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A Daily Flow Profile of Traffic in an Urban Traffic Corridor: The Nigerian Experience

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ABSTRACT

In the commercial city of Lagos, Nigeria, traffic congestion poses a great challenge to commuters, particularly businessmen and workers that need to keep appointments and report in offices timely. A great amount of productive man-hours is therefore wasted in traffic congestion. This coupled with the psychological stress, and the loss of potential income that commuters experience in traffic jams present a frustrating scenario to those affected. As a result, traffic managers are motivated to understand traffic information through data generated from vehicle counts as a means of guiding road users on how to avoid traffic jams in routes. This is an urban traffic corridors problem, which plays an important role in urban traffic network analysis. Unfortunately, till date, there is sparse documented information on urban traffic corridors relevant to Lagos, Nigeria. In this paper, through the application of the screen line traffic count methodology, we investigate the daily flow profile of traffic

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in an urban traffic corridor in Lagos, which is a commercial nerve centre of a developing country.

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KEYWORDS: Traffic Count, Urban Traffic, Traffic Corridor, Traffic Network, Traffic Congestion

1. INTRODUCTION

Metropolitan Lagos has been described as the sixth fastest growing city in the developing world. The city is highly populated with many problems such as overcrowding (high population density), overstretched usage of facilities (roads, schools, and health centers), inadequate electricity supply, and high traffic congestion. As a result of these problems many inhabitants of Lagos metropolitan are constantly relocating to previously uninhabited locations that could guarantee cheaper and better housing as well as provide necessary facilities which are hitherto overstretched in the city. Despite the movement of people to new locations some of these problems that were avoided by staying away from the metropolitan start evolving up in the new location. The problem of traffic flow is one of these important challenges that need to be resolved.

For the less congested Iyana Ipaja/Ikotun area of the city, the traffic flow has been challenging, leading to many hours spent in traffic jams. The challenge of understanding this traffic situation, with a view of proffering solution is therefore tackled in the current paper. In particular, traffic counts are taken along the Iyana Ipaja/Ikotun traffic corridor which experiences very high volume of traffic. The traffic count therefore aims at estimating traffic flow and its characteristics. Thus, the study provides an insight of the type of traffic management system or tool to be employed by traffic management agencies. This will ensure that traffic flows without hindrance. In addition, insights into understanding how to develop a travel demand management system would be gained.

What follows is a review of literature relating to traffic flow in order to identify the important gap that the current paper fills. Yu and Shi (2008) proposed an extended traffic flow model by introducing the relative velocity of arbitrary number of cars that precede and that follow into the Newell-Whitham-type car-following model. Guan and He (2008) investigated the velocity-density relationships of urban freeways. Hou, Xu, and Yan (2008) applied the iterative learning control approach to address the traffic density control problem in a macroscopic level freeway environment with ramp metering. Baykal-Gursoy, Xiao, and Ozbay (2008) modelled traffic flow interrupted by incidents. Zhu and Dai (2008) simulated the soliton and kink-antikink density waves and concluded that the maximal current of traffic-flow increases with decreasing of the safety distance. Wu, Sun, and Gao (2008) proposed a dynamic traffic model (DTM) for routing choice behaviour (RCB) in which both topology

structures and dynamic properties are considered to address the RCB problem by using numerical experiments.

Tang, Huang, Mei and Zhao (2008) introduced a dynamic equation of road flow into each link, and thereby proposed a dynamic model for network flow. Loggle and Immers (2008) extended the original LWR model to incorporate more and realistic details. Golob, Recker, and Yannis (2007) laid the ground work for gauging the level of safety of any type of traffic flow on a freeway, based on data from single loop detectors. Castillo, Menendez and Sanchez-Cambronero (2007) dealt with the problem of predicting traffic flows and updating these predictions when information about OD pairs and/or link flows becomes available. Shi, Wu, Li, and Zhong (2007) researched two-dimensional cellular automation model for traffic flow as it reveals the main characteristics of the traffic networks in cities. Lu, Wong, Zhang, Shu and Chen (2007) explicitly constructed the entropy solutions for the Lighthill-Whitham Richards (LWR) traffic flow model with a flow-density relationship, which is piecewise quadratic, continuous and concave. Guan and He (2008) investigated traffic flow theory by mainly focusing on highway traffic, which is significantly different from urban freeway.

The presented paper has four sections. Their order of presentation is (1) introduction, (2) methodology, (3) results and discussion, and (4) a conclusion. The introduction builds an argument to express the problem and the need to face this challenge. This is complemented with literature search, which indicates the gap that is yet to be filled. The methodology section presents information on the approach utilized in solving the problem. The results section presents the outcomes of the analysis that were obtained from an effort to practically measure the traffic flow. A discussion, which outlines the practical and operational elements of the study, is also given in the section on results. The last section of this paper gives concluding remarks on the study and its benefits.

2. METHODOLOGY

2.1 City Description

Lagos metropolitan incorporates 16 of the 20 Local Government Areas of Lagos State. For now, there is no official boundary as metropolitan Lagos because of its rapid expansion into areas which hitherto seems uninhabited. However for the purpose of this paper, the boundaries of Lagos metropolis to consist of the territory situated within Latitudes 6^0 23' N and 6^0 41' N and Longitudes 3^0 09' E and 3^0 28'E. This area is bounded in the East by the stretch of the Lagos Lagoon and in the South by the Atlantic Ocean. Of the total land mass of 3,577sqkm occupied by Lagos State, metropolitan Lagos extends over an area of 1,140sqkm which consists one third of the Land mass. Figure 1 shows Metropolitan Lagos.

The current National Population Commission (NPC) estimated the states population at 9.1 million people. Various estimates however puts it at between 12.8 and 15.0 million of which Lagos metropolis alone is estimated to have a population of 12

million people and a density of 1,300 persons per square kilometer. This is 15 times more than the national average. It is also expected that growth will continue at the current rate of nearly 6% per annum. This phenomenal increase in population is due to its position as a melting pot of business, economic and social activities. Of all the urban centers in Nigeria, Metro-Lagos has played the most significant role in the wholesale absorption of rural population. The land use pattern of the metropolis is skewed. The over concentration of urban/commercial activities along the North-South corridor of the metropolis and the agglomeration and increased separation of residencies to work place has created a need for daily journey to work on a large scale which has influenced traffic flow pattern that is structured towards the north-south direction during the mornings and reverses in the evenings.

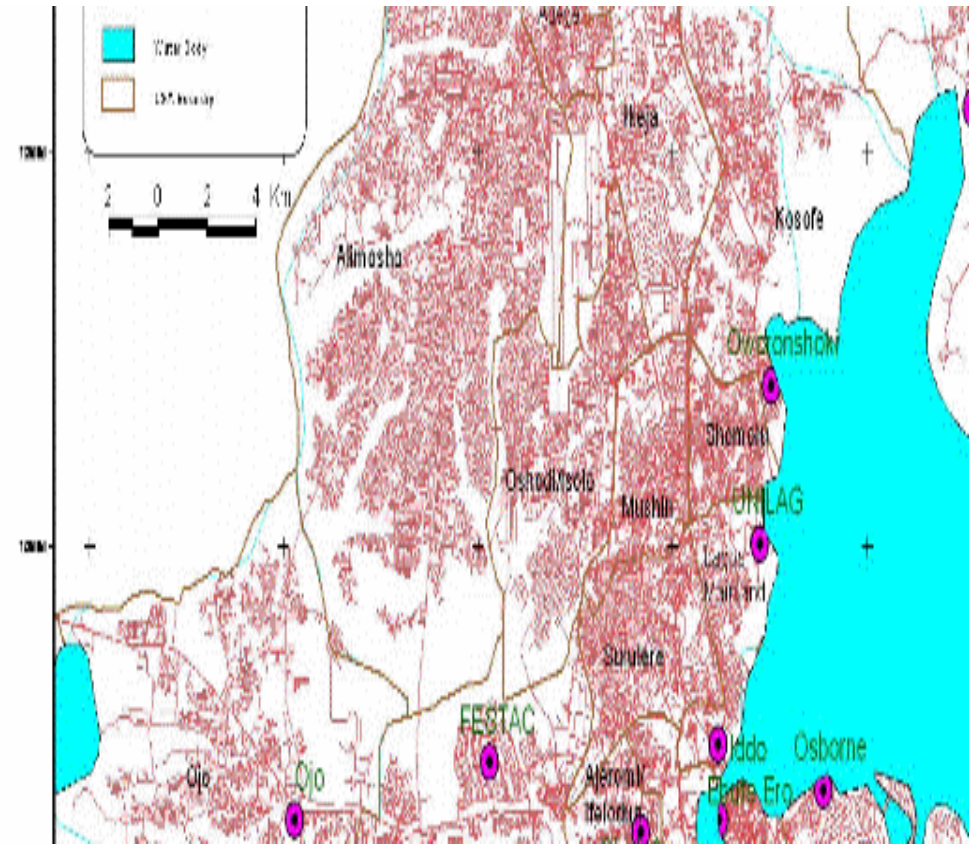

Figure 1. Map of Study Area

Lagos Metropolis can be aptly described as the most heavily motorized part of Nigeria, currently almost all movements are made by road, while water and rail accounts for about 1%.

2.2 The Studied Road

The Iyana-Ikotun road is a dual carriage ten-kilometer road located in Alimoshho Local government area, which is reputed as the largest in terms of population size by current population estimates from the National Population Commission. This accounts for why the State government is interested in establishing a pilot bus franchise scheme to meet the mobility needs of its teeming population. The corridor is mainly of low residential with pockets of medium income settlements. Its land use pattern involves commercial activities lining the full stretch of the road, with markets at Isheri junction, Egbeda Junction, Ikotun rounabout and Iyana Ipaja. The road acts as a major link to traffic going to the Badagry express way, Isolo (that serves as a thoroughfare to the CBD of Lagos Island, Ikoyi and Victoria Island) and various access roads linking it.

2.3 Screen Line Traffic Counts Methodology

Step 1: Screen Line Identification

Six counting stations were selected which include: SL1 Moshalashi, SL2 Egbeda, SL3 Isheri, SL4 Idimu, SL5 Council and SL6 College junctions. These screen lines were used to calibrate the traffic flow pattern. The screen lines were selected after auditing the road and identifying junctions were traffic leakages could occur. Screen lines were placed in between these major leakages to fully capture the traffic flow. The screen lines were arranged in such ways that if the total figures for each screen lines are collated it will give the total traffic flow on the road.

Step 2: Deployment of Personnel

The results of the investigation earlier carried out, assisted in allocating traffic count personnel to each screen line. Each screen line has its own characteristics while some screen lines may have more of a particular vehicular type others may have less. This explains why some personnel were allocated to count more than one vehicular type. Therefore, the characteristics of the vehicular flow types, will determine how many traffic count personnel will be in a particular station.

Step 3: Count Duration and Configuration

The count is a 17^{th} hour count between 6am and 11pm on both sides of the road. Two teams (morning and afternoon) working in two shifts (morning shift 6am-2pm and evening shift 2pm-11pm) which amounted to a total of 96 personnel that the conducted manual counts on each screen with recording done on hourly basis for 4

days which amounted to a total of 68 hours. The days of counting are Monday, Wednesday, Friday and Sunday. Monday was chosen since it is the first working day of the week, Wednesday represents mid week count, Friday represents the last official working day, while Sunday represents counts of a typical off work day. Two supervisors were assigned to monitor the personnel on the field to ensure compliance by field personnel. The vehicular type were categorised in the following as: Mini buses painted, Mini buses unpainted, Cars, Taxis, Molue (Large Buses), and Heavy Duty Vehicles (HDV)

Step 4: Traffic Flow Characteristics in Iyana-Ipaja/Ikotun Road

Manual traffic counts are analysed to determine the basic traffic flow characteristics of the road.

3. RESULTS AND DISCUSSION

Table 1 is a summary of the count. The complete tables are attached as appendix

Table 1: 2-way traffic count summaries of Iyana-Ipaja/Ikotun Road

		SCREEN LINES					
		SL1	SL2	SL3	SL4	SL5	SL6
Days	Direction	Moshalashi	Egbeda	Isheri	Idimu	Council	College
Day1 (Mon)	IYP-IK	15111	12398	11769	9533	9007	6650
	IK-IYP	16807	11344	14337	11056	10037	7967
Day2 (Wed)	IYP-IK	11605	13800	12697	10184	8698	6560
	IK-IYP	16756	11458	10819	10840	10100	7813
Day3 (Fri)	IYP-IK	11577	12026	12510	9286	8433	6452
	IK-IYP	10903	9468	8103	11029	9226	7531
Day4 (Sun)	IYP-IK	11448	13233	9856	9249	9077	6583
	IK-IYP	16664	10403	11981	11230	9957	7354
Total		110871	94130	92072	82407	74535	56910

Legend: IYP (Iyana-Ipaja), IK (Ikotun), SL (Screen Line)

The counts reveal that the daily flow profile varies throughout the week from Iyana-Ipaja to Ikotun and it is largely repeated on the opposite direction, but with a higher flow on Monday at all the screen lines. This may not be a surprise, since Monday being the first working day of the week is usually characterised by high activity. Figure 2 is the traffic daily flow profile from Iyana-Ipaja to Ikotun, while Figure 3 is the flow from Ikotun to Iyana-Ipaja.

Further analysis of Figure 2 reveals that traffic flow on the selected days decreases as the weekend approaches; this does not imply that people don't go to work. Rather it reflects the tendency that exists whereby office workers try to bit the traffic situation in the metropolis by sleeping in their places of work or with a friend and coming back

home on Fridays. SL2 Egbeda is slightly different with Day 2 figures higher than other screen lines, because Egbeda is a major exit point to the CBD.

On the reverse side, movement towards Iyana-Ipaja is lower, the low traffic was recorded in the evenings as only few people move towards Iyanaipaja at that period, workers are already on their way home, and a larger part of the population live towards the Ikotun end of the road, however Egbeda SL2 on day 2 shows a remarkable drop in relation to other screen lines due to the fact that it is used mostly as an exit point (Figure 4). Returning workers enter the road through Iyana-Ipaja.

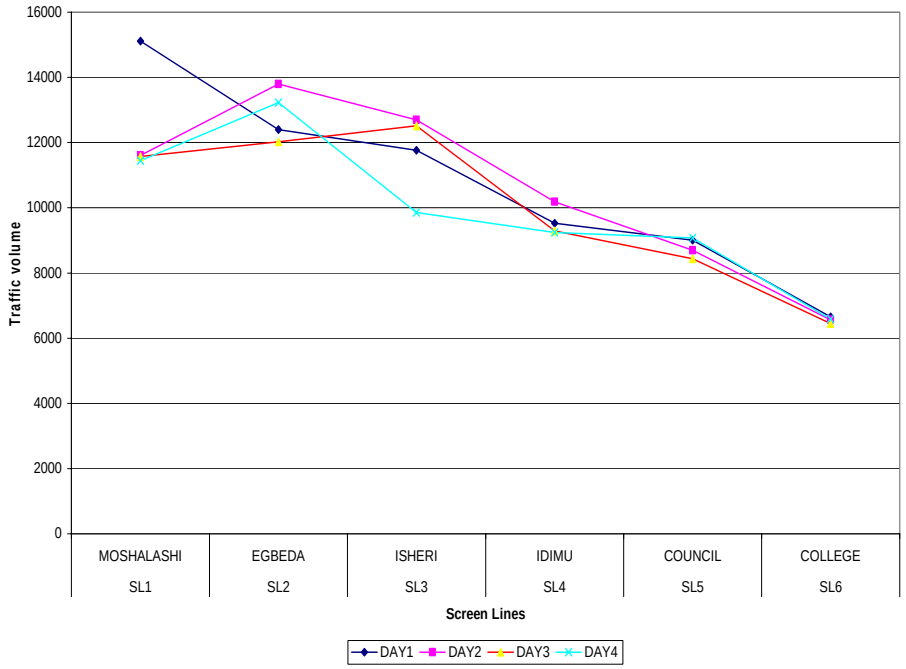

Figure 2. Traffic Daily flow profile from Iyana-Ipaja to Ikotun

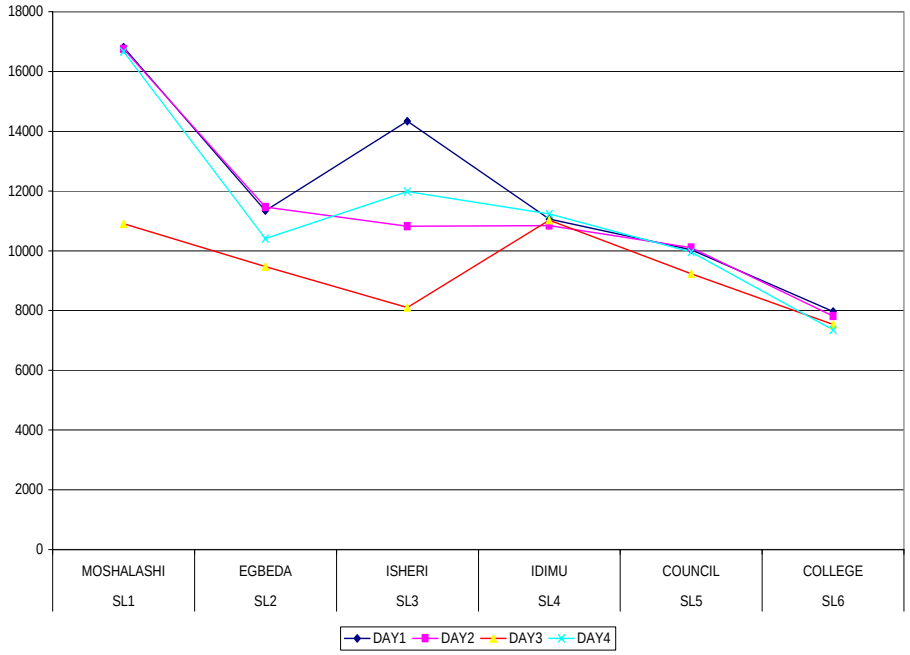

Figure 3. Traffic Daily flow profile from Ikotun to Iyana-Ipaja

4. CONCLUSION

The need for cheaper and better housing has forced many people to seek accommodation further away from the CBD in the South-East traffic corridor of the metropolis. This phenomenon has its own implication on mobility, especially on the Iyana-Ipaja/Ikotun traffic corridor which is experiencing very high volume of traffic. Current population estimate by the National Population Commission (NPC) puts the population in excess of one million. It is not surprising then for the Word Bank and the state government to be interested in establishing a pilot bus franchise scheme. The traffic count therefore is aimed at estimating traffic flow and its characteristics**;** the study gives an insight of the type of traffic management system or tool to be employed by traffic management agencies ensuring that traffic flows without hindrance and how to further develop a travel demand management system that will be beneficial to all.

REFERENCES

Baykal-Gursoy, M. W. Xiao, and K. Ozbay. 2008. Modeling Traffic Flow by Incidents. *European Journal of Operational Research. Available at:* sciencedirect.com.

Castillo, E., Menendez and S. Sanchez-Cambronero. 2007, Predicting Traffic Flow Using Bayesian Networks. *Transportation Research Part B: Methodological. Available* at: sciencedirect.com.

Guan, W. and S. He. 2008. Statistical Features of Traffic Flow on Urban Freeways. *Physica A: Statistical Mechanics and its Applications*, 387(4): 944-954.

Golob, T.F., W. Recker and Pavhs Yannis. 2007. Probabilistic Models of Freeway

Safety Performance Using Traffic Flow Data as Predictors. *Safety Science. Available* at:sciencedirect.com.

Hou, Z., J. Xu, J. Yan. 2008. An Iterative Learning Approach to Density Control of Freeway Traffic Flow via Ramp Metering. *Transportation Research Part C: Emerging Technologies*, 16(1): 71-97.

Logghe, S. and L.H. Immers. 2008. Multi-Class Kinematic Wave Theory of Traffic Flow. *Transportation Research Part B: Methodological. Available* at: sciencedirect.com.

Lu, Y., S.C. Wong, M. Zhang, C-W. Shu and W. Chen. 2007. Explicit Construction of Entropy Solutions for the Lighthill-Witham-Richard's Traffic Flow Model with A Piecewise Quadratic Flow-Density Relationship. *Transportation Research Part B: Methodological. Available* at: sciencedirect.com.

Shi, X-Q, Y-Q Wu, H. Li and R. Zhong. 2007. Second Order Phase Transition in Two-Dimensional Cellular Automation Model of Traffic Flow Containing Road Sections. *Physica A: Statistical Mechanics and its Applications*, 385(2): 659-666.

Tang, T.Q., H.J. Huang, C.Q. Mei and S.G. Zhao. 2008. A Dynamic Model for Traffic Network Flow. *Physica A: Statistical Mechanics and its Applications. Available* at: sciencedirect.com.

Wu, J.J., H.J. Sun, and Z.Y. Gao. 2008. Dynamic Urban Traffic Flow Behaviour on Scale-Free Networks. *Physica A: Statistical Mechanics and its Applications*, 387(2-3): 653-660.

Yu, L. and Z. Shi. 2008. Non-Linear Analysis of an Extended Traffic Flow Model in ITS Environment. *Chaos, Solitons and Fractals*, 36(3): 550-558.

Zhu, H.B and S.Q. Dai. 2008. Numerical Simulation of Solitons and Kink Density Waves in Traffic Flow with Periodic Boundaries. *Physica A: Statistical Mechanics and its Applications. Available* at: sciencedirect.com.

Appendix (Table A1:Traffic count summaries)

IYP-IK

MOSHALASHI				
V/TYPE	Day1	Day2	Day3	Day4
MBP	7507	5527	5828	5536
MBUP	1719	1667	1285	1097
CARS	5082	3550	3691	4147
TAXIS	123	304	108	179
MOLUE	52	30	42	35
HDV	628	527	623	454
TOTAL	15111	11605	11577	11448

ISHERI				
V/TYPE	Day1	Day2	Day3	Day4
MBP	4822	4952	5402	4960
MBUP	1055	1012	1020	859
CARS	5292	6161	5402	3644
TAXIS	127	208	111	88
MOLUE	23	31	13	2
HDV	450	333	562	303
TOTAL	11769	12697	12510	9856

EGBEDA				
V/TYPE	Day1	Day2	Day3	Day4
MBP	5400	5827	5132	5643
MBUP	1177	1392	1298	1658
CARS	5275	5818	4974	5283
TAXIS	139	188	146	177
MOLUE	27	39	24	26
HDV	380	536	452	446
TOTAL	12398	13800	12026	13233

IDIMU				
V/TYPE	Day1	Day2	Day3	Day4
MBP	4617	4942	4171	4687
MBUP	539	498	648	614
CARS	4008	4374	4111	3647
TAXIS	66	72	82	76
MOLUE	9	12	8	11
HDV	294	286	266	214
TOTAL	9533	10184	9286	9249

COUNCIL				
V/TYPE	Day1	Day2	Day3	Day4
MBP	4445	4767	4212	4613
MBUP	616	473	595	581
CARS	3655	3239	3016	3536
TAXIS	60	60	174	47
MOLUE	36	15	30	34
HDV	195	144	406	266
TOTAL	9007	8698	8433	9077

COLLEGE				
V/TYPE	Day1	Day2	Day3	Day4
MBP	4219	4413	4149	4437
MBUP	490	348	389	372
CARS	1800	1657	1730	1602
TAXIS	35	9	31	21
MOLUE	14	21	20	36
HDV	92	112	133	115
TOTAL	6650	6560	6452	6583

IK-IP

MOSHALASHI				
V/TYPE	Day1	Day2	Day3	Day4
MBP	7826	7253	4650	7411
MBUP	1480	1526	910	1312
CARS	6583	7174	4851	7153
TAXIS	165	174	153	195
MOLUE	59	45	34	43
HDV	694	584	305	550
TOTAL	16807	16756	10903	16664

EGBEDA				
V/TYPE	Day1	Day2	Day3	Day4
MBP	5197	5564	4596	4760
MBUP	1614	1395	838	1323
CARS	3987	3900	3540	3700
TAXIS	57	80	88	115
MOLUE	4	19	3	17
HDV	485	500	403	488
TOTAL	11344	11458	9468	10403

ISHERI				
V/TYPE	Day1	Day2	Day3	Day4
MBP	5197	4810	3779	3850
MBUP	1438	799	894	994
CARS	6920	4552	3035	6290
TAXIS	327	98	91	217
MOLUE	20	24	7	22
HDV	435	536	297	608
TOTAL	14337	10819	8103	11981

IDIMU				
V/TYPE	Day1	Day2	Day3	Day4
MBP	4752	4156	4057	4010
MBUP	773	759	759	690
CARS	4793	5218	5492	5693
TAXIS	105	95	143	132
MOLUE	14	20	30	18
HDV	619	592	548	687
TOTAL	11056	10840	11029	11230

COUNCIL				
V/TYPE	Day1	Day2	Day3	Day4
MBP	4374	4182	4218	4115
MBUP	596	622	559	597
CARS	4452	4891	3972	4741
TAXIS	93	86	87	107
MOLUE	13	29	14	14
HDV	509	290	376	383
TOTAL	10037	10100	9226	9957

COLLEGE				
V/TYPE	Day1	Day2	Day3	Day4
MBP	4374	3978	4154	3662
MBUP	472	457	468	426
CARS	2747	2978	2543	2837
TAXIS	57	53	65	62
MOLUE	13	10	28	12
HDV	304	337	273	355
TOTAL	7967	7813	7531	7354

Source: Primary data compiled by authors during the study in the year 2007.

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