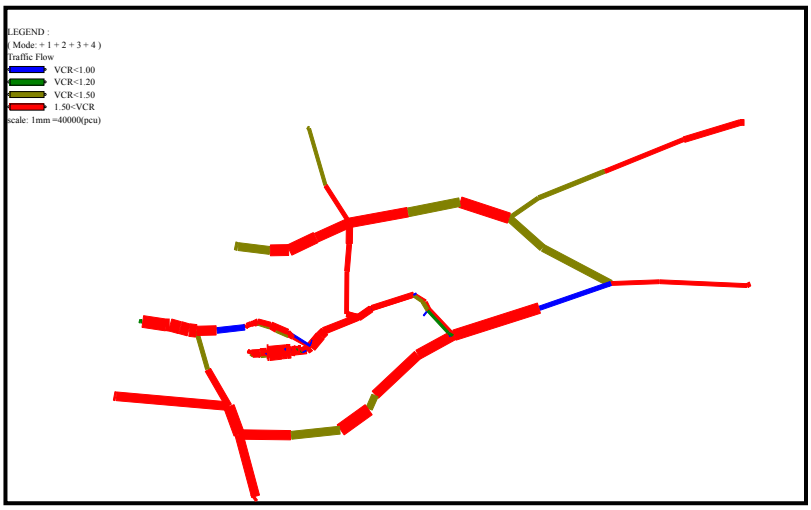


Figure 5.4-12 Assigned Traffic Volumes on Expressway – 2022 (Basic Case)

The results of the traffic assignment are given in Table 5.4-7. From the table, the followings are noted:

Effect to the whole network

- PCU-km will increase by more than 500,000 PCU-km.
- PCU-hr will decrease by about 10% manifesting an increase of road's efficiency.
- Average travel speed will increase by about 25%.
- VCR will improve from 1.45 to 1.38 (the lower, the better).

Effect to the expressway:

- PCU-km will increase by about 6.6 times.
- PCU-hr will increase by about 3 times.
- Average travel speed will increase by about 80%.
- VCR will improve from 1.95 to 0.92 (the lower, the better).

From the above observations, it is obvious that the construction of toll expressway is very effective in improving the level of service of the road networks of Greater Cairo Region.

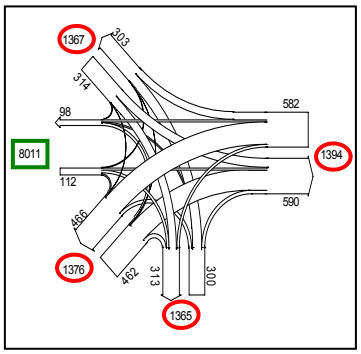
Table 5.4-7 Result of Assigned Traffic Volumes for W/O and W Project

Case		Without Project	With Project
Year		2022	2022
Whole Network	PCU-km	146,489,300	146,997,277
	PCU-hour	11,522,505	11,352,749
	Ave. Speed (km/h)	12.7	15.9
	V/C	1.45	1.38
Expressway	Section: Toll rate	E1 and E2: Free	Expressway: 5 L.E.
	PCU-km	3,858,697	21,885,519
	PCU-hour	251,838	772,168
	Ave. Speed (km/h)	15.3	28.3
	V/C	1.95	0.92

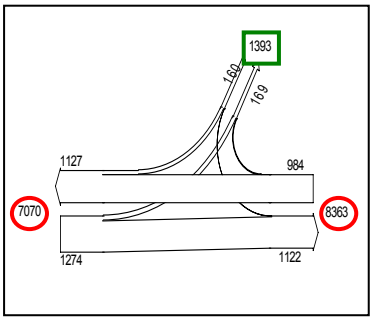
5.4.4 Assigned Traffic Volumes on Interchanges

Figure 5.4-13 presents the results of traffic assignment on the interchanges of the network in 2022 as an example for the case of applying L.E. 5.0 as a flat toll rate on the expressway network.

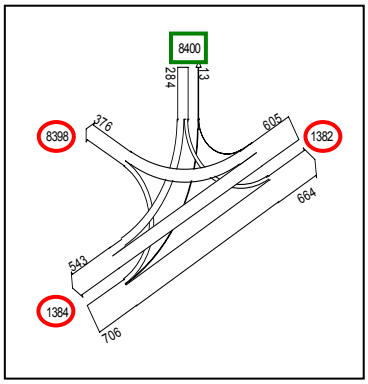
Interchange IC1



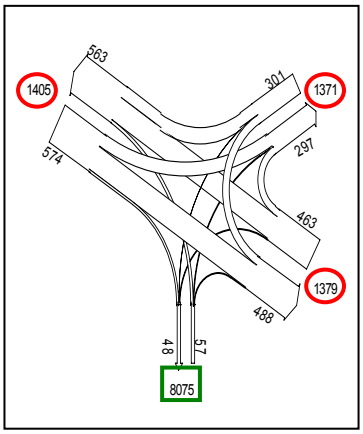
Interchange IC4



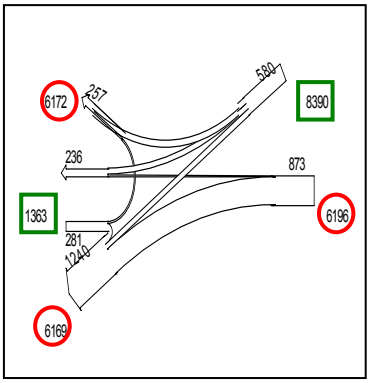
Interchange IC8



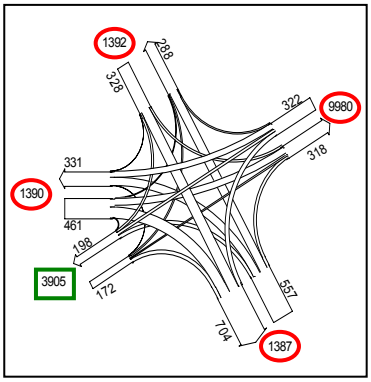
Interchange IC2



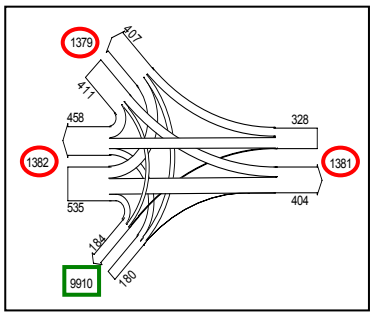
Interchange IC6A 2 Ramps)



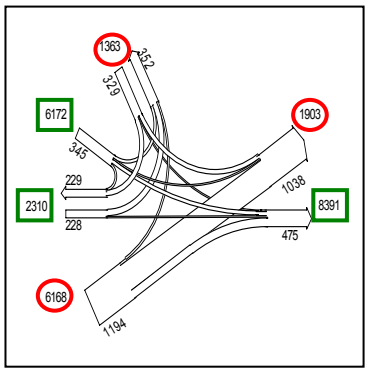
Interchange IC9



Interchange IC3



Interchange IC6B (3 Ramps)



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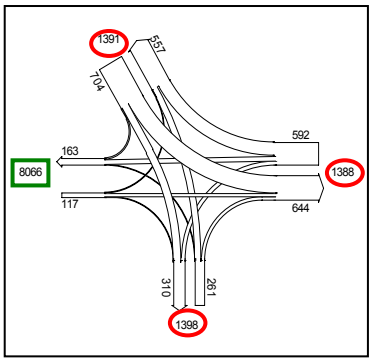

Ramp

Node

Figure 5.4-13 Assigned Traffic Volumes on Interchanges