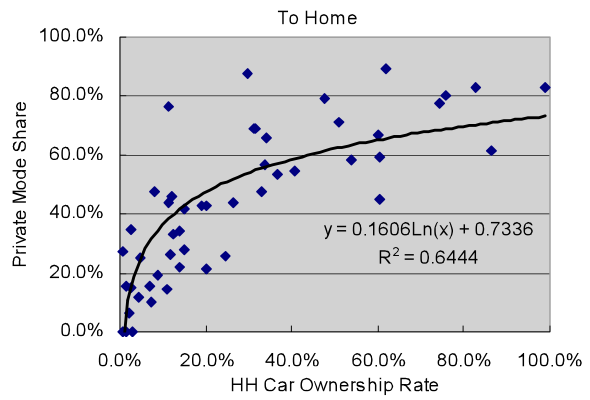
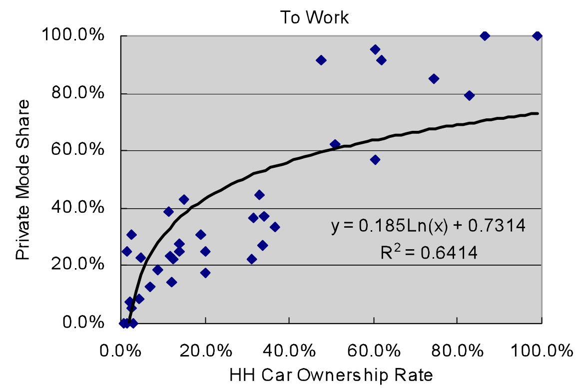
(7) Intra Zonal Private - Public Split Model

Based on the analysis of the person trip survey data, private mode share in intra zonal trip correlate proportionally with car ownership rate. As the rate of car ownership increases, private mode share increases in direct proportion. The relationship between private mode share in intra zone and car ownership rate are modeled as shown in Figure12.5-4. Using the models above, the average private mode shares in the future are estimated as shown in Table12.5-7. Private mode share in each zone is available in Section 12.2 of Appendix 12.



(To Home)



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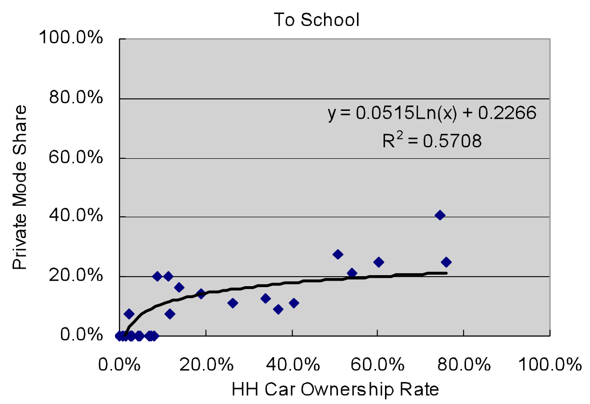

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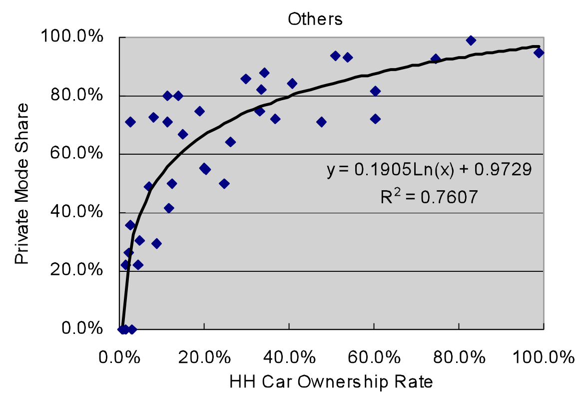


(Others)

FIGURE 12.5-4 RELATIONSHIP BETWEEN INTRA ZONAL PRIVATE MODE SHARE AND CAR OWNERSHIP RATE

TABLE 12.5-7 INTRA ZONAL PRIVATE MODAL SHARE (AVERAGE IN THE STUDY AREA)

Year	HH Car Ownership Rate (%)	Trip Purpose			
		HOME	WORK	SCHOOL	OTHERS
2004	23.3%	52.2%	45.1%	19.2%	76.3%
2010	31.1%	55.1%	48.4%	20.1%	79.7%
2015	41.3%	57.9%	51.7%	21.0%	83.0%
2025	49.2%	62.2%	56.7%	22.4%	88.2%

(8) Future Modal Split

Using the modal split models built above, the future modal split of person trips were projected. The projection was performed under the framework of "Do-nothing" case in 2010, 2015, and 2025 (See Table 12.5-8).

TABLE 12.5-8 FUTURE MODAL SHARE IN DO-NOTHING CASE

	WALK	PRIVATE	PUBLIC	TOTAL
2004	2,326,021	723,614	1,704,392	4,754,027
	49%	15%	36%	100%
2010	2,818,637	1,048,843	2,062,050	5,929,530
	48%	18%	35%	100%
2015	3,014,587	1,386,154	2,246,295	6,647,036
	45%	21%	34%	100%
2025	3,613,754	2,156,583	2,505,633	8,275,969
	44%	26%	30%	100%

The future demand for private and public transport in 2025 was estimated 2.1 million trips and 2.5 million trips in 2025. Comparing the future estimations with the existing case' the number of car trips increases almost three times, whereas the share of private mode trips reaches double, reflecting the high increment of car ownership rate. On the other hand, whereas the number of public transport trips increases slightly, but the total share of public transport decreases. (See Figure 12.5-5 and 12.5-6)

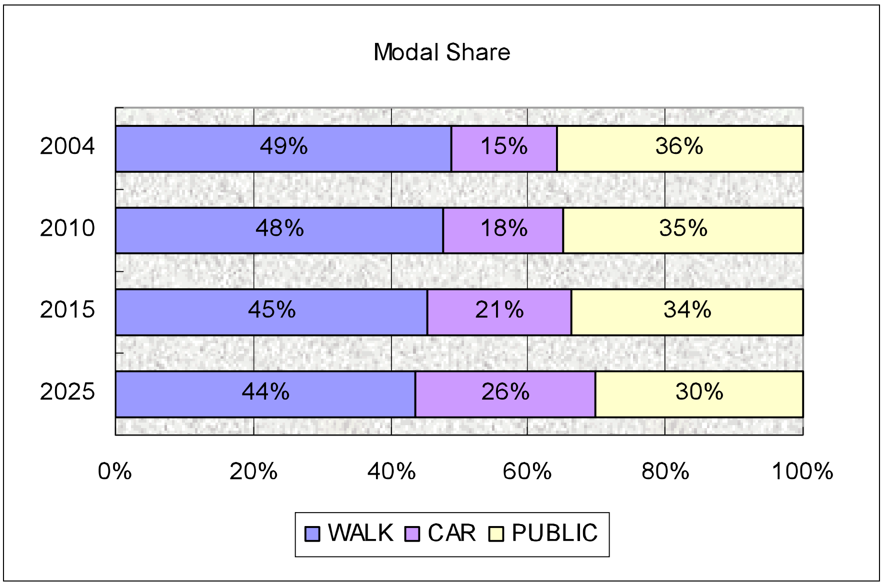
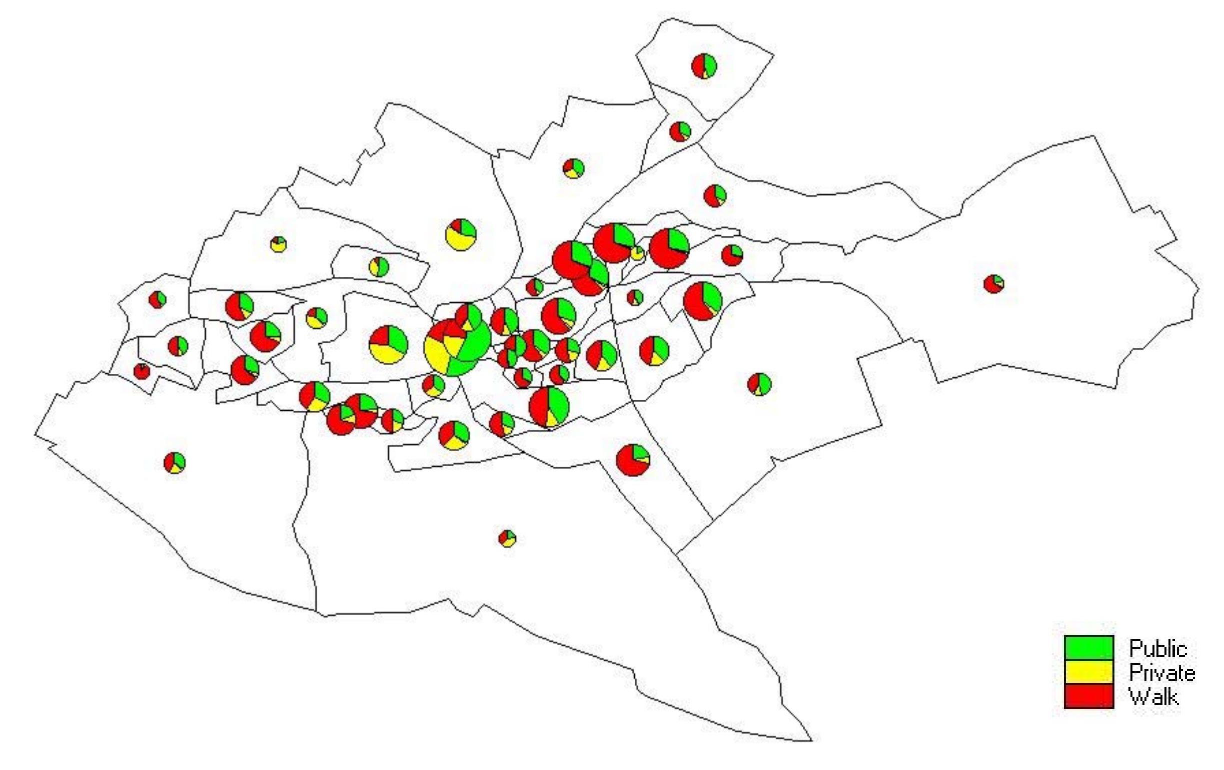
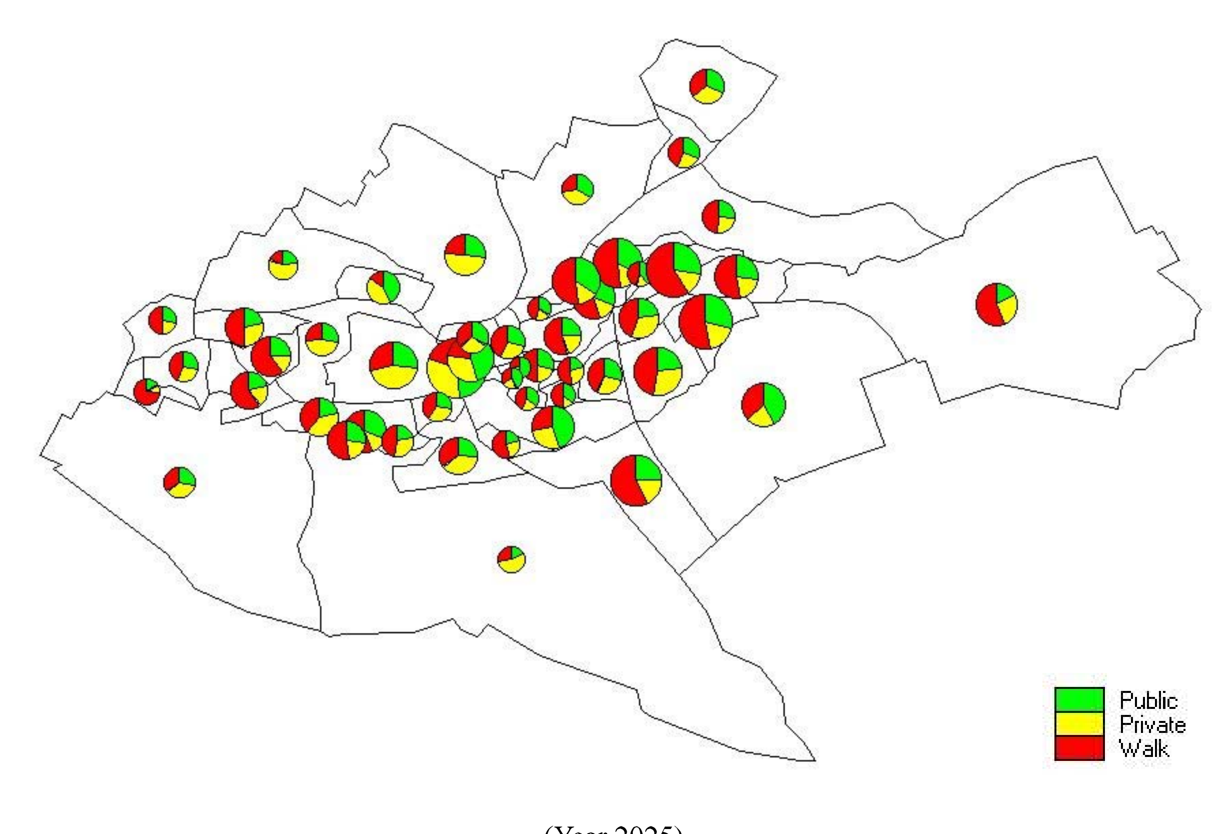


FIGURE 12.5-5 FUTURE MODAL SHARE



(Year 2004)



(Year 2025)

FIGURE 12.5-6 MODAL SHARE BY ZONE (GENERATION BASE) IN 2004 AND 2025

12.6 EXTERNAL ZONE DEMAND

The traffic demand related to external zones is classified into external-external, internal-external, external-internal trips. The existing demand obtained from the Cordon Line Survey is added to the Person Trip Survey data. Future demands related to external zone were forecast by the growth factor method. Applied growth factors in the year of 2010, 2015, and 2025 against 2004 are presented in Table 12.6-1.

TABLE 12.6-1 GROWTH FACTORS FOR EXTERNAL ZONE DEMAND

Area		Div. No.	Pass. Car	Bus	Truck	Remarks
NAIROBI		1 – 8	145% 192% 298%	121% 132% 147%	116% 134% 180%	Growth Rate of the Person Trip Base Estimation
CENTRAL	Thika	9	132% 172% 251%	132% 172% 251%	116% 134% 180%	
	Kiambu	10	108% 124% 157%	108% 124.8% 157.2%	116% 134% 180%	
RIFT VALLEY	Kajiado	11	108% 124% 157%	108% 124% 157%	116% 134% 180%	
EASTERN	Machakos	12	132% 172% 251%	132% 172% 251%	116% 134% 180%	
Outside Nairobi Metropolitan Area			116% 134% 180%	116% 134% 180%	116% 134% 180%	Growth Rate of GDP per Capita in Kenya
Remarks			Growth Rate of Population	Growth Rate of Population	Growth Rate of GDP per Capita in Nairobi City	

Note: Upper: 2010/2004, Middle: 2015/2004, Lower: 2025/2004

12.7 FUTURE TRAFFIC ASSIGNMENT

The traffic assignment process allocates vehicle traffic to individual roadway links. This step takes as input a matrix that indicates the volume of vehicle traffic between origin and destination pairs.

(1) Car Assignment Model

<u>Assignment Method</u>

TRANSCAD supports a wide variety of assignment methods, including all-or-nothing assignments, STOCH assignments, incremental assignments, capacity restraint, and user equilibrium assignments. Since it was desired to consider the impacts of link volume and congestion when assigning trips to a particular path, the all-or-nothing and STOCH methods were considered inappropriate.

A user equilibrium assignment technique was selected for this Study. The user equilibrium assignment prepared in TRANSCAD defines a routine such that every traveler has perfect information concerning the attributes of network alternatives, all travelers choose routes that minimizes their travel time or travel costs, and all travelers have the same valuations of network attributes.

Auto Occupancy Rate and Passenger Car Unit

Trips generated by trip purpose during the trip generation step (and consequently through the trip distribution step) are defined in person trips, as discussed above. Auto occupancy rates and passenger car units (PCU) are utilized to convert from person trips to vehicle trips prior to assigning the traffic to the roadway network. These factors which are obtained from the Screen Line Survey and the Cordon Line Survey are shown Table 12.7-1.

TABLE 12.7-1 OCCUPANCY RATE AND PASSENGER CAR UNIT

Mode	Auto Occupancy Rate		Passenger Car Unit	
	Screen Line Data	Cordon Line Data	Screen Line Data	Cordon Line Data
Private(Car)	1.7	3.1	1.10	1.15
Public(Bus)	19.0	14.7	1.55	1.60

Note: PCU: Passenger Car=1.0, Matatu=1.5, Bus=2.5, Light Truck=1.5, Heavy Truck=3.0

Link Cost Function

Inputs required for user equilibrium assignment (and other capacity restrained assignment methods) are expressed in terms of link performance functions. These functions describe the travel time across a link under various conditions of congestion as measured by volume-to-capacity ratios. The most commonly applied function is the BPR (Bureau of Public Roads) equation. In this equation, the user selects link capacity and two calibration parameters (alpha and beta). While the basic BPR equation used values of 0.15 and 4.0 for alpha and beta, respectively, recent surveys for daily traffic assignment suggest values 0.48 for alpha and 2.82 for beta. The resulting variation of link speed using these values is demonstrated in Figure 12.7-1 and Table 12.7-2.

$$Vc = Vo / \{1 + \alpha (Vol/ C)^\beta \}$$

Where, Vc: Congested Speed

Vo: Free-Flow Speed

Vol: Traffic Volume (PCU)

C: Ideal Traffic Capacity (PCU)

α =0.48, β =2.82

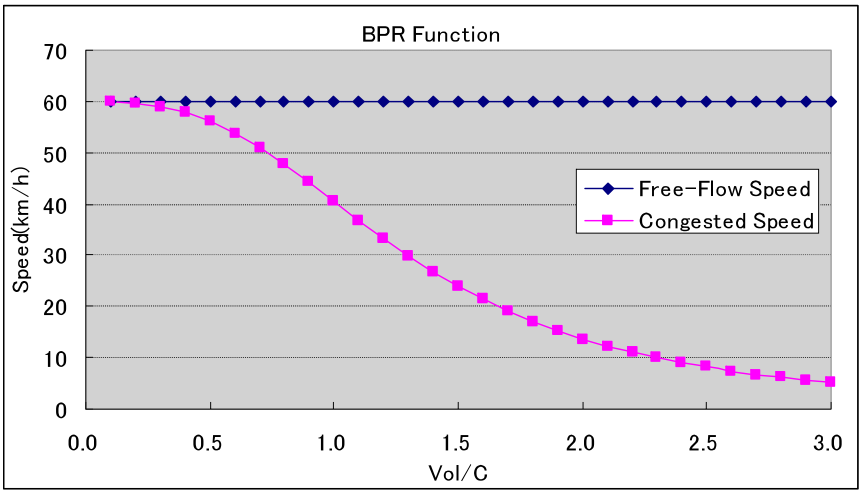


FIGURE 12.7-1 TRAVEL SPEED VARIATION WITH VOL/C

TABLE 12.7-2 FREE FLOW SPEED AND CAPACITY BY ROAD TYPE

Location	Carriageway	Lane	Surface	V0	C
Urban	Divided	6	Paved	60	75000
		4	Paved	50	50000
	Undivided	6	Paved	50	60000
		4	Paved	45	40000
		2	Paved	40	20000
		2	Unpaved	30	10000
Suburban & Rural	Divided	6	Paved	60	90000
		4	Paved	60	60000
	Undivided	4	Paved	50	50000
		2	Paved	45	30000
		2	Unpaved	45	10000
Mountainous	Divided	4	Paved	40	50000
	Undivided	4	Paved	35	40000
		2	Paved	30	20000
		2	Unpaved	20	10000

Note: Vo: Free-Flow Speed (km/h), C: Ideal Traffic Capacity (PCU/day)

(2) Transit (Bus and Rail Mode Passenger) Assignment Model

The all-or-nothing assignment method adopted in the TRANSCAD system, is chosen as the Public mode assignment model.

12.8 ASSESSMENT OF PRESENT TRANSPORT NETWORK

With the objective of effectively assessing the transport policy and undertaking countermeasure studies, it was first assumed that no improvement would be achieved in the transportation supply initially. This is referred to as the "Do-Nothing" case analysis. The car assignment results of the existing case (2004) and "Do-Nothing" case in 2010, 2015 and 2025, are summarized in Table 12.8-1.

TABLE 12.8-1 CAR ASSIGNMENT RESULTS IN DO-NOTHING CASE

	Year 2004	Year 2010	Year 2015	Year 2025
Total Vehicle Trips (in PCU)	779,774	1,055,821	1,331,490	1,933,581
PCU-Hour ('000)	286	554	903	2,484
PCU-Km ('000)	9,935	14,260	17,984	27,934
Average Speed (km/hr)	34.7	25.7	19.9	11.2

Comparing the future road traffic with the existing one, it is apparent that the radial corridors will become heavily congested in the future. Thus, the following derivations are made. (See Tables 12.8-2 and 12.8-3, and Figures 12.8-1 to 12.8-4)

- If any countermeasures against traffic congestion are not implemented in the transport sector, when road traffic volumes drastically increase, the level of service of the road will certainly become worse.
- If improvement of level of service in public transport is not carried out, the number of passengers utilizing public transport will either remain stagnant or deteriorate. This will induce financial difficulties in the public transport sector.
- Some countermeasures to decrease car traffic and increase public mode transport are necessary in the near future.

TABLE12.8.2 ASSESSMENT OF PRESENT TRANSPORT NETWORK CONDITIONS - URBANIZED AREA

Year					2004			2010 Do Nothing			2015 Do Nothing			2025 Do Nothing		
	Area	Name of Road	No. of Lane	Capacity (PCU)	Traffic Vol.(PCU)	V/C Ratio	Required No. of Lane	Traffic Vol.(PCU)	V/C Ratio	Required No. of Lane	Traffic Vol.(PCU)	V/C Ratio	Required No. of Lane	Traffic Vol.(PCU)	V/C Ratio	Required No. of Lane
Radial Road	North	R-6 Thika Road	4	60,000	60,577	1.01	6	93,059	1.55	8	107,493	1.79	10	142,824	2.38	12
		S-5 Kiambu Road	2	25,000	16,390	0.66	2	28,689	1.15	4	36,631	1.47	4	48,436	1.94	4
	East	R-7 Koma Rock	2	25,000	10,923	0.44	2	21,736	0.87	4	26,983	1.08	4	42,693	1.71	4
		S-7 Kangundo Road	2	20,000	7,470	0.37	2	18,808	0.94	2	23,424	1.17	4	36,167	1.81	4
	South East	R-1 Mombasa Road	4	50,000	27,961	0.56	4	40,742	0.81	4	50,893	1.02	6	78,897	1.58	8
	South West	R-2 Langata Road	2	25,000	19,415	0.78	2	30,088	1.20	4	37,495	1.50	4	53,754	2.15	6
	West	R-3 Ngong Road	2	25,000	11,199	0.45	2	11,806	0.47	2	15,922	0.64	2	24,078	0.96	2
		S-3 Naivasha Road	2	25,000	8,474	0.34	2	16,581	0.66	2	19,717	0.79	2	32,128	1.29	4
	North West	R-4 Waiyaki Way	4	50,000	39,616	0.79	4	51,133	1.02	6	62,303	1.25	6	86,564	1.73	8
		R-5 Limuru Road	2	25,000	6,432	0.26	2	9,141	0.37	2	12,911	0.52	2	26,155	1.05	4
		Red Hill Road	2	25,000	5,584	0.22	2	6,597	0.26	2	12,052	0.48	2	27,037	1.08	4
		S-4 Lower Kabete Road	2	25,000	10,707	0.43	2	19,325	0.77	2	24,211	0.97	2	36,834	1.47	4
	Total		**30**	**380,000**	**224,748**	0.59	**32**	**347,705**	0.92	**42**	**430,035**	1.13	**48**	**635,567**	1.67	**64**
Ring Road	East	C-3 First Avenue	2	20,000	12,346	0.62	2	21,685	1.08	4	27,429	1.37	4	37,967	1.90	4
		C-4 Outer Ring Road	2	25,000	26,214	1.05	4	45,086	1.80	4	52,369	2.09	6	71,676	2.87	6
	West	C-2 Mbagathi Road	4	50,000	22,913	0.46	4	38,694	0.77	4	48,514	0.97	4	73,051	1.46	6
		C-4 James Gichuru Road	2	20,000	16,677	0.83	2	22,935	1.15	4	28,968	1.45	4	40,412	2.02	4
URBANIZED AREA Total			**40**	**495,000**	**302,898**	0.61	**44**	**476,105**	0.96	**58**	**587,315**	1.19	**66**	**858,673**	1.73	**84**

TABLE 12.8.3 ASSESSMENT OF PRESENT TRANSPORT NETWORK CONDITIONS - CENTRAL AREA

Year					2004			2010 Do Nothing			2015 Do Nothing			2025 Do Nothing		
	Area	Name of Road	No. of Lane	Capacity (PCU)	Traffic Vol.(PCU)	V/C Ratio	Required No. of Lane	Traffic Vol.(PCU)	V/C Ratio	Required No. of Lane	Traffic Vol.(PCU)	V/C Ratio	Required No. of Lane	Traffic Vol.(PCU)	V/C Ratio	Required No. of Lane
Radial Road	North	R-6 Muranga Road	4	50,000	83,849	1.68	8	116,640	2.33	10	137,663	2.75	12	178,826	3.58	14
	East	R-7 Jogoo Road	4	50,000	63,601	1.27	6	84,653	1.69	8	100,198	2.00	10	133,133	2.66	12
		R-8 Juja Road	2	20,000	25,031	1.25	4	33,863	1.69	4	39,196	1.96	4	52,964	2.65	6
	South East	R-1 Mombasa Road	4	50,000	39,313	0.79	4	51,538	1.03	6	61,253	1.23	6	82,249	1.64	8
		S-1 Enterprise Road	4	50,000	20,329	0.41	4	31,669	0.63	4	39,282	0.79	4	55,014	1.10	6
	South West	R-2 Langata Road	4	60,000	44,123	0.74	4	61,650	1.03	6	74,717	1.25	6	102,927	1.72	10
	West	R-3 Ngong Road	2	25,000	30,146	1.21	4	50,706	2.03	6	55,460	2.22	6	73,834	2.95	6
	North West	R-4 Chiromo Road	6	75,000	72,693	0.97	6	89,132	1.19	8	105,829	1.41	10	143,081	1.91	12
		R-5 Limuru Road	2	20,000	16,300	0.82	2	26,014	1.30	4	31,864	1.59	4	48,209	2.41	4
		S-4 Parklands Road	2	20,000	12,194	0.61	2	17,985	0.90	2	20,642	1.03	4	28,355	1.42	4
CENTRAL AREA Total			**34**	**420,000**	**407,579**	0.97	**44**	**563,850**	1.34	**58**	**666,104**	1.59	**66**	**898,592**	2.14	**82**

FIGURE 12.8-1 CAR ASSIGNMENT RESULT IN EXISTING CASE (2004)

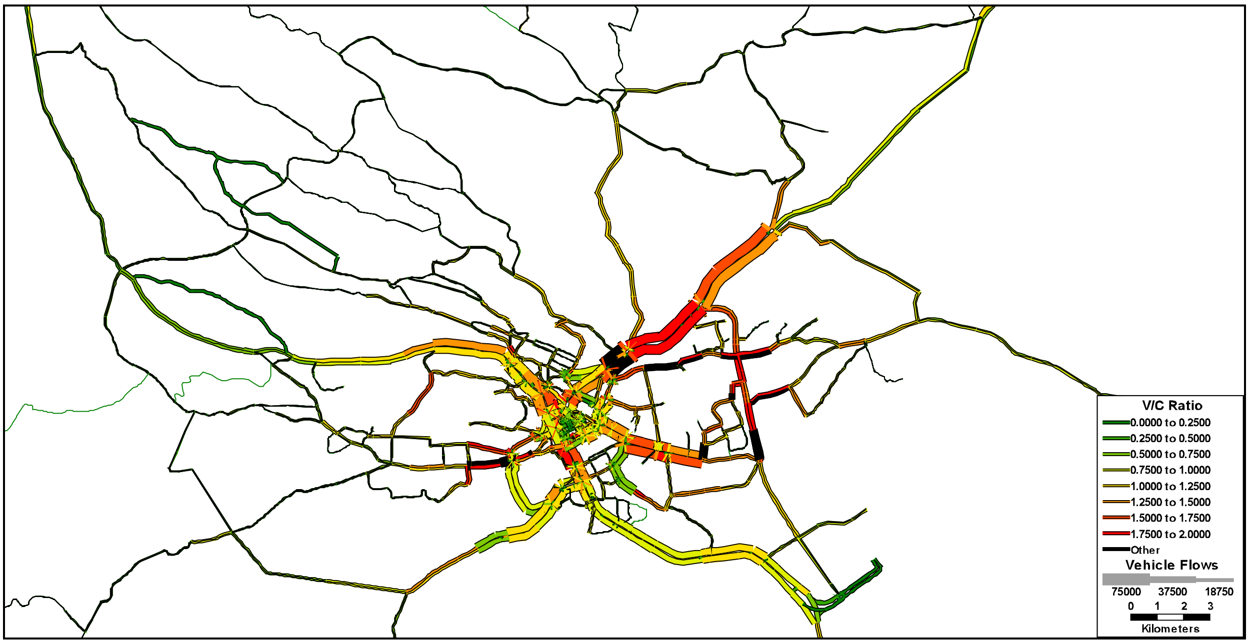


FIGURE 12.8-2 CAR ASSIGNMENT RESULT IN DO-NOTHING CASE 2010

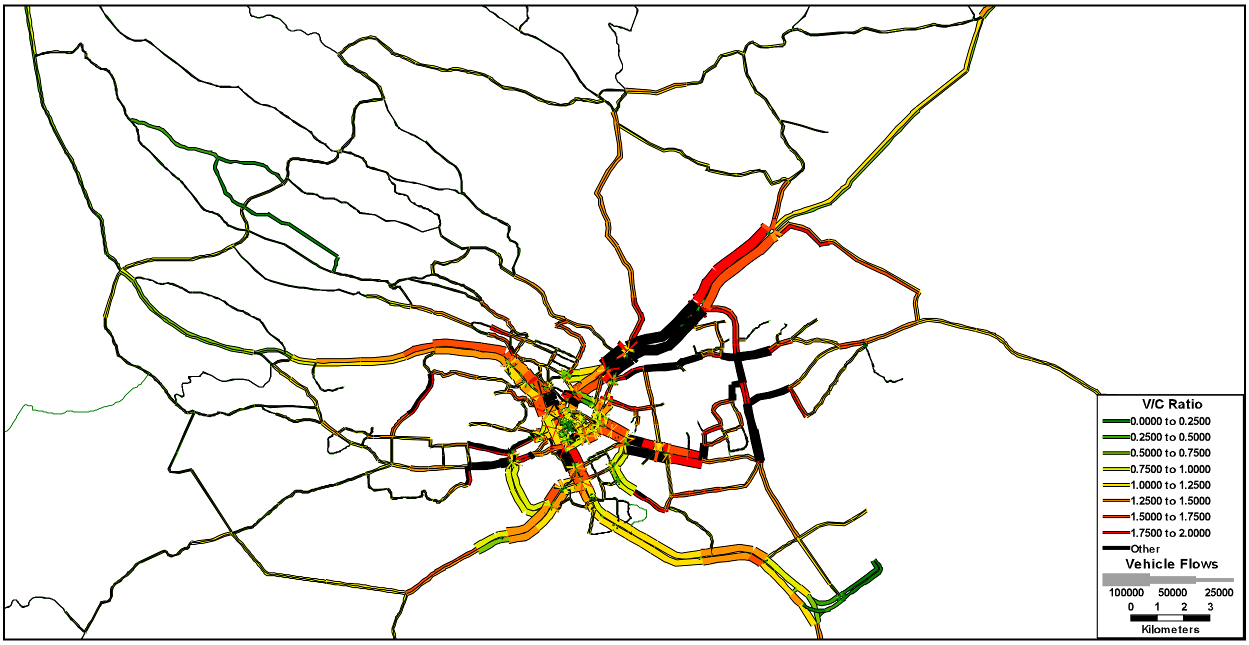


FIGURE 12.8-3 CAR ASSIGNMENT RESULT IN DO-NOTHING CASE 2015

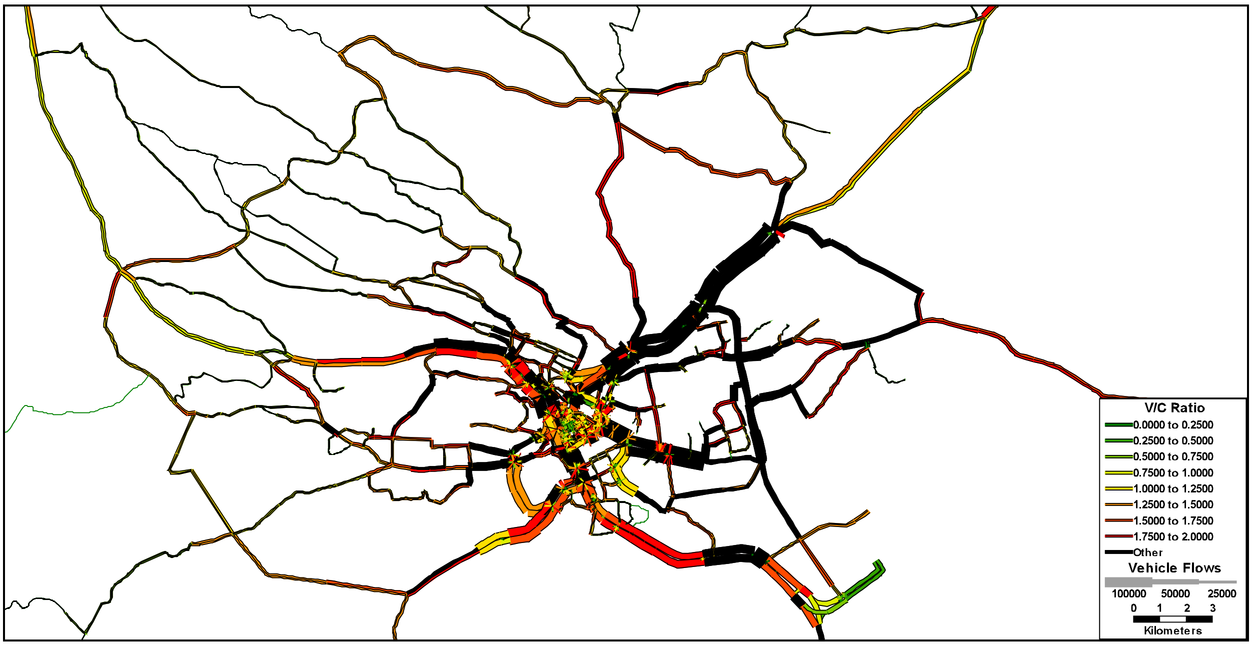


FIGURE 12.8-4 CAR ASSIGNMENT RESULT IN DO-NOTHING CASE 2025