CHAPTER 15

TRAFFIC DEMAND FORECAST

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15.1 Introduction

The purpose of this chapter is to first construct a traffic demand model and then to forecast future traffic volumes for the 2000 km study route for the target years of 2005 and 2015, by referring to and/or applying the following four items:

1) the socio-economic framework of Chapter 14;
2) the results from further detailed socio-economic analyses carried out in this chapter;
3) the results of the traffic surveys executed by this Study; and
4) existing traffic and transportation survey data from KGM.

The main function of the traffic demand forecasts are to provide input for the economic evaluation of the future maintenance scenarios contained in Chapter 16.

15.2 Forecasting Methodology

The methodology that will be applied to forecast traffic demand for this Study is as indicated in Figure 15.2.1.

The focus of this methodology is comprised of three models that predict daily vehicle-km for passenger vehicles, buses, and trucks by province, which are constructed using the variables of provincial population, vehicle ownership, and gross domestic product. These variables are analysed and projections carried out for the years 2005 and 2015 in order to make future vehicle-km estimates.

After building the above three models and predicting future vehicle-km by province for each vehicle type, a traffic flow processing ratio is applied to obtain the future daily vehicle-km for individual road links. This ratio is equivalent to the vehicle-km processed by a link to the total vehicle-km of a provincial road network for each vehicle type. Daily vehicle-km for links are then converted into daily vehicle flows by dividing by link distances. Finally, since road improvements will have an effect on traffic flows, a factor to account for increases in traffic from greater link capacity is included.

It should be noted here that, owing to the non-existence of important data such as origin-destination trip tables and average trip lengths, conventional traffic assignment was not a feasible option.

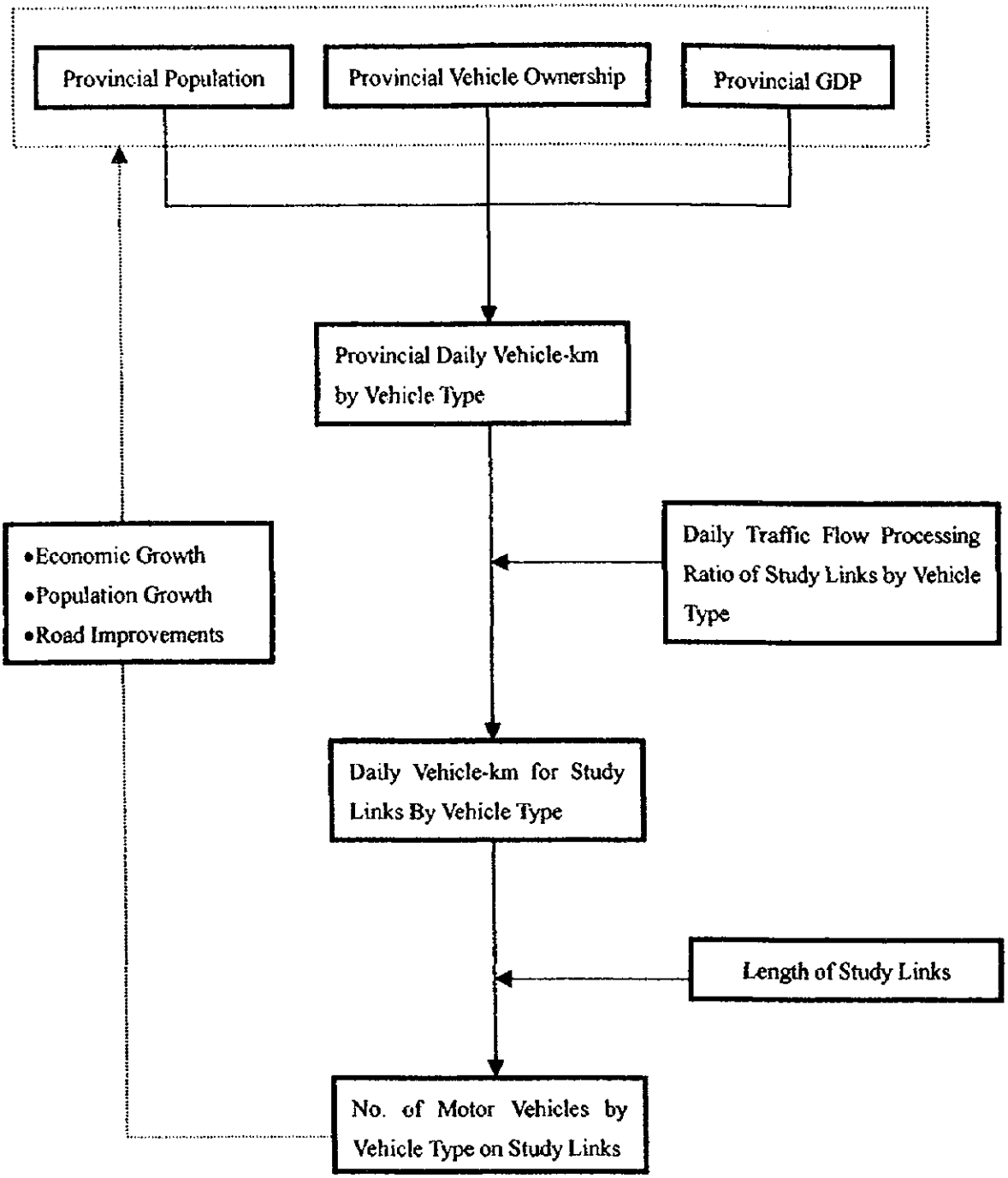


Fig. 15.2.1 Flow for Predicting Traffic Volumes on Links of Study Route

15.3 Data Collection and Analyses

To predict study link traffic volumes based on the above methodology, it is necessary to collect and analyse both socio-economic and traffic related data. These data are analysed in sections 15.3.1 and 15.3.2, respectively. Of the existing traffic data, it should be mentioned that KGM's traffic volumes for the state road network for 1996 from the "Traffic and Transportation Survey" play a central role in the construction of the traffic demand model, i.e.,

these volumes serve as the basis for predicting future traffic on the road links of the study route.

15.3.1 Socio-economic Data and Analysis

Below, the variables that comprise the vehicle-km models are examined and future projections carried out at the provincial level; although, care was taken to ensure that national average growth rates were approximately equal to those stated in Chapter 14. All of these data are from the Turkish State Institute of Statistics.

(1) Population

Future population was projected using census data for 1985, 1990, and 1995, as well as a forecast data for the year 2000. Based on these data, population forecasts for 76 Turkish provinces were carried out. The results are shown in Fig. 15.3.1.

As Fig. 15.3.1 indicates, population will increase at a rate of less than 2% in most of western Turkey; although, the provinces of Istanbul and Bursa will experience growth of more than 3% a year and Kocaeli and Antalya of more than 4% a year. As for central Turkey, the number of its inhabitants will continue to increase at less than 2% annually. In the case of south-eastern Turkey, population is set to grow at the high rates of 3 to 4% annually, while the remaining part of eastern Turkey (especially the north-eastern border provinces) will experience relatively large declines or little or no growth.

(2) GDP

Future GDP was forecasted applying population as an explanatory variable in a simple regression equation, using 1996 GDP (at 1987 prices) and 1995 population figures for 76 Turkish provinces. The coefficient of determination (R^2) for this equation was 0.931, with the t-statistic for population being 31.902.

Future GDP growth based on the above relation is shown in Fig. 15.3.2. The pattern of growth is of course similar to that of population, with there being strong increases of more than 3% a year in western and south-western Turkey. However, most of central and eastern Turkey, as well as the Black Sea area, will experience either negative economic growth or little or no growth. This analysis assumes that present production methods will remain essentially the same and that the allocation of resources is relatively efficient, meaning that any decrease in population will lead to a direct decrease in economic output.

(3) Vehicle Ownership

One of the most important factors affecting vehicle ownership is GDP. Here, the national share of provincial GDP was first applied in a simple regression equation to predict the national share of provincial vehicle stock for 1996. The R^2 of this equation was 0.960 and the t-statistic for GDP 42.358.

The results of the above regression analysis were then multiplied by the future total number of vehicles in Turkey, which was forecasted using time-series data, in order to obtain overall vehicle totals for each province. These totals were then multiplied by current vehicle-type percentages per province to arrive at the number of vehicles by type. Since passenger cars account for more than 90% of the vehicles in many provinces, it is safe to assume that these percentages will remain rather static, as motorization is fairly well advanced.

The results of the above analysis are shown in Fig. 15.3.3. Again, as in the analysis for population and GDP, western and south-western Turkey will experience the strongest growth (more than 9% annually for many provinces), while central Turkey will experience relatively weaker growth (between 5 and 7%). On the other hand, many of the provinces in the Black Sea area and the far eastern part of Turkey will see overall vehicle growth of less than 4 or 5%.

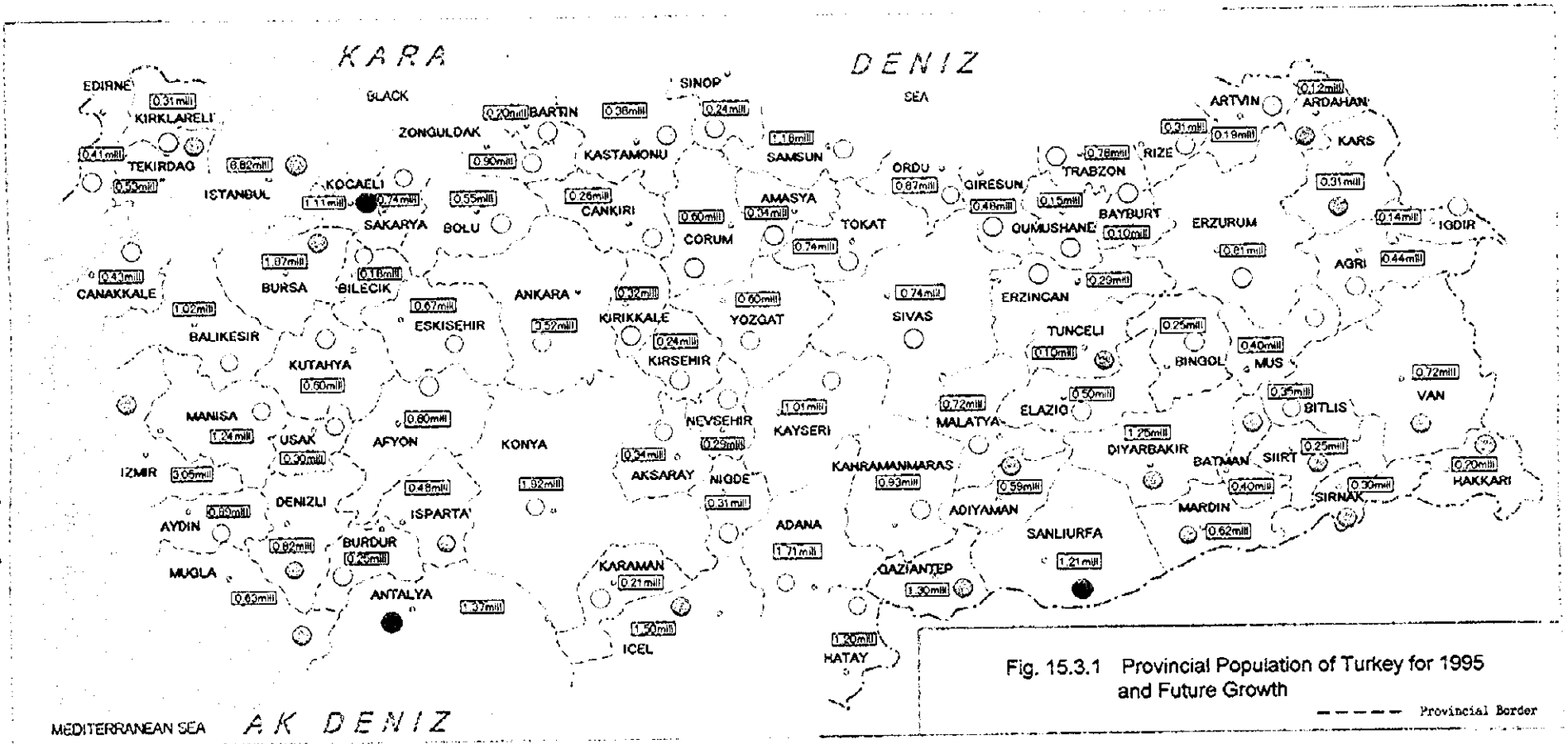


Fig. 15.3.1 Provincial Population of Turkey for 1995 and Future Growth

Provincial Border

Future Annual Growth	
Growth > 4%	
4%≥Growth>2%	
2%≥Growth>0%	
0%≥Growth>-2%	
-2%≥Growth>-4%	
-4%≥Growth	

Note: Yalova, Karabuk, Kilis, and Osmaniye are subsumed within Istanbul, Zonguldak, Gaziantep, and Adana, respectively.

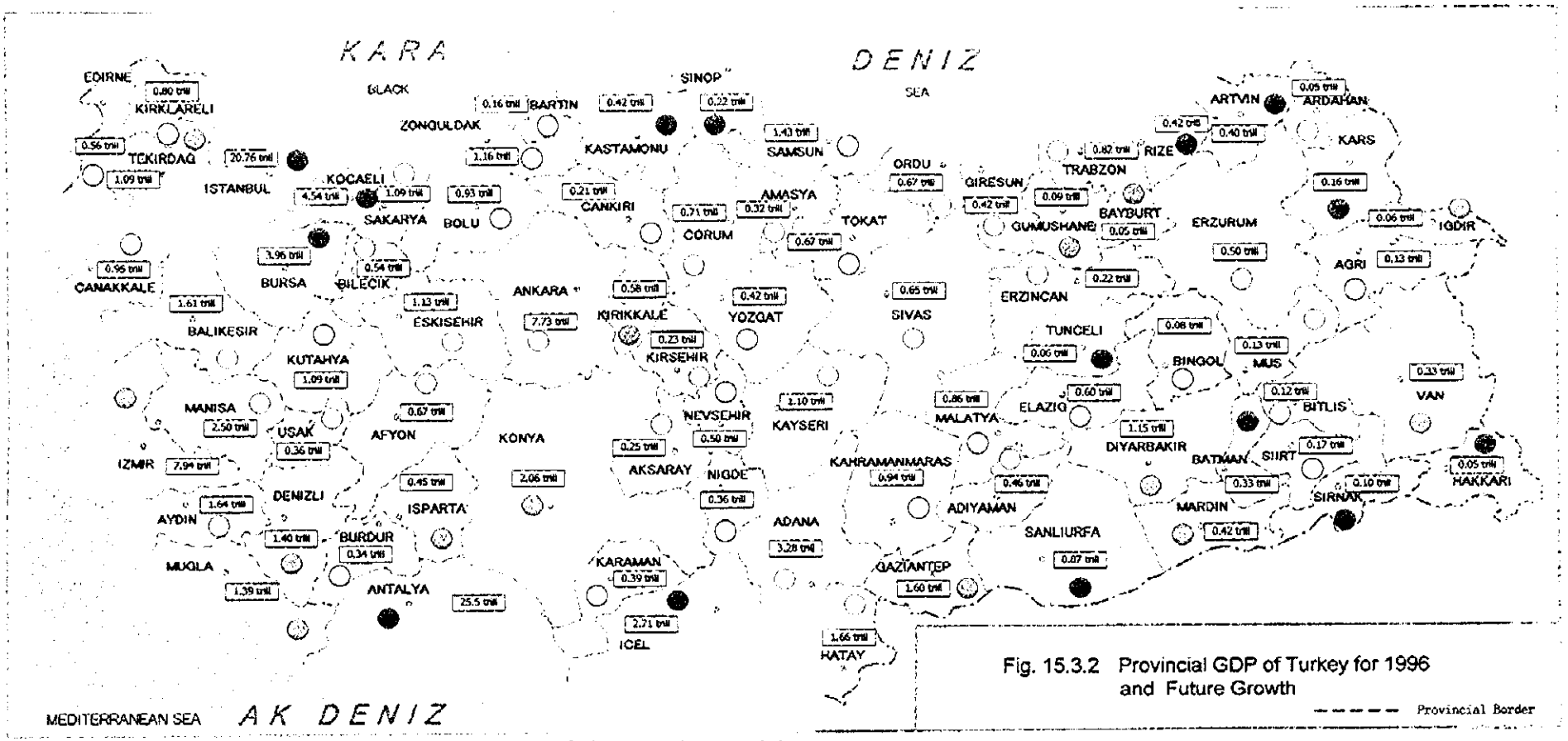


Fig. 15.3.2 Provincial GDP of Turkey for 1996 and Future Growth

Provincial Border

Future Annual Growth	
Growth>3%	
3%≥Growth>2%	
2%≥Growth>1%	
1%≥Growth>0%	
0%≥Growth>-1%	
-1%≥Growth>-2%	
-2%≥Growth	

Note: Yalova, Karabuk, Kilis, and Osmaniye are subsumed within Istanbul, Zonguldak, Gaziantep, and Adana, respectively.

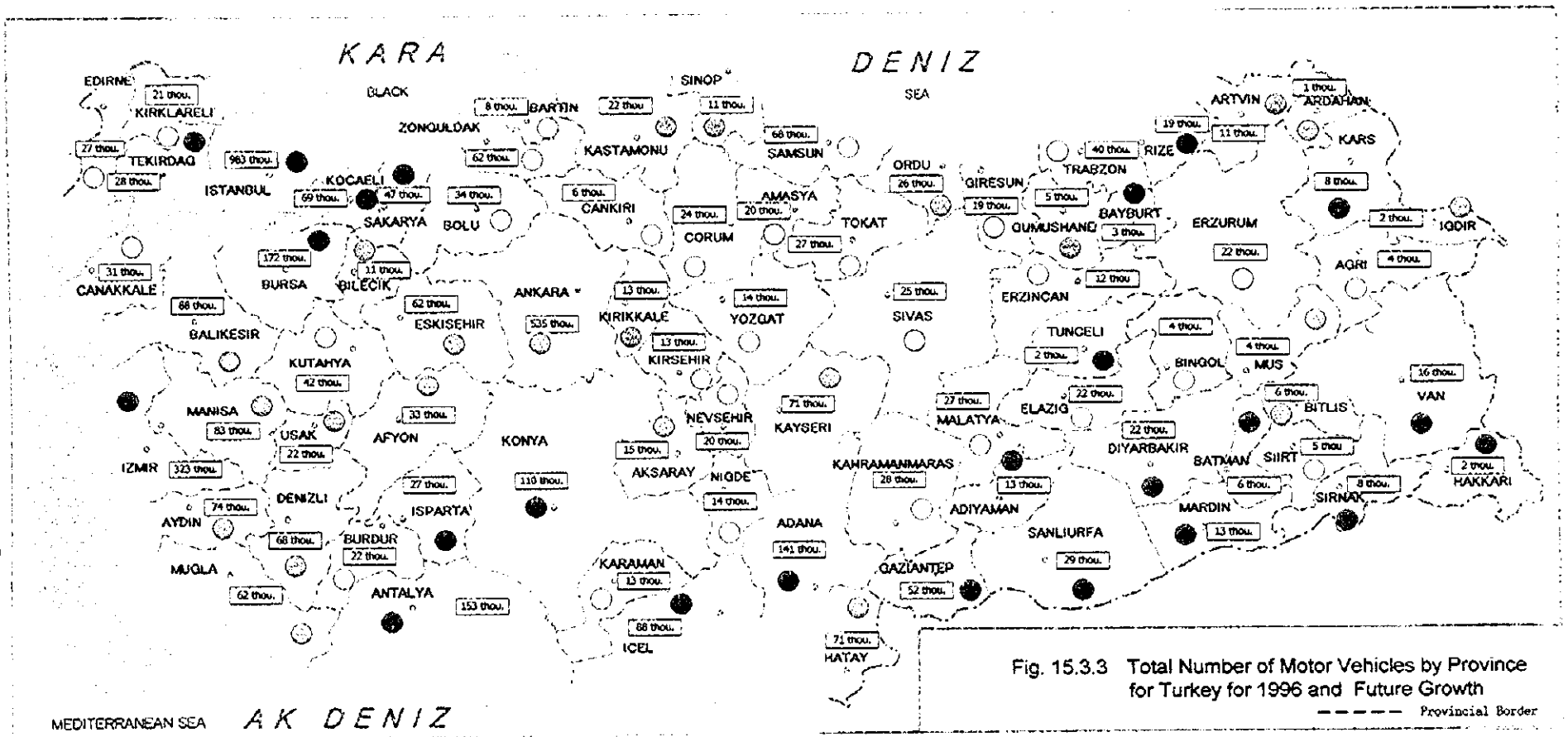


Fig. 15.3.3 Total Number of Motor Vehicles by Province for Turkey for 1996 and Future Growth

Note: Yalova, Karabuk, Kilis, and Osmaniye are subsumed within Istanbul, Zonguldak, Gaziantep, and Adana, respectively.

15.3.2 Data Collection via Traffic Surveys

Besides socio-economic data and analysis, traffic data and analysis is also required in order to build or confirm components of the traffic demand model. In addition to existing traffic data, it was decided that traffic surveys were needed for obtaining more information for this work. Below is a description of the surveys carried out and the analysis of their results.

(1) Objectives of Traffic Surveys

Three traffic surveys (a traffic volume survey, traffic speed survey, and turning movement survey) were executed by the Study Team in order to accomplish the following objectives:

1) confirm and, if necessary, supplement existing KGM traffic volume data,
2) collect and determine traffic speeds,
3) check the relationship between traffic speed and volume, and
4) check the turning movements of traffic at major strategic intersections on the study route.

(2) Selection of Survey Points

It was decided that the traffic volume and speed surveys would be carried out at 12 locations, while the turning movement survey would be carried out at 6 locations. The survey points were basically chosen from the major routes and intersections of the 2000 km study route, with a few exceptions included to provide a more in-depth understanding of the traffic characteristics of Turkey. A detailed description of the survey points are contained in tables 15.3.1 and 15.3.2, with a graphic depiction being provided by Figure 15.3.4.

Table 15.3.1 Location of Survey Points for Traffic Volume/Speed Measurements

No.	Name of Location	Division No.	Sub-division No.	Control Section No.	Km-post
1	Kizilcahamam	4	42	750-05	34
2	Kaynasli	4	41	100-11	38
3	Cumayeri	4	41	100-11	3
4	Samsun/Terme	7	75	010-16	7
5	Trabzon/Yomra	10	105	010-22	12
6	Izmit/Hereke	1	14	100-07	26
7	Istanbul/Gebze	1	14	100-07	6
8	Havza	7	75	795-02	25
9	Merzifon	7	72	795-03	12
10	Eskisehir	4	46	200-07	6
11	Dinar/Afyon	13	134	650-10	44
12	Celtikci/Burdur	13	134	650-12	50

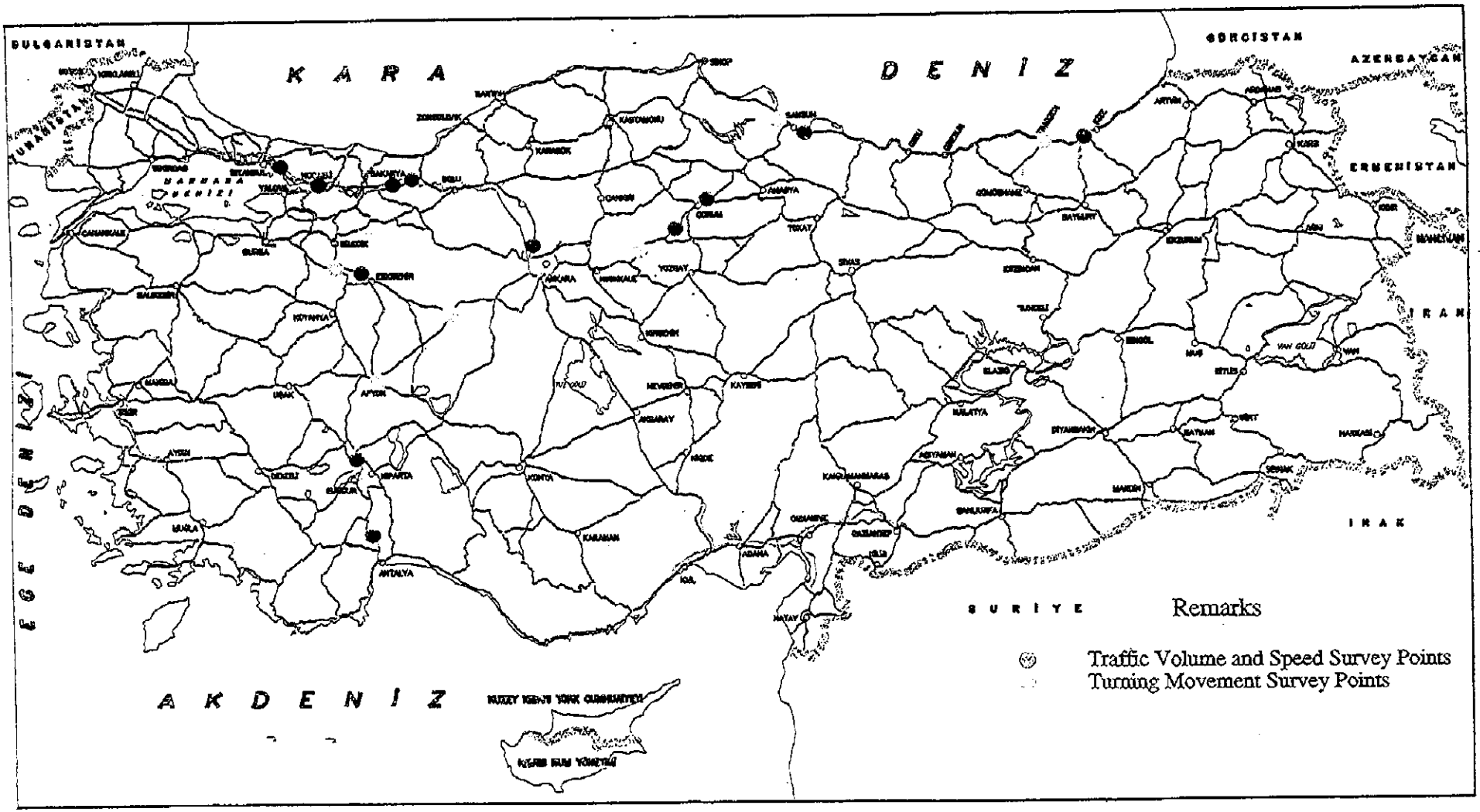


Fig.15.3.4 Traffic Survey Points

15.3.3 Analysis of Traffic Survey Data

(1) Traffic Volume Survey

The results of the traffic volume survey are shown in Table 15.3.3 below. As the table indicates, the traffic volumes of the Study Team survey do not differ much from those of KGM. That is, traffic volumes at 7 of the 12 survey sites were between 0.90 and 1.10 times the traffic volumes contained in KGM's "Traffic and Transportation Survey" report. As for the overall average, Study Team values were 1.10 times higher than those of KGM. There were only two sites that had large deviations: Celtikci and Hereke. The former could perhaps be due to seasonal fluctuations (it is located near a major resort area) and the latter to miscounting because of the large traffic volumes (e.g., Hereke).

Based on the above survey results, it was determined that KGM traffic volumes are reliable and will be applied as is in the building of the traffic demand model.

Table 15.3.3 Comparison of KGM and Study Team Traffic Volume Measurements

Name of Location	Division No.	Control Sect. No.	Segment No.	KGM Traffic Volume*	Study Team Traffic Volume**	Study/KGM Volume Ratio
Kizilcahamam	4	750-05	3	5301	4802	0.91
Kaynasli	4	100-11	5	15431	15436	1.00
Cumayeri	4	100-11	2	7473	10244	1.37
Samsun/Terme	7	010-16		10817	12487	1.15
Yomra	10	010-22	1	8711	8881	1.02
Hereke	1	100-07	2	33819	16870	0.50
Gebze	1	100-07	1	44923	35282	0.78
Havza	7	795-02	2	7741	7714	1.00
Merzifon	7	795-03	0	3659	3621	0.99
Bilecik	14	200-08	1	11565	11724	1.01
Dinar	13	650-10	2	4627	4218	0.91
Celtikci	13	650-12	2	4261	7519	1.76
Average						1.10

*: KGM traffic volumes are 24-hour values.

**: Study Team traffic volumes have been converted into 24-hour values using curve-fitting techniques.

(2) Traffic Speed Survey

The results of the traffic speed survey have been expressed as distribution curves for two-lane and multilane highways, as shown in Fig. 15.3.5 and Fig. 15.3.6. As these figures indicate, the average speed for a two-lane highway is 74 km/h and for a multilane highway 86 km/h. The distributions are relatively symmetrical (or normal in shape), but have a rather large standard

deviation. This is probably due to differences in the geography and highway geometry of the survey sites.

The average speeds obtained by the Study Team survey indicate that traffic on state roads is operating near free-flow conditions and that there is still plenty of capacity remaining on inter-city highways. In fact, after examining the relationship between average speed and traffic volume for 15-minute intervals for each of the survey sites, it was impossible to detect any significant decreases in speed as a result of traffic congestion.

Finally, the speeds obtained here are used as a reference for the application of the HDM model later on in this report and for establishing assumptions concerning traffic assignment later on in this chapter.

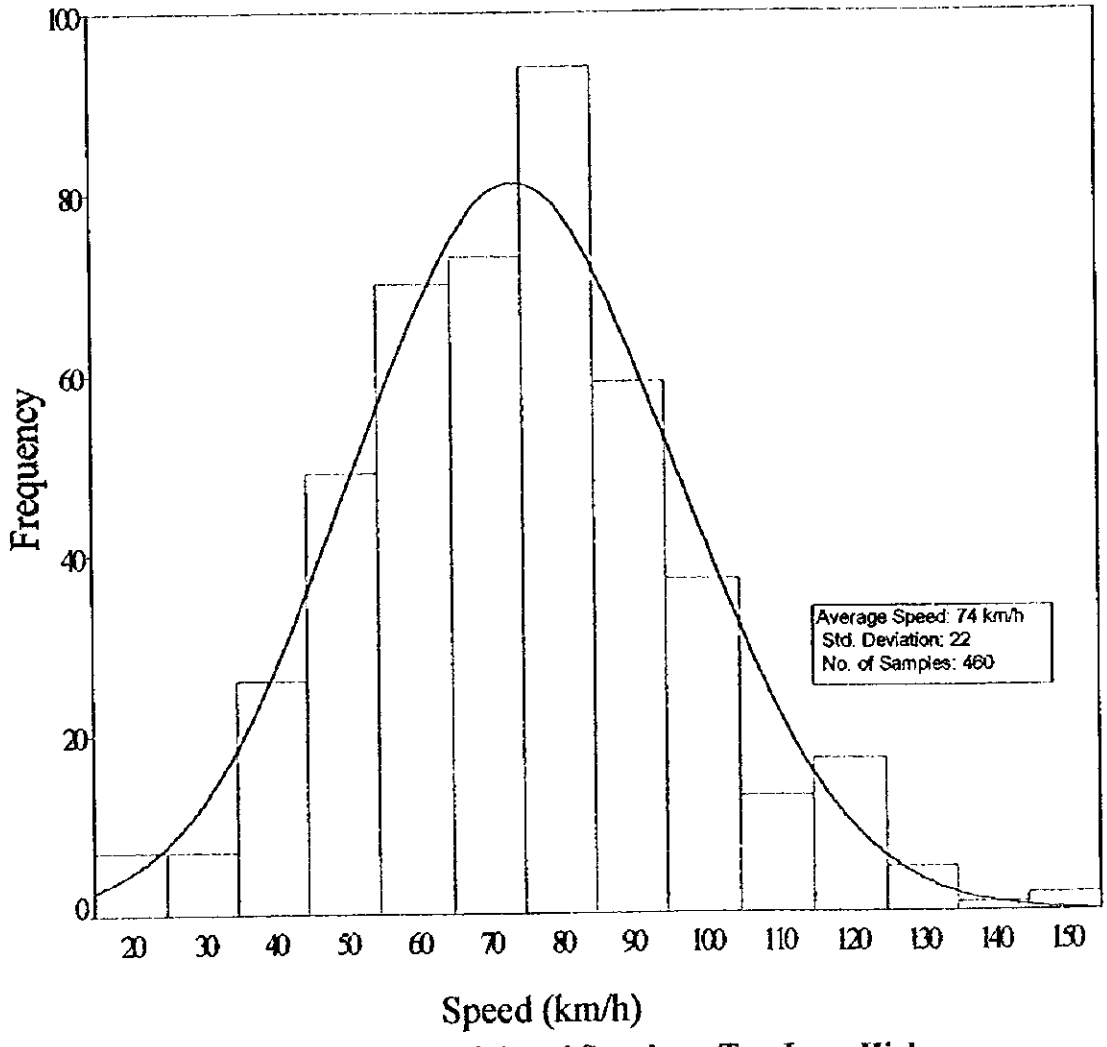


Fig. 15.3.5 Distribution of Travel Speeds on Two Lane Highways

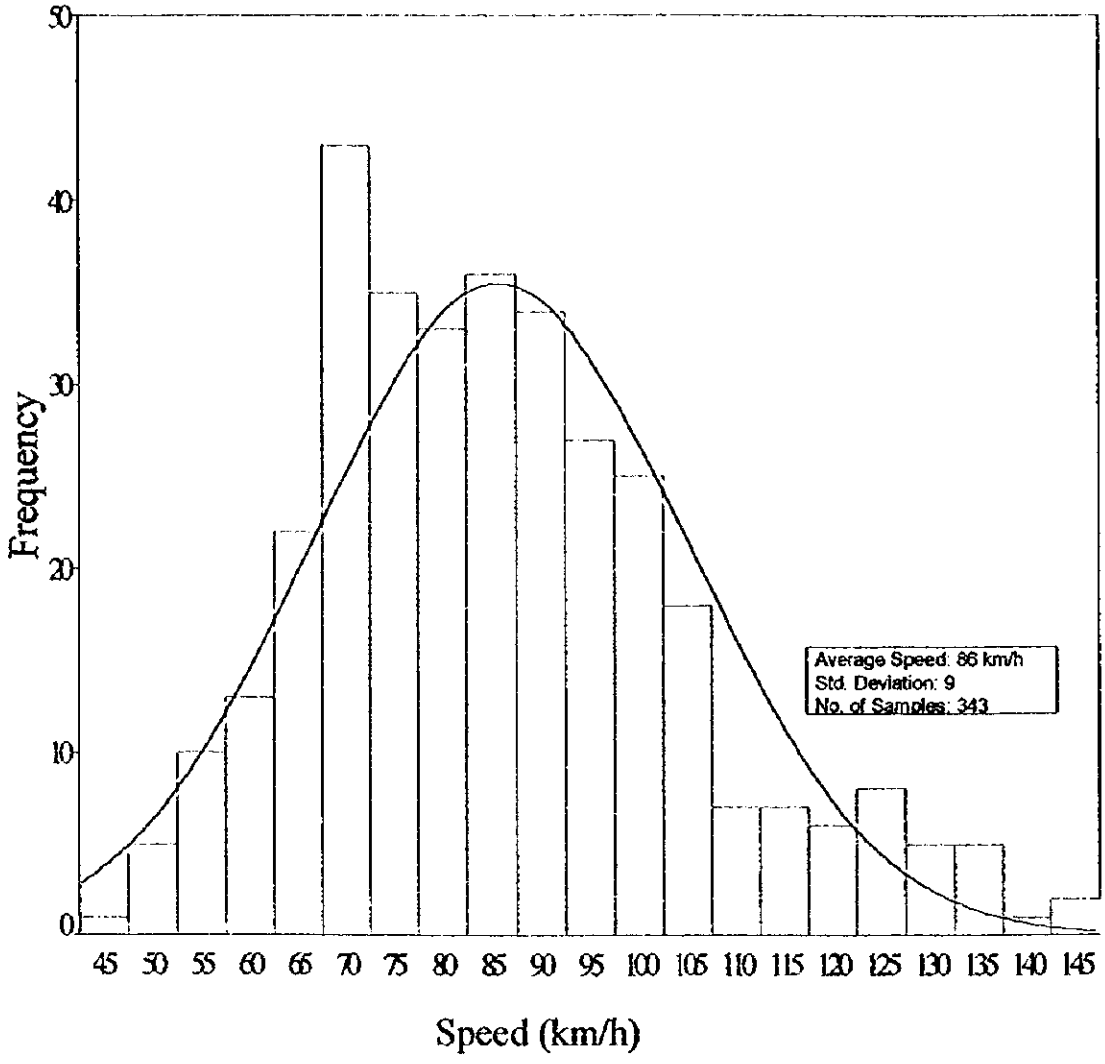


Fig. 15.3.6 Distribution of Travel Speeds on Multilane Highways

(3) Turning Movement Survey

The results of the turning movement survey are as shown in Table 15.3.4 below. These data were used to confirm the directional flows of traffic on the study route at six strategic intersections.

In terms of volume, the Trabzon-Macka/Gumushane-Rize intersection processed by far the largest amount of traffic, or approximately 92 800 vehicles in a 15-hour period compared to about 33 300 vehicles for the second largest intersection (i.e., the Sinop-Merzifon/Ankara-Samsun intersection). As for the other intersections, the amount of traffic they processed was equivalent on average to approximately 9 900 vehicles for the same time period.

Table 15.3.4 Traffic Flows of Survey Intersections

Name of Intersection	Directional Traffic Flows			Total
	Right	Left	Straight	
1. Samson/Kirikkale-Kirsehir/Kayseri-Ankara				
From Samson/Kirikkale	---	441	4454	4895
From Kirsehir/Kayseri	384	2018	---	2402
From Ankara	1709	---	4439	6148
2. Sinop-Merzifon/Ankara-Samsun				
From Sinop	695	---	12623	13318
From Merzifon/Ankara	3892	828	---	4720
From Samsun	---	3736	11507	15243
3. Izmir/Usak-Dinar/Antalya-Afyon				
From Izmir/Usak	79	---	1501	1580
From Dinar/Antalya	2508	64	---	2572
From Afyon	2314	---	1508	3822
4. Trabzon-Macka/Gumushane-Rize				
From Trabzon	4958	---	15302	20260
From Macka/Gumushane	1528	54499	---	56027
From Rize	---	993	15554	16547
5. Bursa-Kutahya-Eskisehir				
From Bursa	1345	---	3556	4901
From Kutahya	46	1964	---	2010
From Eskisehir	---	44	4162	4206
6. Eskisehir-Sivrihisar-Ankara-Afyon				
From Eskisehir	67	240	1147	1454
From Sivrihisar	192	808	282	1282
From Ankara	735	950	1455	3140
From Afyon	1055	34	275	1364

15.4 Model for Traffic Demand Forecasting

In this section, the model for traffic demand forecasting is constructed and validated in 15.4.2 and 15.4.3, respectively. As for the structure and assumptions of the model, they are described in 15.4.1.

15.4.1 Structure and Assumptions of Traffic Demand Model

The traffic demand model is composed of the following three basic components that are executed in the order listed to arrive at future link flows:

- vehicle-km prediction models by vehicle type,
- traffic flow processing ratio for road links, and
- traffic diversion factor

Vehicle-km prediction models are built for passenger vehicles (i.e., passenger cars, minibuses, and small trucks), buses, and trucks (includes trailers), by applying multiple regression analysis to 1996 vehicle-km data obtained from KGM for 76 Turkish provinces. It is assumed that the GDP, registered number of vehicles, and population of provinces can accurately predict provincial vehicle-km. That is, GDP represents the reason for travelling, i.e., economic activity induces movement, the number of vehicles the actual ability to travel, and population the potential aggregate demand.

The traffic flow processing ratio for road links is the proportion of vehicle-km of a link to the total vehicle-km of a provincial highway network for each vehicle type. It is assumed that this ratio for individual links will remain essentially the same. This assumption is made based on the following:

- there is substantial excess capacity on most of the inter-city highway network, as has been shown by the traffic volume/speed surveys carried out by the Study Team, meaning that vehicles will not switch routes unless there is a new route that will greatly reduce travel time;
- the vast majority of future highway network improvements will consist mostly of either widening or dualling and not new construction;
- there has been almost no construction of new roads over the past decade or so;
- much of the inter-city highway has no viable route alternatives; and
- planned construction of most new roads will not take place in or have an effect on the areas that the study route passes through.

Based on the foregoing, it is can be stated that dualling will be the most important aspect in future road improvement. It is assumed here that increases in road link capacity from dualling, as well as from widening, will inevitably lead to some increases in traffic flows. Given the situation just described, it is assumed that there will be a 25% and a 10% diversion of traffic from the next best single carriageway alternative to a newly dualled and widened highway link, respectively. A 50% diversion would occur if the levels of service (e.g., travel times) were exactly the same. However, this seems highly unlikely given the layout of the network and the other factors just mentioned. Therefore, a diversion factor half of that was chosen for newly dualled links and one-fifth of that for newly widened links. New traffic generation is not considered here.

15.4.2 Construction of Model

The vehicle-km prediction models were constructed after testing the prospective variables for such things as multicollinearity and their individual correlation with the dependent variable vehicle-km. As a result, it was determined that GDP and cars/person, the logarithm of GDP

and the total number of buses, and the logarithm of GDP and the total number of trucks were the most appropriate variables for the provincial vehicle-km prediction models for passenger vehicles, buses, and trucks, respectively.

The traffic flow processing ratio for individual links was calculated using 1996 traffic data from KGM and is assumed to be fixed as previously mentioned in 15.4.1.

As for the traffic diversion factor, it was decided to calculate the average traffic volume of 2-lane undivided highways for each province that the study route goes through using future values for 2005 and 2015, respectively, and to add 25% and 10% of these volumes to respective provincial roads that were newly dualled and widened.

15.4.3 Model Validation

Validation can only be carried out for the vehicle-km prediction models, which are the most important component of the traffic demand model. As Table 15.4.1 indicates, the explanatory power of the vehicle-km prediction models are quite high. That is, the R^2 for the models were 0.930, 0.871, and 0.891 for passenger vehicles, buses, and trucks, respectively. In addition, all of the variables of the models were statistically significant, as is evidenced by the high t-values.

Table 15.4.1 Multiple Regression Models for Vehicle-km by Vehicle Type and Province

Type of Model	Variables	Coefficients	Coefficient of Determination (R^2)	t-values
Veh-km by Car	GDP Cars/Person	0.249 8842×10^3	0.930	17.146 9.559
Veh-km by Bus	Ln(GDP) No. of Buses	3239 38.884	0.871	7.468 12.097
Veh-km by Truck	Ln(GDP) No. of Trucks	8852 66.67	0.891	4.049 13.075

15.5 Future Traffic Demand Forecasts

Below, in 15.5.2 and 15.5.3, traffic forecasts for the years 2005 and 2015 are carried out using the above traffic demand model, taking into consideration the future road improvements shown in 15.5.1.

15.5.1 Future Road Network Improvements

Prior to making traffic forecasts for the study route, it is important to clarify what new road

improvements will take place. These are listed in Table 15.5.1 below. As the table indicates, most of the study route from Hopa to Ispata will be dualled by the year 2005, resulting in a large part of the route becoming a 4-lane divided highway. As for widening, most of this will take place in the Afyon-Dinar and Kirikkale areas of the study route in the near future. As for improvements beyond this time frame, plans were not made available from KGM. Therefore, it is assumed that the road network of 2005 will continue as is into the future.

Table 15.5.1 List of Dualling Improvements within Study Area

Route	Province	Control No.	Seg No.	Total	Scheduled Date of Completion
KONYA-KARAMAN	KONYA-KARAMAN	715-04	0	104.0	2000
		715-05	1, 2		
		715-06	1,2,3,4		
AFYON	AFYON	300-07	2,3,4,5	20.0	
EMIRDAG-SIVRIHISAR	ESKISEHIR	260-02	0	49.0	
		260-03	0		
SIVRIHISAR-POLATLI-ETIMESGUT	ESKKISEHIR-ANKARA	200-10	1,2	132.0	
		200-11	0		
		200-12	1, 2, 3		
KIRIKKALE	KIRIKKALE	New Construction	—		
CUBUK	ANKARA	06-10	—		
BOLU	BOLU	100-11	5		
		100-12	1		
CUBUK	ANKARA	06-10	—	15.0	2000
SAMSUN-HAVZA-MERZIFON-CORUM	SAMSUN-CORUM-AMASYA	795-01	1, 2	291.0	2002
		795-02	1, 2		
		795-03	0		
		795-04	1, 2		
		100-17	3, 4		
SAMSUN-BAFRA-SINOP	SAMSUN	010-14	1,2,3,4	160.0	2002
		010-15	1,2,3,4		
SAMSUN-CARSAMBA-ONYE	SAMSUN	010-16	1,2,3,4	93.0	
		010-17	1		
BOLAMAN-PERSEMBE	ORDU	010-18	1	28.0	2002
SINOP-TURKELI-CATALZEYTIA	SINOP	010-12	1, 2	90.0	2005
		010-13	0		
AMASYA	AMASYA	100-18	3	14.0	
DURAGAN -CERCILER	SINOP	57-50	—	2.0	1998
ASARCIK -CAYIRKENT	SAMSUN	55-50	—	1.0	1998
BOYABAT -SAKIZ	SINOP	030-06	2	2.0	1998
HOPA-KEMALPASA	ARTVIN	010-25	2	19.0	1999
TRABZON-RIZE-PAZAR-ARAVI	TRABZON-RIZE-ARTVIN	010-22	4, 5, 6	136.0	2002
		010-23	1, 2, 3		
		010-24	1, 2		
		010-25	1		
ISPARTA-EGIRDIR	ISPARTA	330-09	1	40.0	2000
ANTALYA-ALANYA	ANTALYA	400-10	4, 5	142.0	2001
		400-11	1, 2		
		400-12	1, 2		

15.5.2 Traffic Demand Forecasts for 2005

The traffic demand forecast for the year 2005 is shown for both the case-study sections, which are sections of the study route whose maintenance plans are to be economically evaluated later on in this report, and for the entire 2000 km study route. The former is contained in Table 15.5.2, which also shows traffic projections by KGM, while the latter is graphically presented using the transportation planning software Emme/2. As the table indicates, the projections of the Study Team and those of KGM are relatively close for the year 2005, with those of the Study Team being a little lower on average, or approximately 97% of KGM values.

Table 15.5.2 Comparison of 2005 Traffic Volumes by the Study Team and KGM

Control No. of Link	Seg. No.	Province	Study Team 2005 Traffic Volume Forecasts	KGM 2005 Traffic Volume Forecasts	Study Team/ KGM Volume Ratio
260-01	1,2	Afyon	6113	7193	0.8499
260-02	0	Afyon	6398	7056	0.9067
300-07	2,3,4	Afyon	19307	22451	0.8600
650-09	0	Afyon	11525	11708	0.9844
650-10	1	Afyon	11175	11320	0.9872
650-10	2	Afyon	8760	8464	1.0349
100-17	3,4	Amasya	12922	13215	0.9778
795-03	0	Amasya	7066	6321	1.1179
650-12	1	Burdur	6868	8178	0.8398
650-12	2	Burdur	6965	7514	0.9269
200-06	1	Bursa	31923	35110	0.9092
200-06	2	Bursa	18581	21263	0.8739
200-06	3	Bursa	17882	17880	1.0001
200-06	4	Bursa	13695	12268	1.1163
200-06	5	Bursa	11132	9486	1.1736
200-08	1	Eskisehir	17641	20179	0.8742
200-08	2,3	Eskisehir	20696	21351	0.9694
200-08	4	Eskisehir	10074	11693	0.8615
200-09	0	Eskisehir	6462	7471	0.8650
650-11	3	Isparta	11250	12428	0.9052
650-11	4	Isparta	7397	8178	0.9045
010-23	1	Rize	9001	9643	0.9334
010-23	2	Rize	9177	9887	0.9281
010-23	3	Rize	7640	7973	0.9582
010-24	1	Rize	6319	6305	1.0023
010-24 010-25	2 1	Rize	5423	5192	1.0445
Average					0.9540

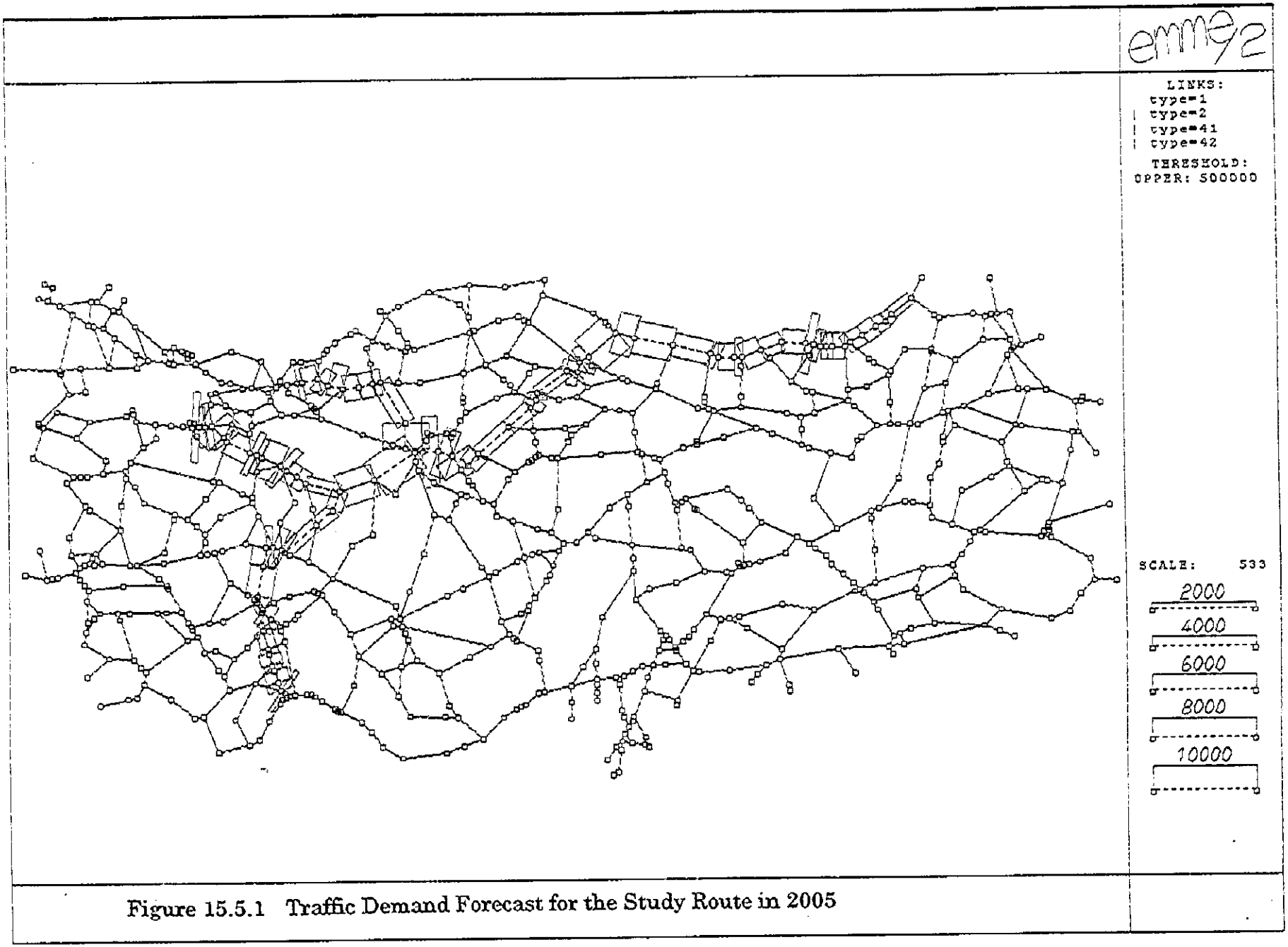


Figure 15.5.1 Traffic Demand Forecast for the Study Route in 2005

As for the entire 2000 km route, Fig. 15.5.1 above indicates that those road sections having the largest traffic volumes (i.e., more than 10 000 vehicles/day/direction) will be located on roads near or going through the Ankara (e.g, the road to Kirikkale and the road going towards Kizilcahamam), Anatlya, Bursa, Bilecik, Eskisehir, and Trabzon areas. The sections of the study route that are least congested are located on the Dinar to Antalya and the Rize to Hopa roads. The rest of the route has traffic volumes mostly in the 4000 to 8000 vehicle/day/direction range.

15.5.3 Traffic Demand Forecasts for 2015

Traffic demand forecasts for 2015 are also shown for the case-study links and for the entire 2000 km study route in the same manner as in 15.5.2.

Table 15.5.3 Comparison of 2015 Traffic Volumes by the Study Team and KGM

Control No. of Link	Segment No.	Province	Study Team 2015 Traffic Volume Forecasts	KGM 2015 Traffic Volume Forecasts	Study Team/ KGM Volume Ratio
260-01	1,2	Afyon	11998	17437	0.6881
260-02	0	Afyon	12495	19234	0.6496
300-07	2,3,4	Afyon	38954	51086	0.7625
650-09	0	Afyon	23177	23182	0.9998
650-10	1	Afyon	22439	22337	1.0046
650-10	2	Afyon	17341	18826	0.9211
100-17	3,4	Amasya	22903	23704	0.9662
795-03	0	Amasya	12411	11051	1.1231
650-12	1	Burdur	12970	15792	0.8213
650-12	2	Burdur	13096	15710	0.8336
200-06	1	Bursa	65905	76446	0.8621
200-06	2	Bursa	35869	42925	0.8356
200-06	3	Bursa	36393	36155	1.0066
200-06	4	Bursa	29279	24047	1.2176
200-06	5	Bursa	24099	18418	1.3084
200-08	1	Eskisehir	34290	39067	0.8777
200-08	2,3	Eskisehir	40470	44123	0.9172
200-08	4	Eskisehir	19502	22839	0.8539
200-09	0	Eskisehir	12505	14538	0.8602
650-11	3	Isparta	22452	24050	0.9335
650-11	4	Isparta	14740	15792	0.9334
010-23	1	Rize	9687	18138	0.5341
010-23	2	Rize	15853	18736	0.8461
010-23	3	Rize	13866	13279	1.0442
010-24	1	Rize	11325	9814	1.1539
010-24 010-25	2 1	Rize	9748	8088	1.2053
Average					0.9292

As Table 15.5.3 indicates, Study Team traffic volumes have grown at a slower pace than those of KGM, with the values of the Study Team being equal to approximately 93% of KGM values on average. However, it should be noted that there are rather large variations within the route. For example, Study Team estimates for 2 case-study sections in Afyon and a section in Rize are only 69%, 65%, and 53% of KGM values, respectively, while Study Team estimates for 2 sections in Bursa and a section in Rize are respectively 21%, 30%, and 20% larger. As for the other case-study sections, the values of the Study Team and KGM are relatively close to each other.

As Fig. 15.5.2 indicates below, traffic has grown at a factor of approximately 2 for most of the study route links. The tendencies that were observed in Section 15.5.2 above can also be seen here. That is, the tail ends of the study route (i.e., the road leading to the Georgian border and the road from Dinar to Antalya) have much less traffic on average than the other road links. Obviously, roads near Ankara and the other major urban centres are the most congested, with maximum traffic volumes in the range of 20 to 30 thousand vehicles/day/direction

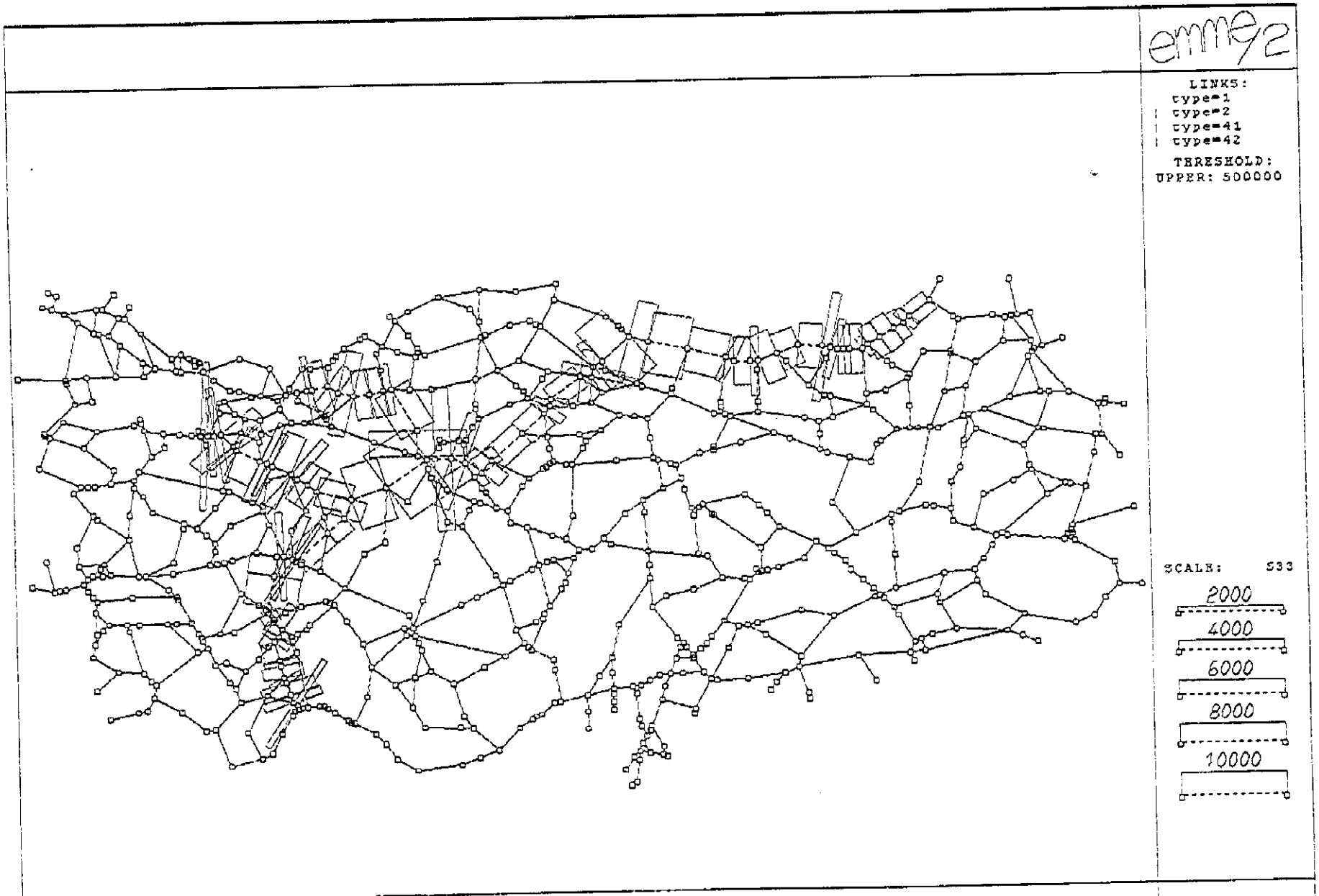


Figure 15.5.2 Traffic Demand Forecast for the Study Route in 2015

CHAPTER 16

FEASIBILITY STUDY (CASE STUDY)

CHAPTER 16 FEASIBILITY STUDY

16.1 General

In carrying out the study for the 2000 km route, the study team have experienced the differences in climatic conditions and in the quality of roads in the various Sub-Divisions. In order to illustrate as best as we can the typical damage, repair methods, necessary staff level and maintenance equipment to use, we have arrived at six representative case study Sub-Divisions. The Sub-Divisions selected are considered representative of the KGM's road stock as a whole. Each case study will only deal with the lengths of study road that pass through the particular Sub-Division.

16.2 Case Study Sections

16.2.1 Selection of Case Study Sections

The six Sub-Divisions selected as our case study are as follows:-

1.	Burdur	Sub-Division 134
2.	Afyon	Sub-Division 31
3.	Iznik	Sub-Division 147
4.	Eskisehir	Sub-Division 46
5.	Amasya	Sub-Division 72
6.	Rize	Sub-Division 103

The location of these Sub-Divisions is as indicated in Figure 16.2.1. Some of the reasons for selecting the above Sub-Divisions are as given below. These Sub-Divisions are considered to have:-

- social economic importance
- a variety of study sub divisions according to climate, topography, and population.
- damage that will use typical repair methods
- cases that are in immediate need of repair
- characteristic damage
- significant inter city traffic flows
- represent each of the divisions through which the study route passes

As can be seen the Sub-Divisions selected meet the criteria set out above. A summary the road network for each Sub-Division selected for case study is also given in Table 16.2.1.

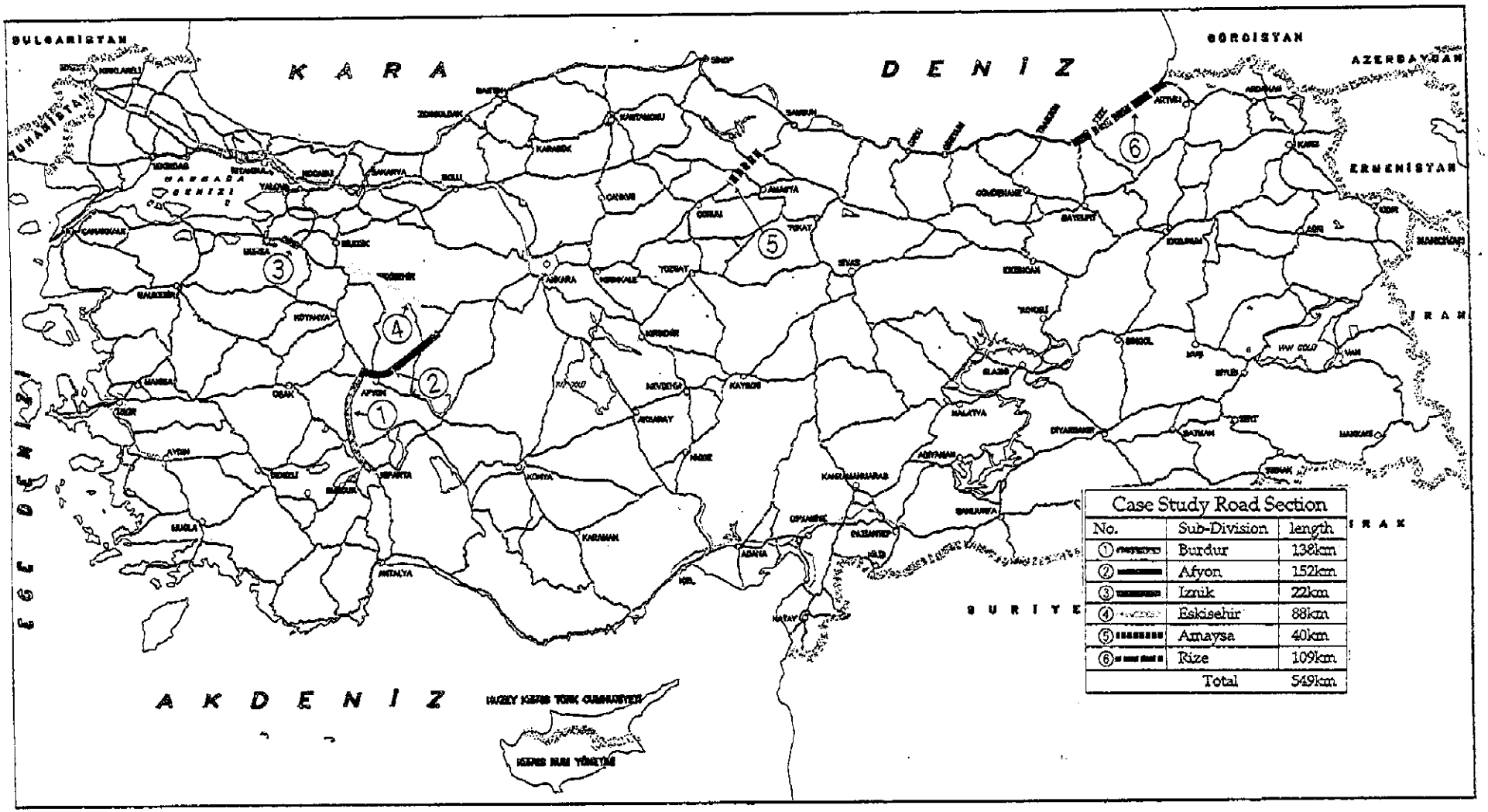


Figure 16.2.1 Location of Case Study Sections

Table 16.2.1 Summary of Route Network for Sub-Divisions Selected for Case Study

Sub-Division Name	Sub Division No:	State Highways			Provincial Roads			Total Length of Road	Total Length of road dual	Total Length of Study Road
		AC	ST	Oth	AC	ST	Oth			
Afyon	31	63	359	0	0	253	34	709	15.2	152
Eski chir	46	112	147	0	0	306	0	65	46.0	88
Amasya	72	84	180	0	0	230	0	494	24.4	40
Rize	103	0	216	3	0	110	39	368	18.3	
Burdur	134	0	407	0	0	270	0	677	36.5	138
Iznik	147	27	237	1	1	195	11	472	40.9	22

Notes 1 AC - Asphalt Concrete, ST - Surface Treated, Oth - Others
2 All lengths are in km.

16.2.2 Current Status of Case Study Sections

(1) Highways

The existing condition of the highways was surveyed in May 1997. The data collected was stored in the data base program designed specifically for this project. The data for the six case study sections was extracted and the results for the 26 items which are in the scope of this study are as presented in Appendix 1.

(2) Staffing Level

The object of this study is to identify the strength and weakness of each of the study cases and to recommend changes as necessary. The existing situation for each Sub-Division has been obtained from the 'Work of the Maintenance Division in 1996' (*1996 Yl Bak m Dairesi Çal malar*), a KGM document published by the Maintenance Division. This is the most recent available document on the existing situation of all KGM maintenance facilities. The results of the current staffing arrangement at each of the study Sub-Divisions are as tabulated in Table 16.2.2.

Table 16.2.2 The Staffing Arrangement at the Six Study Sub-Divisions

Personnel Category	SUB-DIVISIONS																	
	Afyon 31			Eski ehir 46			Amasya 72			Rize 103			Burdur 134			Iznik 147		
	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot
Site based Labourers	6	3	9	13	12	25	13	4	17	8	5	13	8	2	10	10	15	25
Office based labourers	5	2	7	9	7	16	4	0	4	4	1	5	8	4	12	6	1	7
Skilled labourers	0	0	0	0	2	2	0	0	0	2	8	10	1	1	2	0	0	0
Building & Goods attendant	3	4	7	7	5	12	3	1	4	7	7	14	8	1	9	8	0	8
Chefs and Assistants	0	0	0	1	1	2	3	0	3	1	1	2	0	2	2	0	1	1
Drivers	13	7	20	14	1	15	14	2	16	10	2	12	6	8	14	6	4	10
Maintenance truck drivers	0	0	0	1	2	3	0	0	0	0	0	0	2	0	2	0	0	0
Small machine operators	1	0	1	1	0	1	1	0	1	2	1	3	1	0	1	1	0	1
Heavy machine operators	4	0	4	2	0	2	1	0	1	6	0	6	5	2	7	1	0	1
Operators	3	0	3	9	0	9	5	0	5	8	1	9	9	0	9	3	0	3
Unskilled labourers	1	15	16	0	14	14	0	13	13	1	9	10	2	8	10	0	0	0
Boiler attendants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Others	15	1	16	12	0	12	8	2	10	12	2	14	8	7	15	13	3	16
TOTAL	**51**	**32**	**83**	**69**	**44**	**113**	**52**	**22**	**74**	**61**	**37**	**98**	**58**	**35**	**93**	**48**	**24**	**72**

Notes

1 Notation used P - Permanent, T - Temporary, tot - Total

(3) Equipment and Machinery Availability

It would appear that each Sub-Division has a different collection of equipment and machinery at their disposal. It is understandable for certain items of equipment and machinery such as snow ploughs and blowers to be available only to the Sub-Divisions which are affected by snow. We would however expect to find a certain minimum number of equipment and machinery which is necessary to carry out the routine highway maintenance work.

The results of the current equipment and machinery availability at each of the study Sub-Divisions are tabulated in Table 16.2.3 a and Table 16.2.3 b.

Table 16.2.3 a The Equipment and machinery Availability at the Six Study Sub-Divisions

	Machinery & Equipment Category		SUB-DIVISIONS					
			Afyon	Eskisehir	Amasya	Rize	Burdur	Iznik
			31	46	72	103	134	147
1	Cars	Car	4	4	3	3	3	3
		Pickup/ van	1	1	1	1	1	0
		maintenance & traffic techicians vehicle	1	1	1	1	1	2
2	Service vehicle	KGM's	1	1	0	1	0	1
		hired	0	1	0	0	0	0
3	Unimog	2150	0	1	0	0	0	0
		1700/1750	0	1	0	0	0	0
		1500	4	0	5	1	2	0
		600	4	2	1	1	1	1
4	Trucks	Brimond	0	0	0	0	0	0
		AS - 600	0	0	0	0	0	0
		BMC TM-140	1	2	1	3	2	1
		support vehicle	4	2	4	1	3	4
		front side plough	0	3	0	3	2	0
		plough 4000 te/hr Oshk-Mann-Schm	0	0	0	0	2	4
5	snow blades	CP5 MOD SCH-Y-Y	0	0	0	0	0	0
		Multiple parts	5	5	0	0	0	1
		AS-600 / BMC Truck	0	0	0	0	5	0
		V Type	8	4	3	3	0	6
6	Snow blower vehicle	Sch VF-2 406 A	0	0	0	0	0	0
		Ribon Circular	0	0	0	0	0	0
		Plough SF-2	0	0	0	0	0	0
		Scart	1	0	0	0	0	0
		Zil	0	0	0	0	0	1
		Rolba	1	1	1	1	0	0
7	Salt Sprayer	Normal	1	0	0	0	0	1
		Liquid	4	1	3	0	2	3
8	traffic	Guard rail washer RP-L	31	20	16	20	20	16
		Sign Washer RL-3	7	4	3	0	4	5
9	Grass	Off road FME-400	1	0	0	0	0	0
		Road side RMB-4-2	1	1	2	1	2	1
10	Loader	Hoist laoder	1	1	1	2	3	1
		Front loader	0	0	0	0	0	0
		Slurry pump W-5	0	0	0	0	0	0
11	Hydraulic	Pneumatic drill BR-45	0	0	0	1	0	0
		Wacker Plate	1	1	0	0	1	1

Table 16.2.3 b The Equipment and Machinery Availability at the Six Study Sub-Divisions

		Machinery & Equipment Category	SUB-DIVISIONS					
			Afyon	Eskisehir	Amasya	Pize	Burdur	Iznik
			31	46	72	103	134	147
12		Tunnel washer	1	1	0	0	0	1
		Sweeper WKS-3	0	1	0	1	0	0
		Grader	2	2	1	3	3	1
		Maintenance (small) grador	4	4	4	1	7	4
		Tyred front laoder 920-950	1	1	1	0	1	1
13	Plant	Fixed	0	0	0	1	0	0
		Mobile	2	1	2	4	3	2
14	misc	bitumen sprayer	3	0	0	0	3	0
		Roller	4	3	3	5	4	2
		Tracked tractor	0	0	0	0	1	0
		compressor	0	0	0	0	0	0
		Mobile welding machine	4	0	2	0	3	4
		Mobile lubrication machine	5	0	3	0	3	4
		Road planer	1	0	0	0	0	0
		Pavement saw cutter	0	0	1	0	0	0
		Trailer	1	0	1	0	1	0
		Tipper trailer	0	1	1	0	0	0
		Excavator attachment	1	0	0	1	1	0
		Fixed radio	0	0	0	1	0	0
		Mobile radio	1	1	2	0	1	1

Note
KGM's equipment and machinery list is very detailed. In the proposed revision only the general classification will be given.

(4) Current Maintenance Budget

The budget of Maintenance Department is not easy to quantify even though some of the data is available in the publication referred to in Section 16.2.2 (2). The main reason is because the maintenance activities are strictly associated with low value routine work and certain items such as aggregate and bitumen are not part of the budget calculation. This probably explains the reason for the relatively high proportion of the budget being allocated to personnel salaries. In some other countries, notably UK, there is an upper limit of US $160 000 for the value of work before being considered to be outside the scope of normal maintenance work.

The KGM's published data is as tabulated in Table 16.2.4. Some modifications to the data Have been made by giving a monetary value to the amounts of the aggregate and salt.

Table 16.2.4 BUDGET EXPENDITURE BY SUB-DIVISION

FOR 1996

		Afyon 31	Eskisehir 46	Amasya 72	Rize 103	Burdur 134	Iznik 147
Personnel Expenditure		61 769 329	81 263 273	63 175 543	66 154 248	76 809 802	60 842 800
Spare parts & construction materials		7 559 246	3 792 673	2 173 607	3 652 621	4 382 094	6 674 794
Fuel		10 765 655	7 814 817	5 409 736	19 441 080	13 187 804	10 148 367
Telephone		260 620	96 300	110 259	444 761	274 340	77 594
Electricity		820 545	270 766	210 640	243 794	548 314	412 975
Water		432 924	101 693	283 063	877 335	160 605	253 063
Salt	TL	278	252	.0	0	39	241
Asphalt	Ton	580	408	373	753	1 000	323
	TL	7 803 320	3 476 503	4 629 350	6 239 074	10 000 000	1 801 912
Aggregate	m3	9 300	5 991	2 132	14 912	14 720	5 000
	TL						
GRAND TOTAL		89 411 917	96 816 277	75 992 198	97 052 913	105 362 998	80 211 746

16.3 Preliminary Assessment of KGM's Maintenance System

This section describes the preliminary considerations for the repair work in the case study Sub Divisions. It discusses the possibilities of introducing new ideas into the organisation of the KGM direct labour force, machinery and equipment availability, material stockpile and budget requirements. The ideas being put forward are as a result of comparing the local conditions in Turkey and the successful application of such systems in internationally.

16.3.1 Repair Work Design

The types of repair that can be use are detailed in Chapter 7 of this report. From the results of the detailed inspection, the recommended repairs for the damage recorded in the six study Sub-Division roads are as shown in Appendix 2.

16.3.2 Cost Estimation and Justification

Repair costs will be determined by the repair method appropriate for the damage. The pavement will generally be repaired by one of the main repair methods described below:-

1. Sealing
2. Filling
3. Patching
4. Planing
5. Overlay

Generally the cost of the repair will increase from 1 to 5 as the solutions to repair the damage become more costly the more the pavement is damaged. The following table suggests the options for repair according to severity and type of damage.

Table 16.3.1 Types of Repair

Damage Type	Repair Method		
	Low- Isolated or low level of defect	Medium- Linked defects	High- Major Repairs Needed
Crack	Sealing	Patching	Overlay
Pothole	Filling	Patching	Overlay
Settlement	Filling	Patching	Overlay
Wave	Filling	Planing	Planing + Overlay
Rutting	Filling	Patching/ Planing	Planing + Overlay

16.3.3 Estimate of Repair Quantities

The database has been used to store the inspection data collected from the 2000 km of pilot study roads. These records indicate the damage level, damage type and linear extent of the various damage types.

The database records have been interrogated to ascertain the overall lengths on which the various types of damage have occurred. In arriving at the estimated repair quantities the following general guidelines for estimating repair quantities have been used:-

- All type A damage is to be repaired as soon as practicably possible. A repair programme for type A damage is to be developed and regularly updated.
- It is desirable that 50% of type B damage will be repaired during the first financial year with 50% the following financial year. A programme of repair works is to be developed that prioritises the repair of the damaged elements.
- All type C damage is to be monitored for further deterioration. Subsequent inspections will highlight any change from type C damage to a higher damage rating.

For an estimate of repair quantities utilising the above, the following principles have been adopted:-

For pavement, the inspection summary records detail the defect for each type of damage separately. The inspection records have been examined to determine the extent of the various defect combinations. For example, type A rutting may be in combination with type B cracking. In some instances all five damage types may be in combination together. All pavement combination types involving either type A or type B are summarised for each case study link and are contained in Appendix 2.

The following guidelines have been used to arrive at the estimated final repair quantities.

Predominately type A damage	Assume that 100% of the lane length is affected Assume that 100% of the width is damaged
Predominately type B damage	Assume that 50% of the lane length is affected Where 4 type B items assume that 50% of the width is damaged Where 3 type B items assume that 30% of the width is damaged Where 2 type B items assume that 20% of the width is damaged Where 1 type B item assume that 10% of the width is damaged
Predominately type C damage	Assume that 20% of the lane length is affected Assume that 10% of the width is damaged

It is considered unlikely that any type C damage will be repaired though preventative maintenance may be cost effective e.g. the sealing of hairline cracks to reduce ingress of water into the sub surface layer.

16.3.4 Unit Rates for Maintenance Items

In the derivation of the unit rates for our maintenance work items, consideration was given to the appropriate level of local resources and suitable materials necessary for carrying out the work. This was then compared with the rates used for similar types of work tendered by the KGM. In all cases these unit rates have been found to be compatible and our rates have also been accepted by KGM as appropriate for maintenance work. The list of unit rates applicable for the agreed scope of maintenance work are as tabulated in Table 16.3.2.

As mentioned in the other chapters, the KGM staff salaries consume about 70% of their annual maintenance budget. This is substantial and information obtained for the various categories of staff will be very useful in the evaluation of staff resource management. We have also tabulated the salaries of the various staff categories for comparison. The salaries given are converted to US Dollars for ease of comparison and are tabulated in Table 16.3.3.

Table 16.3.2 a Unit Cost for Maintenance Works

Item No.	Description of Work	Unit	Rate $	Comments
1	**Excavation**			
1-1.	Excavation of Existing Carriageway	m^3	7.40	
1-2.	Excavation of Suitable Material	m^3	0.90	
1-3.	Excavation of Rock / Concrete	m^3	10.30	By machine
1-4.	Excavation of Rock / Concrete	m^3	7.20	By blasting
1-5.	Removal of Material to Tips On Site	m^3	2.50	
1-6.	Removal of Material to Tips Off Site	m^3	7.20	
1-7.	Hand Excavation In Earth	m^3	3.40	
2	**Earthworks**			
2-1.	Embankment (Using Imported Selected Material)	m^3	11.40	
2-2.	Compaction of Filled Area	m^3	1.75	
2-3.	Regrading existing slope(including compaction)	m^2	2.15	by machine
2-4.	Hydroseeding (spraying of grass seed mix)	m^2		

Table 16.3.2 b Unit Cost for Maintenance Works

Item No.	Description of Work	Unit	Rate $	Comments
3	**Pavement - Asphaltic Concrete Pavement**			
3-1.	Retexturing Existing Asphaltic Concrete Pavement	m^2	1.00	
3-2.	Crack Sealing Pavement	m^2	0.80	
3-3.	Repair of Potholes (Including All Preparatory Work)	m^2	8.50	
3-4.	Patching (Including All Preparatory Work)	m^2	7.75	
3-5.	Planning out existing wearing course	m^2	2.00	
3-6.	Overlay Existing Asphalt Concrete with 50mm layer	m^2	8.81	
3-7.	Overlay Existing Asphalt Concrete with 150mm layer	m^2	24.68	
3-8.	Reconstruction (subbase, base, bitumen base, binder and wearing course)	m^2	29.38	
3-9.	Laying of 50 mm wearing course			
3-10.	Laying of 80 mm binder course			
3-11.	Laying of 100 mm bitumen base course			
3-12.	Laying of 100 mm base course			
3-13.	laying of 200 mm Sub-base			
3-14.	laying of 200 mm Sub-base			
3-15.	Laying of asphaltic kerbs	lin m		
4	**Pavement -Surface Treated Pavement**			
4-1.	Retexturing Existing Surface TreatedAsphalt Pavement	m^2	1.00	
4-2.	Crack Sealing Pavement	m^2	0.80	
4-3.	Repair of Potholes (Including All Preparatory Work)	m^2	8.20	
4-4.	Patching (Including All Preparatory Work)	m^2	7.40	
4-5.	Overlay Existing Surface Tr. Asphalt with 40mm layer	m^2	6.65	
4-6.	Reconstruction (subbase, base and wearing course)	m^2	23.50	

Table 16.3.2 c Unit Cost for Maintenance Works

Item No.	Description of Work	Unit	Rate $	Comments
5	**Slope/Embankment Protection Works**			
5-1.	Cylinder Gabion	m^3		
5-2.	Cubical Gabion	m^3		
5-3.	Mat Gabion	m^3		
5-4.	Placed Large Rock Boulders Protection	m^3		equivalent to rockfill
5-5.	Stone Riprap With Mortar (Slope > 1:1.4)	m^2		
5-6.	Stone Riprap With Mortar (Slope < 1:1.5)	m^2		
5-7.	Berm Ditch (Natural)	lin m		
5-8.	Berm Ditch (Concrete Lined)	lin m		
5-9.	Toe Ditch (Natural)	lin m		
5-10.	Toe Ditch (Concrete Lined)	lin m		
5-11.	Perimeter Ditch (concrete lined)	lin m		
5-12.	Shotcrete	m^2		
5-13.	Concrete Block Crib	m^2		
5-14.	Sprayed Concrete Crib	m^2		
5-15.	Rockfall Netting	m^2		
5-16.	Rockfall Protective Fence	lin m		
6	**Drainage**			
6-1.	Installation of Perforated Drain	lin m	13.10	Including slopes
6-2.	Installation of Pipe Culvert <500mm diameter	lin m	16.25	Including slopes
6-3.	Installation of pipe Culvert >500mm and < 1000mm dia.	lin m	36.10	including pavement
6-4.	Installation of pipe Culvert > 1000mm dia.	lin m	99.00	including pavement
6-5.	Installation of Box Culvert 1.5m x 1.5m (single cell)	lin m		including pavement
6-6.	Installation of Box Culvert 1.5m x 1.5m (double cell)	lin m		
6-7.	Provision of Carriageway Edge Channelling	lin m	9.50	
6-8.	Provision of Kerbing	lin m	5.70	
6-9.	Provision of kerb Chute	lin m	6.60	
6-9.	Installation of French Drain, 1.5 m deep x 0.8 m wide	lin m		incl. 200 mm dia. pipe

Table 16.3.2 d Unit Cost for Maintenance Works

Item No.	Description of Work	Unit	Rate $	Comments
7	**Retaining Wall**			
7-1.	Stone Masonry Wall H =1m	lin m	50.00	
7-2.	H=2m	lin m	130.70	
7-3.	H=3m	lin m	195.00	
7-4.	Concrete Gravity Wall H=1m	lin m	70.00	
7-5.	H=2m	lin m	183.00	
7-6.	H=3m	lin m	273.00	
8	**Concrete**			
8-1.	Structural Concrete	m^3	77.00	
8-2.	Ancillary Concrete	m^3	58.00	
9	**Cleaning /Removal of Debris**			
9-1.	Removal of Debris From Side Ditch	lin m	180.00	
9-2.	Removal of Debris From Culvert	lin m	120.00	

Table 16.3.3 Typical Salaries of KGM Staff in U S Dollars

Item No	Position	Basic gross monthly salary (1998) in $/month	Basic gross monthly salary (1998) in $/month include OT*
1	Site based Labourers	870	1160
2	Office based labourers	615	820
3	Skilled labourers	905	1210
4	Building & Goods attendant	880	1170
5	Chefs and Assistants	880	1170
6	Drivers	1065	1420
7	Maintenance truck drivers	990	1320
8	Small machine operators	870	1160
9	Heavy machine operators	905	1320
10	Operators	905	1320
11	Unskilled labourers	630	840
12	Boiler attendants	880	1170
13	Chief engineers	905	905
14	Engineers 10 years experience	840	840
15	Engineers 5 years experience	835	835
16	New graduate engineers	810	810
17	Clerk of works	905	905
18	Chief technicians	650	650
19	Senior technicians	630	630
20	Junior technicians	580	580
21	Secretary	400	400
22	Clerks	365	365

Notes

1 Salaries have been assessed as at January 1998 and converted to US Dollars

2 Salaries have been taken as average and typical and include taxes.

3 Working the weekends and Public holidays are not included in the above. Working on Saturday is 2 times normal rate and working on Sundays and public holidays is 3 times normal rate.

4* In addition to normal pay, workers overtime work can account for about 4 months (on average) additional pay in a year.

5* Technical staff are not eligible for overtime payments.

16.4 Introduction of a New Maintenance Management System

The proposal for a new maintenance management system is primarily based on our perception of a system that has improved efficiency to suit the actual requirements of the task of maintaining a network of highways. The system is also geared for possibly more work to be handled by competent private contractors and consultants and also the possibility of privatisation of the total maintenance activities by KGM. The role of KGM will be reduced to purely administering the system, financial control and the government department for setting technical standards for which work must be carried out properly and economically.

The concept of privatisation of maintenance services has already been in practice for more than 12 years in the UK. Maintenance regions have been privatised in batches of 4 or 5 regions over a period of 5 years. This concept enables important lessons to be learned and the existing system reviewed for possible improvements to be introduced such as ways of dealing with consultants and contractors who do not perform satisfactorily. There are obvious advantages and disadvantages for a privatised maintenance management system but on balance, we feel that the advantages far out weigh the disadvantages. In this report we have merely embarked on the course which will be possible for privatisation should it be pursued by KGM. Otherwise it can also function under the KGM.

16.4.1 Length of Highways for Maintenance

The task for KGM's maintenance program is enormous and requires a large annual budget to be able to achieve the set objectives. Under the present economic conditions and given the trend over the years, it is unlikely that the highway budget for maintenance will be significantly increased at all. We would therefore recommend that a substantial length of the responsibility for provincial roads be transferred to other authorities such as the General Directorate for Village Affairs and Local Municipalities. The KGM shall only be responsible for the State Highways as they are the important economic links for the country. Thus the network can be reduced to around 30 000 km.

Our six case study Sub-Divisions would become more manageable and the route lengths are reduced to approximately 55% (on average) of the existing responsibility. It will not be possible to implement this plan in 1998/1999 but we would recommend its implementation by the year 2005. The details are as indicated below.

Table 16.4.1 Reduced Network Route Lengths for the Six Case Study Sub-Divisions

Sub division	Asphalt Road km	Surface Treated km	Others km	Total km	% of existing network
Afyon 31	63	359	0	422	60
Eskişehir 46	112	147	0	259	46
Amasya 72	84	180	0	264	53
Rize 103	0	216	3	216	59
Burdur 134	0	407	0	407	60
Iznik	27	237	1	264	56

With the reduction of the route lengths, it will also be possible to aim for the stage conversion of all the Surface Treated roads to Asphalt Concrete roads, which in the long term is more cost effective. This is demonstrated in the economic study of this report.

More importantly, new roads must also be constructed in Asphalt Concrete, thereby reducing the quantity of Surface Treated roads to be reconstructed. Hence the target of converting all the Surface Treated roads will be more feasible.

16.4.2 Staffing Level and function

We are proposing to redeploy to some other functions staff who we consider to be not essential for the maintenance organisation. The emphasis will be to have the minimum skilled core staff and to employ temporary staff as and when necessary. This has the advantage of reducing the fixed overheads and making the maintenance unit more productive and attractive for possible future privatisation. The job description of staff should also be reviewed in line with the modern day requirements of employment. Staff should generally not be employed for a specific function only e.g. employing a driver just to drive a truck or car only. Such restrictive practice is most uneconomic. The driver should also be trained to do other tasks such as operating large and small machines, thereby reducing the need for employing other personnel.

KGM must operate a continuous programme of training for their staff, both technical and non-technical. Continuous training programmes in recent developments in technology and working practices are essential in producing consistent and quality work. This will certainly also be very important where redeployment of staff to other functions is necessary to avoid abrupt social imbalances. We understand that this will be difficult and may require a change in the Law as has been done in Europe.

In considering the number of personnel required for carrying out the maintenance work, the frequency of each activity is also accounted for, see Tables 16.4.2 and 16.4.3. As a result, we have arrived at the summary table, Table 16.4.4, which is our proposed minimum number of staff required. Some adjustments to the staff level can be made after implementation of the proposal when unforeseen circumstances have been encountered. We are also proposing an increase in the number of technical staff which will be necessary for the inspection and maintenance work. Early detection of maintenance problems can help prevent the situation from deteriorating further thus reducing the cost of maintenance. Inspection work includes routine, periodic, safety and emergency inspection of the highways and structures by the technical staff.

Table 16.4.2 Activities of a Maintenance Division for the Year.

Month / Activity Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ROUTINE												
1 Cleaning signs		◆			◆							◆
2 Clean culverts								←	→			
3 Clean Ditches									↔			
4 Clean delineators/refelectors		↔			↔							↔
5 Clean safety fences				↔								
6 Pot hole filling						↔						
7 Crack Sealing						↔						
8 Lane marking repairs							↔					
9 Sweeping debris				↔				↔				↔
10 Grass/ weed control							↔					
11 cleaning manholes/catchpits			↔						↔			
12 Repair of safety fence					↔							
13 Repair scour protection					↔							
14 Slope protection								↔				
15 Bridgeworks				←	···	···	···	···	···	···	→	
16 Inspection	←	···	···	···	···	···	···	···	···	···	···	→
PERIODIC												
1 Lane marking renewals/2-3 years									↔			
2 Filling of shoulders/ 2-3 years								↔				
3 Surfacing overlay 5-10 years						←	···	···	→			
4 Inspection								←	···	···	→	
EMERGENCY												
1 Safety fence repairs												
2 Install Flood control measures												
3 Traffic sign repairs												
4 Repair damage slopes	←	···	···	···	···	···	···	···	···	···	···	→
5 Repair storm drains												
6 Repair lighting/electrical facilities												
7 Winter maintenance												
8 Inspection												

on call and as when required

Table 16.4.3 Staff and Equipment and Machinery Requirement for 100 km of Roads to be Maintained.

Activity Description	STAFF REQUIREMENTS					
ROUTINE	Eng	Tech	Insp	drive	skill	u'skil
1 Cleaning signs				1		1
2 Clean culverts				1	1	6
3 Clean Ditches				2	1	6
4 Clean delineators/reflectors					1	6
5 Clean safety fences				1		1
6 Pot hole filling				1	1	4
7 Crack Sealing					1	
8 Lane marking repairs					1	4
9 Sweeping debris				1		
10 Grass/ weed control				2	1	6
11 cleaning manholes/catchpits				1		1
12 Repair safety fences				1	1	2
13 Repair scour protection				2	1	4
14 Slope protection				2	1	4
15 Bridgeworks				1	1	4
16 Inspection		2	2			
PERIODIC						
1 Lane marking renewals				3	1	2
2 Filling of shoulders				3	1	2
3 Surfacing overlay				7	1	6
4 Inspection	2	2	2			
EMERGENCY						
1 Safety fence repairs				1	1	2
2 Install Flood control measures				1	1	5
3 Traffic sign repairs				1	1	2
4 Repair damage slopes				3	1	4
5 Repair storm drains				1	1	5
6 check lighting/electrical facilities				1	1	2
7 Winter maintenance				4	1	1
8 Inspection	1	1	1			

col.

Equipment and Machinery Requirements																					
1 ca	2 pic	3 tru 7.5	4 tru 16	5 hoi st	6 bla des	7 sal t	8 gra der	9 co pm	10 cut ter	11 ex ca v	12 roll er*	13 spr ea d	14 tra ct	15 sig n	16 saf ety	17 fen dri	18 lan e	19 cra ne	20 do zer	21 tm	22 gul ly
														1							
	1		1																		
	1	1								1										1	
	1																				
															1						
	1		1					1	1		1									1	
	1							1	1											1	
	1																			1	
	1												2							1	
																					1
	1															1				1	
	1		1							1											
	1		1							1	1									1	
	1	1		1				1		1	1									1	
2																				1	
		1															1			1	
			2				1				1									1	
	1		2									1								1	
																				1	
															1						
	1	1																			
	1			1														1			
	1		2							1	1										
	1									1											
	1																	1			
					1	2	1												1		
1																					

Table 16.4.3 ...continued

Notes

1 For the purpose of our study and as a guide the above schedule is based on 100 km of road.

2 The severity of the damage will be a factor in the resource required. This will be dependent on the quality of the routine maintenance strategy being employed.

3 Where the route length is increased, the staff will be increased accordingly but not all categories of staff will be increased in direct proportion to the length.

4 Bridgeworks are not part of this scope of the study and hence the resources are not detailed. The resource requirements however are grouped under a single heading.

5 Notations for the equipment and machinery requirement list

Column No.	Vehicle type
1	car with inspection equipment such as data logger (if available), measuring tapes etc.
2	pickup with assorted tools such as shovels, pickaxes, wheel barrow etc.
3	min 7.5 te trucks
4	min 16 te trucks
5	lorry mounted hoist
6	detachable snow blades
7	min 7 cu m capacity salt spreader
8	grader
8	compressor with attachments for air jetting and breaking (using pneumatic breaker)
10	asphalt cutter
11	excavator
12	hand operated roller or wacker plates for small patching work
13	asphalt paver including 2 rollers (rubber tyred and cylinder), 1 bowser, 1 bitumen spreader
14	bowser
15	sign cleaning machines
16	safety fence cleaning machine
17	safety fence driving machine
18	lane marking machine
19	crane
20	dozer
21	traffic safety equipment including temporary works signs, traffic cones, amber flashing signs etc
22	road sweeper / gully emptier

Table 16.4.4 Staff Proposal at year 2005 and 2015

	Personnel Category	SUB-DIVISIONS																																	
		Afyon 31						Eskisehir46						Amasya72						Rize103						Burdur134						Izmir147					
		current			proposed			current			proposed			current			proposed			current			proposed			current			proposed			current			proposed		
		P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot
1	Site based Labourers (unskilled)	6	3	9	12	28	40	13	12	25	6	21	27	13	4	17	6	18	24	8	5	13	4	14	18	8	2	10	8	24	32	10	15	25	5	18	23
2	Office based labourers (eg supervisor)	5	2	7	4	0	4	9	7	16	3	0	3	4	0	4	3	0	3	4	1	5	2	0	2	8	4	12	4	0	4	6	1	7	3	0	3
3	Skilled labourers (eg team leader)	0	0	0	4	8	12	0	2	2	3	7	10	0	0	0	3	8	11	2	8	10	2	4	6	1	1	2	4	8	12	0	0	0	3	5	8
4	Building & Goods attendant	3	4	7	0	6	6	7	5	12	0	3	3	3	1	4	0	3	3	7	7	14	0	4	4	8	1	9	0	4	4	8	0	8	0	5	5
5	Chefs and Assistants	0	0	0	0	0	0	1	1	2	0	0	0	3	0	3	0	0	0	1	1	2	0	0	0	0	3	3	0	0	0	0	1	1	0	0	0
6	Drivers	13	7	20	1	0	1	14	1	15	1	0	1	14	2	16	1	0	1	10	2	12	1	0	1	6	8	14	1	0	1	6	4	10	1	0	1
7	Maintenance truck drivers	0	0	0	5	0	5	1	2	3	4	0	4	0	0	0	3	0	3	0	0	0	2	0	2	2	0	2	5	0	5	0	0	0	3	0	3
8	Small machine operators	1	0	1	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0	3	1	3	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0
9	Heavy machine operators	4	0	4	2	0	2	2	0	2	2	0	2	1	0	1	2	0	2	6	0	6	2	0	2	5	2	7	2	0	2	1	0	1	2	0	2
10	Operators	3	0	3	0	0	0	9	0	9	0	0	0	5	0	5	0	0	0	8	1	9	0	0	0	9	0	9	0	0	0	3	0	3	0	0	0
11	Unskilled labourers (see site based Labour	1	15	16				0	14	14				0	13	13				1	9	10				2	8	10	0	0	0	0	0	0	0	0	0
12	Boiler attendants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0			
13	Others	15	1	16	21	1	22	11	0	11	17	1	18	8	2	10	17	1	18	12	2	14	14	0	14	8	7	15	21	1	22	13	3	16	17	1	18
14	Maintenance Engineer	1	0	1			0			0			0			0			0			0			0			0			0			0			0
	TOTAL	52	32	84	49	43	92	88	44	112	36	32	68	82	22	74	35	30	65	81	37	98	27	22	49	58	35	93	45	37	82	48	24	72	34	29	63
	staff ratio % of total	62	38		53	47		61	39		53	47		70	30		54	46		62	38		55	45		62	38		55	45		67	33		54	46	
	productive staff % of total	36	23	56	46	40	86	33	27	60	47	43	90	38	26	64	48	42	89	40	27	66	49	37	86	39	22	60	49	40	89	39	25	64	48	38	86
	productive staff % of category	56	59		90	86		54	68		89	91		54	86		89	90		64	70		89	82		62	57		89	89		56	75		88	83	
	km of road in control			709						565						494						566						677						472			
	number of workstations			6						3						3						4						4						5			

Annex Table - Revised technical staff proposal

Our proposal for the technical staff, which in KGM's classification'others' are as detailed in table below.

1	Sub Division Maintenance Engineer	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	
2	Senior Engineer Highways	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	
3	Senior Engineer Structures	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	
4	Assistant Engineers	7	0	7	5	0	5	5	0	5	4	0	4	7	0	7	5	0	5	5	0	5	
5	Technicians	5	0	5	4	0	4	4	0	4	3	0	3	5	0	5	4	0	4	4	0	4	
6	Clerk of works - Inspection	5	0	5	4	0	4	4	0	4	3	0	3	5	0	5	4	0	4	4	0	4	
7	secretary	1	1	2	1	1	2	1	1	2	1	0	1	1	1	2	1	1	2	1	1	2	
	Total	21	1	22	17	1	18	17	1	18	14	0	14	21	1	22	17	1	18	17	1	18	

The total in the Annex Table is transfered to main table as in item '13 others', which is different from KGM's. KGM's category of others contains staff such as secretary, technician, tea boy, gardener, telephone operator etc.

NOTES

1 For maximum efficiency, drivers must also be trained for operating small and large machines and some general activities.

2 The above proposal is for the staff configuration by year 2005. Some working practices will have to be changed in order to achieve this, eg in employment Law.

3 By Target year 2015, it is hope that KGM would consider the complete privatisation of the maintenance services. Technical activities (Annex Table) shall be seperated from Actual maintenance activities (main Table)

4 After year 2015, KGM need only have a team of engineers to administor the work undertaken by the consultants and contractors. This team shall be based at the Division Headquarter, See Chapter 17.

Table 16.4.4 Staff Proposal at year 2005 and 2015

	Personnel Category	SUB-DIVISIONS																									
		Afyon 31						[illegible]4						Amasya72						Rize103						Burdur134						[illegible]47					
		current			proposed			current			proposed			current			proposed			current			proposed			current			proposed			current			proposed		
		P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot	P	T	tot
1	Site based Labourers (unskilled)	6	3	9	12	28	40	13	12	25	6	21	27	13	4	17	6	18	24	8	5	13	4	14	18	8	2	10	8	24	32	10	15	25	5	18	23
2	Office based labourers (eg supervisor)	5	2	7	4	0	4	9	7	16	3	0	3	4	0	4	3	0	3	4	1	5	2	0	2	8	4	12	4	0	4	6	1	7	3	0	3
3	Skilled labourers (eg team leader)	0	0	0	4	8	12	0	2	2	3	7	10	0	0	0	3	8	11	2	8	10	2	4	6	1	1	2	4	8	12	0	0	0	3	5	8
4	Building & Goods attendant	3	4	7	0	6	6	7	5	12	0	3	3	3	1	4	0	3	3	7	7	14	0	4	4	8	1	9	0	4	4	8	0	8	0	5	5
5	Chefs and Assistants	0	0	0	0	0	0	1	1	2	0	0	0	3	0	3	0	0	0	1	1	2	0	0	0	0	2	2	0	0	0	0	1	1	0	0	0
6	Drivers	13	7	20	1	0	1	14	1	15	1	0	1	14	2	16	1	0	1	10	2	12	1	0	1	6	8	14	1	0	1	6	4	10	1	0	1
7	Maintenance truck drivers	0	0	0	5	0	5	1	2	3	4	0	4	0	0	0	3	0	3	0	0	0	2	0	2	2	0	2	5	0	5	0	0	0	3	0	3
8	Small machine operators	1	0	1	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0	2	1	3	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0
9	Heavy machine operators	4	0	4	2	0	2	2	0	2	2	0	2	1	0	1	2	0	2	6	0	6	2	0	2	5	2	7	2	0	2	1	0	1	2	0	2
10	Operators	3	0	3	0	0	0	9	0	9	0	0	0	5	0	5	0	0	0	8	1	9	0	0	0	9	0	9	0	0	0	3	0	3	0	0	0
11	Unskilled labourers (see site based Labour	1	15	16				0	14	14				0	13	13				1	9	10				2	8	10	0	0	0	0	0	0	0	0	0
12	Boiler attendants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0	0	0			
13	Others	15	1	16	21	1	22	11	0	11	17	1	18	8	2	10	17	1	18	12	2	14	14	0	14	8	7	15	21	1	22	13	3	16	17	1	18
14	Maintenance Engineer	1	0	1			0			0			0			0			0			0			0			0			0			0			0
	TOTAL	52	32	84	49	43	92	65	44	112	36	32	68	52	22	74	35	30	65	61	37	98	27	22	49	58	35	93	45	37	82	48	24	72	24	29	53
	staff ratio % of total	62	38		53	47		58	39		53	47		70	30		54	46		62	38		55	45		62	38		55	45		67	33		54	46	
	productive staff % of total	36	23	58	48	40	88	33	27	60	47	43	90	38	26	64	48	42	89	40	27	66	49	37	86	39	22	60	49	40	89	39	25	64	48	38	86
	productive staff % of category	58	59		90	86		54	68		89	91		54	86		89	90		64	70		89	82		62	57		89	89		58	75		88	83	
	km of road in control			[illegible]						[illegible]						466						309						[illegible]					475			
	number of workstations			6						3						3						4						4						5			

Annex Table - Revised technical staff proposal

Our proposal for the technical staff, which in KGM's classification/others are as detailed in table below

1	Sub Division Maintenance Engineer	-	0	-	-	0	1	-	0	1	-	0	1	1	0	1	-	0	1				
2	Senior Engineer Highways	-	0	-	-	0	1	1	0	1	-	0	1	1	0	1	-	0	1				
3	Senior Engineer Structures	-	0	-	-	0	1	1	0	1	-	0	1	1	0	1	-	0	1				
4	Assistant Engineers	-	0	-	5	0	5	5	0	5	4	0	4	7	0	7	5	0	5				
5	Technicians	5	0	5	4	0	4	4	0	4	3	0	3	5	0	5	4	0	4				
6	Clerk of works - inspection	5	0	5	4	0	4	4	0	4	3	0	3	5	0	5	4	0	4				
7	secretary	-	1	-	-	1	2	1	-	2	1	0	1	1	-	2	-	1	2				
	Total	21	-	-	17	-	19	17	-	18	16	0	14	21	1	22	17	1	18				

The total in the Annex Table is translated to main table as staff categories which is different from KGM's KGM's categories, others contains staff such as secretary, technician, inspector, foreman, operator etc

NOTES

1 For maximum efficiency, drivers must also be trained for operating small and large machines and some general activities

2 The above proposal is for the staff configuration by year 2005. Some working practices will have to be changed in order to achieve this, eg in employment Law

3 By Target year 2015, it is hope that KGM would consider the complete privatisation of the maintenance services. Technical activities (Annex Table) shall be seperated from Actual maintenance activities (main Table)

4 After year 2015, KGM need only have a team of engineers to administer the work undertaken by the consultants and contractors. This team shall be based at the Division Headquarter, See Chapter 17

The staff employed in a typical Private Contractor and Private Consulting Engineering company on private Sector contracts internationally are as shown in Tablse 16.4.5 and 16.4.6.

Table 16.4.5 Contractor's Staff responsible for Maintenance Work

	Contractor's Maintenance Staff	Motorway ~500km	State Roads ~500km
A	**Permanent, full time**		
1	Maintenance Manager	part time	part time
2	Deputy Maintenance Manager	1	1
3	Cost Estimator	1	1
4	Works supervisors	3	2
5	Senior Labourers	8	8
6	Labourers	24	26
7	Drivers (only for trucks)	5	5
8	Small machine operators	included in item 7	included in item 7
9	Heavy machine operators	included in item 7	included in item 7
10	Depot labourer	1	2
11	Security	2	4
12	Secretary	1	1
13	Admin. staff	1	1
	Total	48	52
B	**Temporary services hired in as and when required**		
14	*Surfacing 1 team for 6 months*		
	Supervisor	1	1
	Drivers/machine operators	4	4
	Labourers	9	9
15	*Safety fence team*		
	Supervisor	1	1
	Driver/labourer	3	3
16	*Electrical repair team*		
	Supervisor	1	1
	Drivers/labourers	2/3	2/3

Table 16.4.6 Consultants Staff Responsible for Maintenance Work

	Consultants Maintenance Staff	Motorway ~500km	State Roads ~500km
A	**Permanent full time**		
1	Project Manager	part time	part time
2	Maintenance Manager	1	1
3	Senior Bridge Engineer	1	1
4	Bridge Engineer	4	2
5	Bridge Inspector	2	2
6	Bridge/Inventory Technician	1	1
7	Highway Engineer	1	1
8	Highway Inspectors	6	3
9	Highway Technicians	3	2
10	Secretary/Admin. support	2	1
11	Traffic accident/insurance claims	1	0
	Total	23	15
B	**Temporary – from consultants design office as and when required**		
12	Surveyor	1	1
	Surveyor's Assistant	2	2
13	Major works supervision, design and major maintenance works	dependent on project size and complexity	

16.4.3 Equipment and Machinery

The function of the maintenance group was studied and the requirements for the equipment have been grouped into two broad categories namely general and winter maintenance. In regions that are often affected by snow, provision for sufficient snow clearing machinery and equipment is essential. The basic requirements for the general maintenance activities include routine highway and structural inspection activities, filling of pot holes, crack sealing, cleaning of traffic signs and safety fences, cleaning culverts and ditches, sweeping debris from the carriageway and arranging traffic safety measures for working on carriageways. The proposed minimum equipment and machinery list is to ensure that the above named activities can be satisfactorily carried out.

In line with the advancement of technology, we propose that KGM must invest in computer technology, at least start with Personal Computers which are inexpensive these days, to assist with the management of data. This will include the storage of huge amount of information from inspection work carried out on the highway network. This data shall be accessible at least to the KGM Division level via on-line connections to enable the Division Maintenance Chief Engineers to appreciate, manage and plan the resources available to match the expected work load. Investments in computers should start in 1998.

We would not recommend the storage of an excessive amount of machine and equipment parts as they are expensive items to keep and can certainly affect the cash flow. In these days most machine and equipment parts can be easily obtained within Turkey. Only the minimum amount of spare parts that are not easily obtainable (i.e. requiring long delivery time; have to be imported etc..) and frequently required parts should be stocked. Otherwise it should only be purchased as and when required.

Table 16.4.7 Minimum Equipment and Machinery Availability at Maintenance Stations

Types of Equipment and Machinery	Regions that are often affected by			
	heavy rain	ice and snow	fog	others
snow ploughs		✔		
detachable snow blades		✔		
Grader	✔	✔	✔	✔
compressor	✔	✔	✔	✔
portable concrete mixer	✔	✔	✔	✔
lorry mounted hoist	✔	✔	✔	✔
pickups/vans	✔	✔	✔	✔
cars	✔	✔	✔	✔
trucks	✔	✔	✔	✔
excavator	✔	✔	✔	✔
road sweeper/gully emptier	✔	✔	✔	✔
hand operated vibrating roller	✔	✔	✔	✔
dowser	✔	✔	✔	✔
traffic management accessories e.g. cones, amber flashing lights, temporary works sign	✔	✔	✔	✔
pumps, hoses and accessories for water removal etc.	✔	✔	✔	✔
assorted hand tools such as shovels, pick axes, ladder, 3-5 m tapes, etc.	✔	✔	✔	✔
assorted personnel safety equipment such as reflective jackets, helmets etc.	✔	✔	✔	✔

Note
Equipment and Machinery may be hired or supplied by subcontractors undertaking the maintenance work.

16.4.4 Materials

There are a certain amount of construction materials that are frequently needed for maintenance work. They should be kept in store for convenience. In some cases they might be needed for emergency. Some construction materials such as cement are weather sensitive and must be stored in a secure place away from the elements. Aggregates and other construction materials must be kept clean. Materials that we would recommend KGM maintenance departments to stock are as follows:-

Table 16.4.8 Minimum Materials to be Available at Maintenance Stations.

Types of Materials	Regions that are often affected by			
	heavy rain	ice and snow	fog	others
salt and grit		✔		
sand bags	✔	✔		
cement	✔	✔	✔	✔
aggregates	✔	✔	✔	✔
light reinforcement	✔	✔	✔	✔
bitumen	✔	✔	✔	✔
paint	✔	✔	✔	✔
cold mix	✔	✔	✔	✔
safety fences	✔	✔	✔	✔

16.4.5 Services

Turkey operates a free market economy and the level of competition is getting keener. In recent years there has been a marked increase in the number of privately owned service providers and the types of services generally on offer. As such certain services offered by the private sector can offer efficiency, quality and economy. It can also offer relief to the KGM's problem of labour and resource shortages.

Careful selection of a reliable and experienced service provider is important in achieving the desired results. KGM must satisfy themselves that any service providers invited to tender are familiar with the task that is required of them, have the necessary personnel, have the appropriate equipment and machinery and are capable of completing the work satisfactorily. Cost should not be the only selection criteria under any circumstances and KGM must satisfy themselves that the financial offer is realistic. Otherwise the quality of work will suffer and the administration of the contract will not be easy.

Currently KGM is providing most of their services in-house. Services that we consider possible to be obtained from external service providers which should not present difficulties for KGM to administer are:-

- catering or possibly a cash allowance that can be used more freely to suit working location
- servicing of vehicle fleet

- transport of personnel
- grass/weed control
- cleaning of culverts and ditches
- supply of bituminous materials and concrete
- supply of aggregates
- repair of safety fences
- cleaning of signs
- inspections and reporting
- security patrol for workstations

Proper supervision by knowledgeable staff will be necessary for the successful completion of the works. Certification of work for payment should only be made upon successful completion. It is also very important for KGM to make the payment on time. Cash flow is very important to the well being of any service provider and delays in payment can seriously affect their quality of performance.

With the reduction in the amount of materials to be stocked and the number machinery and equipment to be provided by KGM, certain services provided by the work stations will no longer be necessary. For efficiency and economy, materials can be held centrally to minimise the quantity to be stocked and likewise for the machinery and equipment parts. Redundant work stations can either be closed or sold and the overall operational cost of the Maintenance Division can be reduced.

16.5 Implementation Cost of the New Management System for the Study Route

The implementation cost studies are only for the length of the study roads that pass through the six study Sub-Divisions. It is intended that the results be applied to the 2000 km road as agreed with JICA and KGM.

In this study, we have analysed the personnel, equipment and machinery requirements for the six study Sub-Divisions as a whole. The results of the study will be prorated to the lengths of highway forming the study route.

16.5.1 Staffing Proposal

From our assessment of the KGM method of working and the practice of similar maintenance authorities in Japan and UK, Appendix 3 shows our proposed staff composition to undertake the maintenance of the study roads in each of the six study Sub-Divisions.

For the staffing arrangement, we propose that the responsibility be broadly divided into two classifications. One category shall be responsible for the technical matters such as:-

- all inspection work
- condition evaluation and prioritising the repair work
- construction supervision of subcontract maintenance/ new construction work
- updating of database for the network in the Sub-Division

The other category shall be responsible for:-

- implementing traffic safety measures
- construction supervision
- carrying out the actual repair work.

This will make it easier for control of the work and also if privatisation does take place, then it will be easier, as the responsibility of the two disciplines are entirely separated.

16.5.2 Equipment and Machinery proposal

As for the staff proposal, we have also studied the particular requirements necessary for the study routes in the six Sub-Divisions and the results are shown in Appendix 3. Again this is the target for the year 2005.

As the wealth and quality of life improves, the Turkish citizen would expect a better level of service from KGM. More equipment and machinery will have to be made available to deal with the winter maintenance to keep the highways open to traffic. The majority of the proposed additional vehicles are for dealing with snow and ice problems. Unfortunately most of the snow and ice maintenance work is carried out with specialist equipment and machinery, which has very limited other application and is not usually available from contractors. This equipment and machinery must be purchased by KGM and if the maintenance work is privatised, they shall remain the property of KGM but shall be maintained by the contractor under the Agreement.

There is also equipment and machinery which has been proposed for other types of work. These are deemed to be necessary to do the maintenance work but not necessarily to be owned by KGM. It may be more economical to hire this equipment when required. Other facilities such as asphalt plants shall be sold and reliance on commercial supplier should be aimed at by the target year of 2005.

16.5.3 Cost of proposal

The cost of the staff, machinery and equipment proposed as necessary for the study routes in the six Sub-Divisions are as detailed in Appendix 3.

There are certainly cost savings to be achieved when the personnel are re-organised e.g. drivers are trained to operate machines and other tasks. The cost of the changes have been analysed and we can conclude that savings, in some cases substantial savings, can be achieved with improved efficiency in personnel function and responsibility. It will require a period of time for personnel to accept the need for changes in working practices, which can be motivated by financial incentives through improved and competitive pay packages. From the study it appears that this can be achieved within the present KGM budget, without the need for additional finance.

In view of the need for changes in employment legislation and contracts to be made before our proposal can be put into practice, we have aimed at a target date of 2005 as the possible implementation date. Changes in employment legislation are often time consuming but under the current political climate in Turkey, which aims to privatised much of the state enterprises/ services, the opportunity has never been better.

16.6 Economic Evaluation of the Six Case Studies - Burdur, Afyon, Iznik, Eskisehir, Amasya and Rize

16.6.1 General Introduction

Out of the 2000 kilometre Study Route Network, some six Case Studies were selected for more detailed economic and engineering analysis. These six Case Studies, and their key characteristics are summarised in Table 16.6.1 below:-

Table 16.6.1 The Six Case Studies

Case Study	Division	Subdivision	Kilometres	Roads
Burdur	13	134	138	650-10 & 11 & 12
Afyon	3	31	152	260-01 & 2, 300-07, 650-09
Iznik	14	147	22	200-06
Eskisehir	4	46	88	200-08 & 09
Amasya	7	72	40	795-03, 100-17
Rize	10	103	109	010-23 & 24 & 25
Total			549	

More detailed information was collected upon each of the Case Study road sections, supplemented by the detailed engineering inspections that were carried out in the course of the study on selected kilometres.

16.6.2 The Proposed New Maintenance Concept for the Case Studies

KGM's present practice on the Case Study roads could be described as **'full patching of the surface'**. This is efficiently and effectively carried out by KGM. Potholes are filled and other areas of surface distress are made good. The policy is essentially a 'condition-responsive' approach allowing for 100% patching.

Full patching is often included and integrated into routine maintenance by highway authorities because it is an annual operation or a recurrent cost. Patching will cover mainly surface patching and repair of surfacing distress. Included are skin patches of binder and stone or slurry seal on cracked or ravelled areas, the replacement of the surfacing in small severely-cracked areas, and the filling of potholes. Crack sealing could also be included. When budgets allow, KGM undertakes overlays or reconstruction. The former could be described as periodic maintenance. Reconstruction is essentially new construction and represents a replacement of capital as opposed to the maintenance of an existing capital asset.

The new maintenance approach proposed here for the Case Studies is that KGM should adopt a policy, and a plan, of scheduled overlays. That is to say, that there is a clear plan of

overlaying sections of road according to a definite timetable and in a pre-specified manner. A **'scheduled overlay approach'** is being proposed by ourselves as the most effective, efficient and economic manner in which to carry out road maintenance in the six Case Studies (Burdur, Afyon, Iznik, Eskisehir, Amasya and Rize) in Turkey.

The cycle for overlaying is taken as a ten year cycle. A special and innovative feature of our approach is to overlay the surface treated roads with an exceptional thickness (150mm) of asphaltic concrete in the first overlay and then follow up ten years later with a 50mm second asphaltic concrete overlay. In this way the road can then be considered as an asphaltic concrete road. The reason for this is that the performance of the asphaltic concrete roads is significantly better than that of the surface treated roads. The existing asphalt concrete roads are dealt with on a ten year cycle with a 50mm asphalt concrete overlay.

NEW INNOVATIVE CONCEPT FOR MAINTENANCE STRATEGY	
For Asphalt Concrete Roads -	50mm ten year cycle overlay
For Surface Treated Roads -	**First Overlay 150mm of asphalt concrete** **Second Overlay 50 mm of asphalt concrete ten years later - so road becomes asphalt concrete road**

It must be stressed that the thicknesses adopted here and the cycle of ten years are both for planning purposes. Obviously modifications to both the cycle and the thickness would have to be made in specific circumstances in response to known engineering data in a detailed situation. So, it will take a little time for the schedules to settle down into a regular ten year cycle.

16.6.3 Approach to the Economic Evaluation and Feasibility Study

This new maintenance concept has been subjected, for feasibility assessment, to an economic evaluation. The methodology for this assessment has been to use the World Bank's HDM III model (Highway Design and Maintenance Standards Model) for estimating the Net Present Value (NPV), the Economic Internal Rate of Return (EIRR) , and the Benefit Cost Ratio (B/C Ratio) of the new maintenance concept.

The HDM Model interrelates the life-cycle costs of highway construction, maintenance and vehicle operation. HDM III is the third generation version of this model.

HDM has five submodels, namely traffic, road construction, road deterioration and maintenance, vehicle operating costs, and exogenous costs/benefits. These models develop three interacting sets of costs (construction, maintenance, and road user) determined by first predicting physical quantities of resource consumption and then multiplying these by unit costs and prices. The user of the model can then search for the alternative with the lowest discounted total cost and can call for rates of return, net present values and first year benefits. This enables the user of the model to come to decisions on priorities.

HDM is not intended to be used for final engineering design, rather it is a tool for economic analysis of alternative standards, either at a project or network level.

Details of the approach adopted to the economic analysis can be seen in the following Appendices:-

16.7 HDM - Road Deterioration Submodel and Inputs for the Six Case Studies
16.8 HDM - Road Maintenance Intervention Inputs for the Six Case Studies
16.9 HDM - VOC Submodel and Inputs for the Six Case Studies

Each of the new maintenance concepts for the Six Case Studies has been subjected to an economic analysis using HDM III. In some cases, some of the Case Study lengths had to be divided into separate links because there were significant differences in traffic levels, surface condition, and road capacity on these different links. The different links are shown in Table16.6.2. Detailed write ups of each of the Case Study Evaluations are contained in the following Appendices:-

16.1 Burdur Case Study
16.2 Afyon Case Study
16.3 Iznik Case Study
16.4 Eskisehir Case Study
16.5 Amasya Case Study
16.6 Rize Case Study

Table 16.6.2 The Three Case Studies That Have to be Divided into Links

Case Study	Kilometres	Roads
Afyon 1	89	260-01 & 2
Afyon 2	18	300-07
Afyon 3	45	650-09
Eskisehir 1	29	200-08
Eskisehir 2	89	200-08 & 09
Amasya 1	25	795-03
Amasya 2	15	100-17

16.6.4 Traffic Development on the Case Studies

Traffic Development is, of course, the key input into evaluating the economic value of a road and its maintenance. The traffic represents the users of the road, whose costs exceed those of KGM by a considerable margin. Reducing the users' costs by good maintenance pays off for the overall Turkish economy.

Traffic on the Study Route Network (2000 km), on the Case Study Roads (549 km) within the Study Route Network, and on the overall Turkish State Road Network (31000 km) has been reported upon in detail in Chapter Fifteen. Traffic models that take into account the effects of population growth, economic growth, vehicle ownership, road capacity and route assignments

have provided traffic input into the Case Studies. Also the traffic data and forecasts prepared by KGM's Transportation and Cost Analysis Division have provided traffic input into the Case Studies.

Traffic has been growing rapidly in Turkey. Vehicle growth over the last 15 years has averaged 9.0% per annum. As a broad generalisation, we are forecasting that traffic growth continues at a significant pace through to 2005, but after that time there is some moderation in the annual growth rates. The HDM Model takes in traffic as Annual Average Daily Traffic (AADT) by different vehicle classes together with annual growth rates, which can be changed once in the lifetime of the project at a selected year. Consequently, this input has to simulate through these limited input variables what is likely to be the traffic on the Case Study road through the life of the project.

16.6.5 Maintenance Engineering Strategy for the Case Studies

The Strategy for the Maintenance Engineering for the Case Studies has been developed after consideration of all the various factors that will impinge upon road deterioration, not only of the pavement but also the associated elements of the road 'right of way', including:-

- Slope Design, Embankment and Retaining Wall
- Drainage Systems
- Snow & Ice Control Facilities

Assessment of the pavement deterioration has taken into account:-

- the volume and loading of traffic
- rainfall and moisture balance
- initial road conditions
- material strength properties and thicknesses
- the variability of material behaviour
- construction quality
- a range of maintenance options

Road pavements deteriorate over time under the combined effects of traffic and weather. Traffic axle loadings induce levels of stress and strain within the pavement layers which are functions of the stiffness and layer thicknesses of the materials, and which under repeated loading cause the initiation of fatigue in bound materials and the deformation of all materials. Weathering causes bituminous surfacing materials to become brittle and thus more susceptible to cracking and to disintegration (which includes ravelling, spalling and edge-breaking).

The HDM III submodel predicts road deterioration through five separate distress modes:-

1. Cracking (Initiation and Progression - all cracking and wide cracking)
2. Ravelling (Initiation and Progression)
3. Potholing (Initiation and Progression)
4. Rutting
5. Roughness

After analysis of all these factors, the maintenance engineering strategy for the six Case Studies has been determined as shown in the Table 16.6.3 below:-

Table 16.6.3 Six Case Studies - New Maintenance Engineering Strategy - Ten Year Overlay Cycle

Case Study	Road	km	PresentSurface	Overlay Depth mm	First Year for Overlay
Burdur	650-10/12	138	ST	first -150mm & then 50 mm - 2nd	1999
Afyon 1	260-01 & 2	89	AC	50	2006
Afyon 2	300-07	18	AC	50	2006
Afyon 3	650-09	45	ST	first -150mm & then 50 mm - 2nd	2003
Iznik		22	AC	50	2000
Eskisehir 1	200-08	29	AC	50	2000
Eskisehir 2	200-08 & 09	59	AC	50	2000
Amasya 1	795-03	25	ST	first -150mm & then 50 mm - 2nd	1999
Amasya 2	100-17	15	AC	50	2004
Rize		109	ST	first -150mm & then 50 mm - 2nd	1999

The capital costs associated with the engineering strategies have been based upon a series of unit costs for overlays and patching:-

Economic Costs

Full Patching Cost		US$ 7.40-7.75 per square metre (Economic Costs)
Overlay Cost	- for 50mm	US$ 6.65-7.05 per square metre (Economic Costs)
	- for 150mm	US$ 18.62 -19.74 per square metre (Economic Costs)

The Financial Costs will be 25% higher.

Of course, the assumption is that the overlay would be done in a managerially and logistically appropriate manner, e.g. 20 kilometres at a contract, and not in a few square metres at a time. By contrast, patching would follow the current practice by KGM, but full patching could allow for minor distress repairs involving a virtual reconstruction of a few square metres.

The very important issues associated with slope, embankment, drainage, retaining walls, snow and ice control facilities have been handled through the routine maintenance allocations along the lines shown in Table 16.6.4.

Table 16.6.4 Case Studies - Routine Maintenance Costs Per Kilometer
- USS per Kilometer (Economic Costs)

Routine Maintenance Item	Burdur	Afyon 1	Afyon 2 Dual	Afyon 3	Iznik	Eskisehir 1 Dual	Eskisehir 2	Amasya 1	Amasya 2 Dual	Rize
Kilometres	138	89	18	45	22	29	59	25	15	109
Surface	ST	AC	AC	ST	AC	AC	AC	ST	AC	ST
Pavement (Additional to Patching)	51	28	56	22	14	34	17	48	67	28
Snow & Ice Prevention	110	550	1100	550	550	1140	570	100	100	100
Others										
Gully	15	15	15	15	15	30	15	15	50	30
Shoulder	200	150	150	150	150	300	150	150	300	150
Side Ditch	180	180	180	220	180	360	180	180	360	180
Retaining Wall	80	80	80	80	100	80	80	80	80	80
Slope	72	112	555	111	45	50	50	80	50	46
Embankment	40	24	40	40	45	40	40	80	40	40
Culvert	120	121	120	120	120	240	120	120	240	180
TOTAL PER KILOMETRE	868	1260	2296	1308	1219	2274	1222	853	1287	834
Total Routine Maintenance Annual Costs per length of road - US$ millions										
Economic Costs	0.12	0.11	0.04	0.06	0.03	0.07	0.07	0.02	0.02	0.09
Financial Costs	0.15	0.14	0.05	0.07	0.03	0.08	0.09	0.03	0.02	0.11

Table16.6.5 The Six Case Studies - Overlay Capital Costs
(Financial Costs US$ million)

Case Study	km	PresentSurface	Financial Capital Cost of First AC Overlay	First Year for Overlay
Burdur	138	ST	22.49	1999
Afyon 1	89	AC	5.49	2006
Afyon 2	18	AC	2.22	2006
Afyon 3	45	ST	7.33	2003
Iznik	22	AC	1.36	2000
Eskisehir 1	29	AC	3.58	2000
Eskisehir 2	59	AC	3.64	2000
Amasya 1	25	ST	4.07	1999
Amasya 2	15	AC	1.85	2004
Rize	109	ST	17.26	1999

The financial capital costs of the new maintenance overlays are illustrated in Table 16.6.5.

16.6.6 Road User Costs

The economic returns from road maintenance arise primarily from the reductions in road user costs. These costs will include vehicle operating cost savings (VOC savings), passenger time savings, cargo holding savings, and accident savings. The major reduction usually occurs in vehicle operating costs, largely arising from an improvement in the roughness of the road.

For each of the case study links, the vehicle operating costs have been estimated for the life of the new maintenance concepts. The difference between the existing approach of **full patching** has been compared with the new approach of **scheduled overlays**. The latter costs more than the former but produces a better quality of pavement such that the reductions in VOC for road users delivers economic returns upon the capital investment in the new maintenance strategy.

The equation used for estimating road roughness is as follows:-

$$\Delta QI_d = 13\,K_{gp}\,\{\,134\,EMT\,(SNCK+1)^{-5.0}\,YE4 + 0.114\,(RDS_b - RDS_a) + 0.0066\,\Delta CRX_d + 0.42\,\Delta APOT_d] + K_{ge}\,0.023\,QI_a$$

where:-

ΔQI_d = the predicted change in road roughness during the analysis year due to road deterioration, in QI

SNCK = the modified structural number adjusted for the effect of cracking, given by:- SNCK = max (1.5; SNC - ΔSNK)

ΔSNK = the predicted reduction in the structural number due to cracking since the last pavement reseal, overlay or reconstruction, given by

$\Delta SNK = 0.0000758\,[CRX_a' \; HSNEW + ECR\; HSOLD]$

An illustration of the change in VOC with roughness on the typical Case Study Road is given in Figure 16.6.1 below.

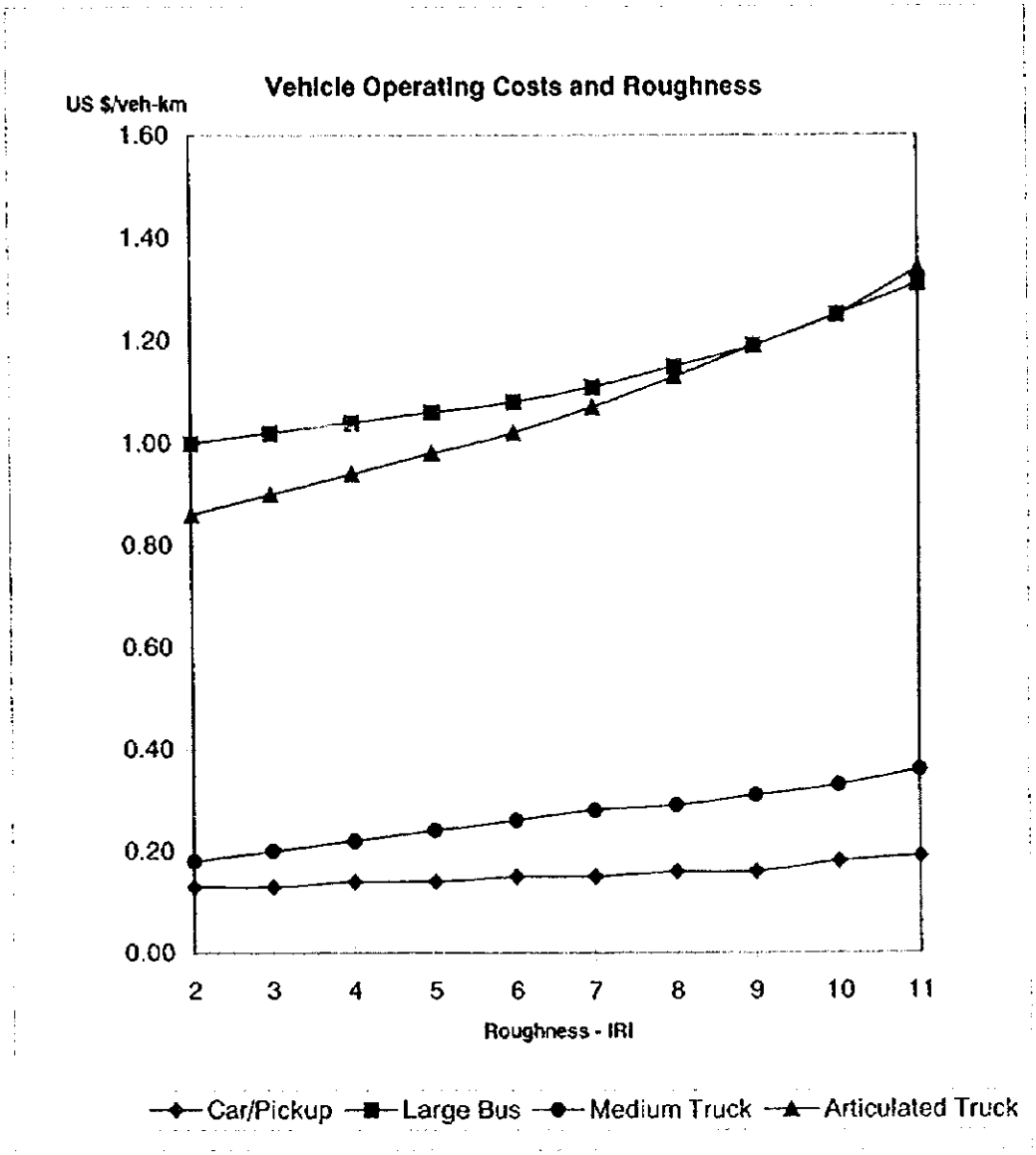


Fig. 16.1.1 Typical Case Study Road, Change of Vehicle Operating Costs with Roughness

16.6.7 The Economic Returns from the New Maintenance Strategy.

We have computed the economic returns from the new Maintenance Strategy of scheduled overlays. The results are illustrated in Table 16.6.6. The figures indicate that setting up the maintenance planning in the Case Study subdivisions and gearing this planning towards a systematic schedule of overlaying of the state highways will give better economic returns than the current system of very extensive annual patching.

Table 16.6.6 The Six Case Studies - Economic Returns Through The Economic Life
(Economic Prices)

Case Study	NPV US$ millions	EIRR Economic Internal Rate of Return	B/C Ratio Benefit/ Cost Ratio	First Year for Overlay
Burdur	295.56	156.8%	19.5	1999
Afyon 1	14.37	32.2%	7.9	2006
Afyon 2	32.54	50.4%	39.4	2006
Afyon 3	26.25	68.6%	27.0	2003
Iznik	35.10	134.0%	35.3	2000
Eskisehir 1	77.23	74.0%	29.7	2000
Eskisehir 2	39.67	60.2%	15.5	2000
Amasya 1	59.66	147.7%	21.6	1999
Amasya 2	18.44	47.8%	21.8	2004
Rize	158.34	97.6%	13.9	1999

The above economic rates of return involve comparing the new maintenance strategy (scheduled overlays) with the existing KGM practice (full patching). The rate of return applies to the new maintenance strategy (WITH PROJECT) compared to KGM's existing practice (WITHOUT PROJECT). It reflects the better use of resources and assets as used in the NEW MAINTENANCE STRATEGY.

16.6.8 Economic Returns in 2005 and 2015

The detailed economic returns for the different Case Studies are shown in Table 16.6.7.

Table 16.6.7 Economic Returns for Six The Case Studies in 2005 & 2010

CASE STUDY	NPV US$ millions	EIRR	B/C RATIO
2005			
Burdur	148.45	155.8%	10.3
Afyon	12.47	16.1%	1.7
Iznik	9.69	132.1%	10.5
Eskisehir	15.06	52.4%	3.5
Amasya	25.65	96.6%	6.5
Rize	59.15	94.6%	5.8
2015			
Burdur	277.44	156.8%	18.3
Afyon	108.17	44.2%	13.7
Iznik	30.80	134.0%	31.1
Eskisehir	97.74	64.5%	17.1
Amasya	69.17	110.0%	18.6
Rize	143.99	97.6%	12.7

The Economic Rates of Return are, for the most part, good, and well above the opportunity costs of capital. The reasons for the good rates of return are that:-

- on the surface treated roads, the road condition is already rather poor, with the result that surface improvements with an overlay immediately provide a high level of benefit to the road users.

- also, on the surface treated roads, the innovative programme to change the road to an asphalt concrete road develops high benefits for road users quickly, and thus for the Turkish economy

Whilst new road projects usually develop economic rates of return between 5% and 40%, maintenance projects can often develop much higher economic rates of return (over 100%) because a relatively small capital expenditure on road maintenance can put a major capital asset (namely the road) back into full operation providing a high level of benefit to the road users.

Also a comparison can be made between the present value of the operating costs (KGM plus Road Users) under the existing approach and the same under the new maintenance strategy. The difference (that is to say the savings) is attributable to the NEW MAINTENANCE STRATEGY.

The new maintenance strategy makes a significant difference to the overall operating costs, such that the present value of the operating savings build up to US$ 312 million between 1999 and 2005, and up to US$ 944 million by 2015, for the Turkish economy. (See Figures 16.6.2 and 16.6.3).

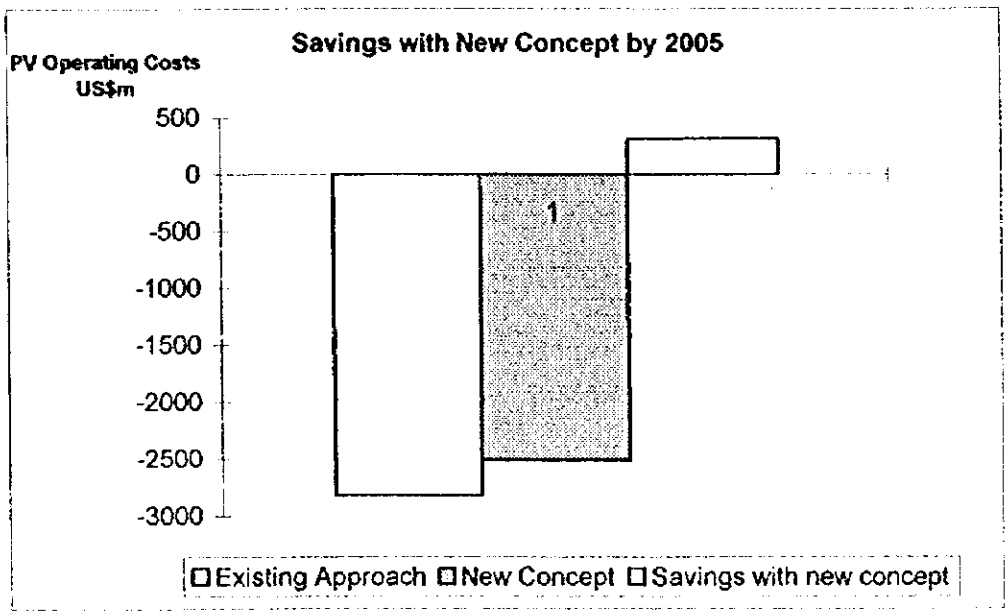


Fig. 16.6.2 Operating Cost Savings by the Year 2005

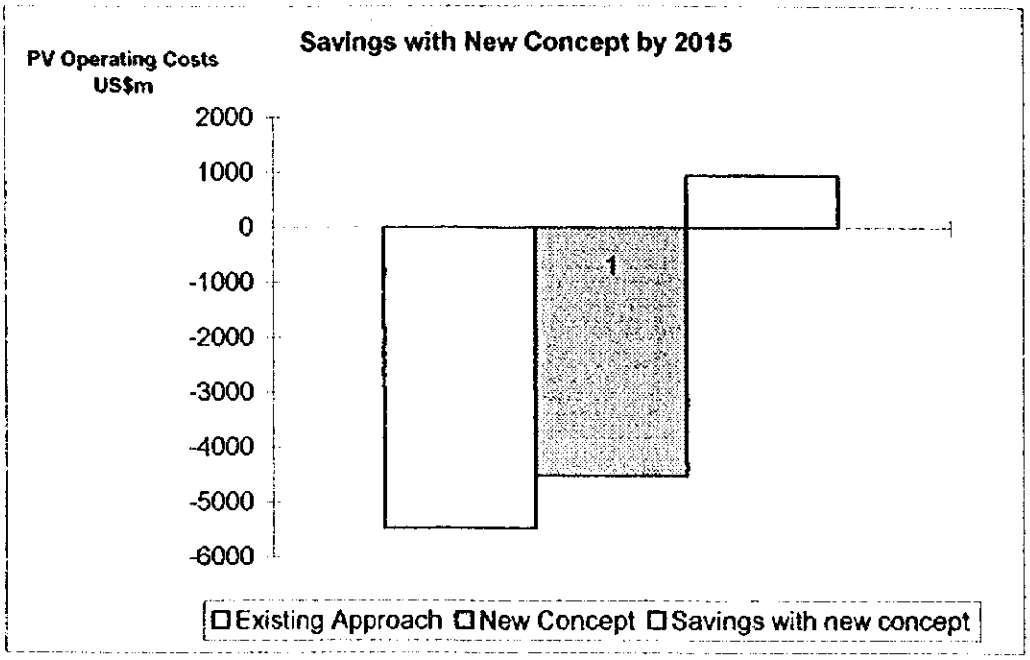


Fig. 16.6.3 Operating Cost Savings by the Year 2015

TABLE 16.6.8		ESKISEHIR 1 CASE STUDY			ECONOMIC ANALYSIS OF NEW MAINTENANCE APPROACH									
Kilometres	29		cses1irr.xls							Year of tripling		Road User Savings Allocation		
Factor to adjust capital costs		1.00	Present=	1998						2013		67%	after tripling	
Calculations														
Year	KGM	KGM	NEW APPROACH----------			CURRENT APPROACH--------			MAINT-	VOC&TIME SAVING		Exoge-	Net	Benefit
	Capital	Capital	Recurrent	VOC	Time	Recurrent	VOC	Time	ENANCE	VOC	Time	nous	Benefit	Flow
	Costs(PV)	Costs	Costs		Costs	Costs		Costs	Savings	Savings	Savings	Benefits	Flow	
	US$ mill.	US$ mill.	US$ mill.	US$ mill.	US$ mill.	US$ mill.	US$ mill.	US$ mill.	US$ mill.	US$ mill.	US$ mill.	US$ mill.	US$ mill.	US$ mill.
1999	3.02	0.00	0.07	51.17	6.45	0.07	51.17	6.45	0.00	0.00	0.00		-3.02	
2000		2.86	0.07	54.66	6.83	0.07	54.66	6.83	0.00	0.00	0.00		0.00	0.00
2001		0.00	0.07	56.38	7.18	0.07	58.49	7.25	0.00	2.11	0.07		2.18	2.18
2002		0.00	0.07	59.76	7.61	0.07	62.71	7.70	0.00	2.96	0.09		3.05	3.05
2003		0.00	0.07	63.35	8.07	0.07	67.38	8.19	0.00	4.03	0.13		4.15	4.15
2004		0.00	0.07	67.17	8.55	0.08	72.73	8.73	0.01	5.56	0.18		5.75	5.75
2005		0.00	0.07	71.24	9.07	0.08	78.52	9.32	0.02	7.28	0.25		7.54	7.54
2006		0.00	0.07	73.47	9.35	0.09	82.50	9.68	0.02	9.03	0.33		9.38	9.38
2007		0.00	0.07	75.78	9.64	0.09	86.69	10.07	0.02	10.92	0.44		11.37	11.37
2008		0.00	0.07	78.17	9.94	0.09	91.46	10.52	0.02	13.29	0.58		13.90	13.90
2009		0.00	0.07	80.89	10.25	0.09	96.94	11.05	0.02	16.06	0.80		16.87	16.87
2010		2.86	0.07	84.03	10.58	0.09	103.28	11.68	0.02	19.24	1.10		20.37	20.37
2011		0.00	0.07	84.50	10.82	0.09	110.70	12.45	0.02	26.20	1.63		27.85	27.85
2012		0.00	0.07	87.14	11.16	0.09	119.57	13.42	0.02	32.43	2.26		34.71	34.71
2013		0.00	0.07	89.87	11.51	0.09	130.23	14.65	0.02	40.36	3.14		43.53	43.53
2014		0.00	0.07	92.70	11.86	0.09	139.11	15.71	0.02	46.41	3.85		33.69	33.69
2015		0.00	0.07	95.63	12.24	0.09	144.25	16.31	0.02	48.62	4.07		35.33	35.33
2016		0.00	0.07	98.66	12.62	0.09	148.64	16.81	0.02	49.98	4.19		36.32	36.32
2017		0.00	0.07	101.82	13.02	0.09	153.19	17.33	0.02	51.37	4.31		37.33	37.33
2018		0.00	0.07	105.10	13.44	0.09	157.88	17.87	0.02	52.77	4.43	2.86	40.27	40.27
Present Value		3.02								Present Value of Benefits				89.51
Present Value 1999-2005			0.30	269.58	34.16	0.31	281.35	34.55		Net Present Value @		12%	77.23	
Present Value 1999-2015			0.47	479.23	60.86	0.54	547.08	64.87		Economic Internal Rate of Return			74.0%	
Residual Value %		50			Current	New	PV Savings attributable			First Year Rate of Return			76.1%	
Discount Rate		12%	PV COSTS		Approach	Approach	to new approach			Cost	2.86	FYR	2.18	MAX2006
			1999-2005		316.20	304.04		12.17		B/C Ratio			29.7	
			1999-2015		612.48	540.56		71.93						

16.7 Case Study Summary

From our study, it can be seen that the adopted strategy is an advantage for KGM. From the three aspects that we have analysed it can be concluded that:-

- A programme of scheduled overlays does actually produce very good economic returns and reduces the cost of commuted maintenance.
- Reorganisation of staff functions brings efficiency and reduces cost

CHAPTER 17

IMPLEMENTATION PLAN

CHAPTER 17 IMPLEMENTATION PLAN

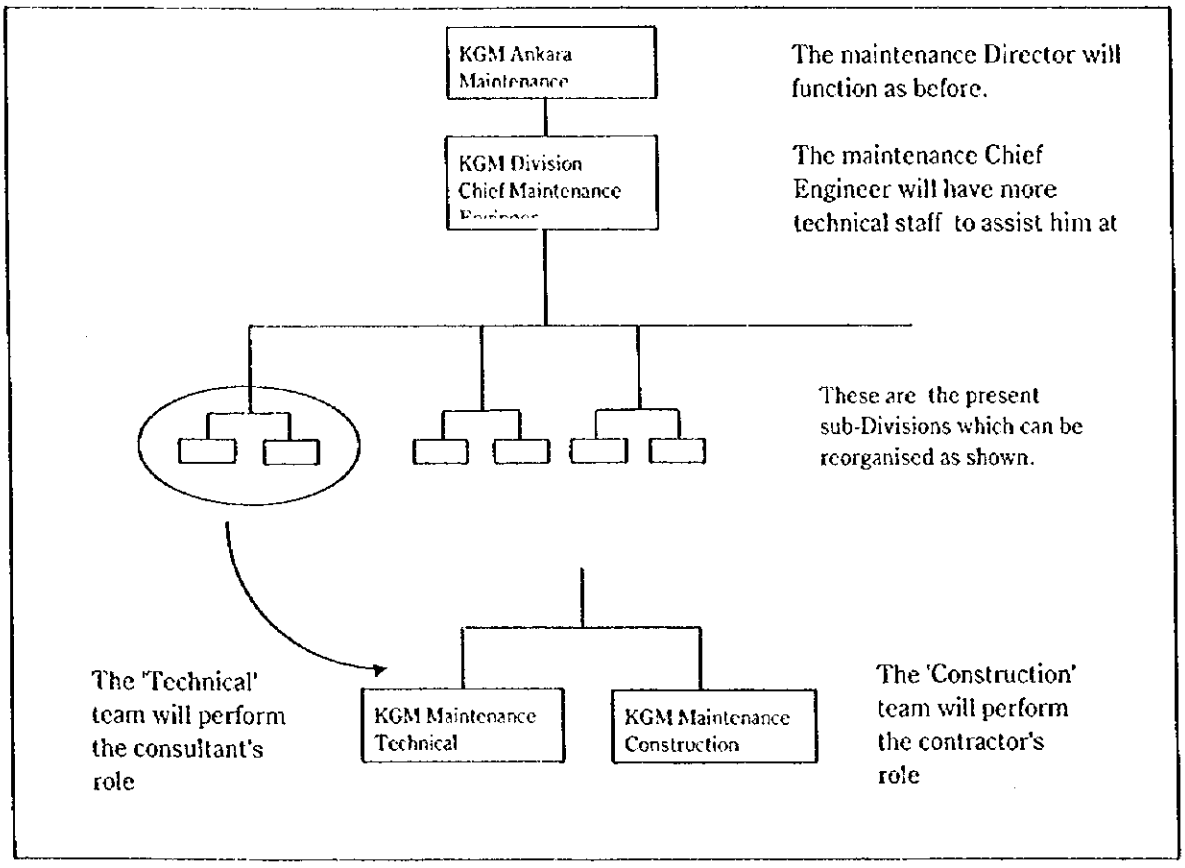
17.1 General

KGM has a very big responsibility for keeping the traffic running on the state highways. The country's economy will be grossly affected if work on the highways is constantly disrupting the smooth transportation of passenger and goods. An efficient and economically acceptable maintenance strategy is needed to achieve this goal. With Asphalt concrete roads the pavement thickness will be higher and strength will be increased, effectively increasing the life of the pavement. Hence the corresponding cost for maintenance will be considerably reduced.

The information that we have obtained from the case study route sections will be expanded for the entire 2000 km study route. The aim is to have an implementation plan which will prioritise the major maintenance work, which is to have a programme of scheduled overlay. The decision for prioritising will be based on the damage data that we have collected.

17.2 Preliminary Design

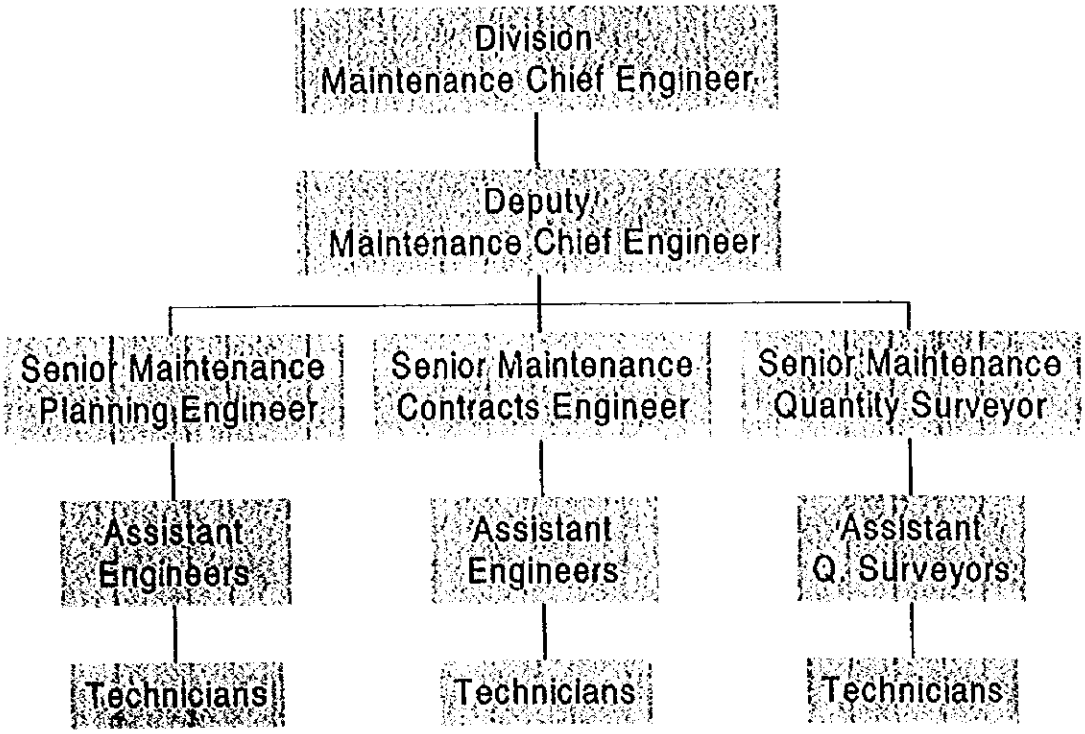
In introducing the changes in the management system, it is anticipated that with time and available budget the maintenance work will be carried out with technologically more advanced equipment. Coupled with the possibility of privatising the services, the core KGM staff at Division level will be considerably reduced. The emphasis will be for more technical staff to identify the problems and to solve the problems before it gets too costly to repair. The following is the organisation chart anticipated:



If privatising the maintenance services is to be adopted, the 'Technical' and 'Construction' team can be privatised seperately without affecting the proper functioning of the maintenance activities. The function of the Division maintenance Chief Engineer will also not be affected. Alternatively, they can all function equally well within the KGM's organisation, if they are not privatised.

In the proposed new management system, the KGM maintenance team at the Division can be organised as follows:

Organisation Chart of KGM at each of the Divisions



There shall also be an on-line computer system linking the various Sub-Divisions to the Division. This will enable the Maintenance Chief Engineer of the Division to have an up todate assessment of the maintenance work load at all the Sub-Divisions. The Maintenance Chief Engineer for each Division will be able to control and coordinate all the maintenance activities more effectively.

17.3 Cost Estimations

We have collected the data for approximately 2000 km of State Highways. This data has been stored in the data base programme specially designed for this project. The data has been extracted and interpreted for the 18 Sub-Divisions of our study route. A comparative study was carried out between the six case study sub-Divisions and the other 12 sub-divisions to find possible similar maintenance requirements. It is concluded that the following pairing is compatible:

Sub- Division Name	Sub- Division Number	Case study section identification	Similar to case study section
Antalya	132		A
Burdur	134	A	
Afyon	31	B	
Bursa	143		C
Iznik	147	C	
Bilecik	144		C
Eskisehir	46	D	
Polatli	45		B
Kizilcahamam	42		B
Bolu	41		C
Kirikkale	44		E
Corum	73		E
Amasya	72	E	
Samsun	75		E
Ordu	77		E
Giresun	104		F
Akcaabat	105		F
Rize	103	F	

Hence the associated cost for the maintenance work for each of the other 12 sub-divisions has been prorated from the six case study sections. The results of this and the six case studies are summarised in Table 17.3.1, and are for year 1998 to year 2015.

Table 17.3.1 Summary of Maintenance Operational Costs (Long term and Short term) for 18 Sub-Divisions

Sub-Division No: km Year Under Consideration	Rize 103 109	Giresun 104 105	Akcaabat 105 113	Zorum 73 159	Eski?ehir 46 88	Antalya 132 88	Samsun 75 173	Burdur 134 138	Ordu 77 108	Amasya 72 40	Kirikkale 44 101	Polatl? 45 177	Afyon 31 152	K?z?lcahamam 42 133	Bolu 41 124	Bursa 143 31	Bilecik 144 78	Iznik 147 22
1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998	397824	383105	412543	930746	258433	269150	1012699	1223411	632205	234150	591229	746684	640931	560814	244405	61101	155030	43365
1999	1044122	1005489	1082755	2200182	581980	839963	2393909	1312442	1494464	553505	1397600	1570184	1347797	1179323	247730	61933	157139	43955
2000	1048122	1009341	1086903	2151946	886905	810490	2341425	1266390	1461699	541370	1366959	2246480	1928309	1687271	4815708	1203927	3054677	854455
2001	1040845	1002334	1079356	422880	864605	801786	460115	1252790	287240	106385	268622	2213482	1899984	1662486	228004	57001	144627	40455
2002	356545	343353	369737	432023	833965	798586	470063	1247790	293450	108685	274430	1380274	1184784	1036686	236571	59143	150061	41975
2003	366545	352983	380107	433732	1162565	798586	471922	1247790	294611	109115	275515	1405799	1206694	1055858	234204	58551	148559	41555
2004	360545	347205	373885	2598000	606115	182906	2826755	285790	1764680	653585	1650302	1341444	1151454	1007523	249027	62257	157961	44185
2005	345520	332736	358304	2609401	608385	191098	2839159	298590	1772423	656453	1657544	428271	367614	321663	252944	63236	160446	44880
2006	323560	311588	335532	391832	593810	180243	426233	281630	266150	98574	248899	389913	334689	292853	216338	54084	137226	38385
2007	326560	314477	338643	399782	253520	173843	434983	271630	271550	100574	253949	365204	313479	274294	227694	56924	144430	40400
2008	330560	318329	342791	400179	253070	173843	435415	271630	271820	100674	254202	391043	335659	293702	228202	57050	144752	40490
2009	993860	957087	1030633	2120698	254855	788000	2307426	1231250	1440474	533509	1347110	1394702	1197169	1047523	246265	61566	156210	43695
2010	1018810	981114	1056506	2152534	832055	819795	2342065	1280930	1462099	541518	1367333	2212812	1899409	1661983	4847834	1211958	3075054	860155
2011	998860	961902	1035818	416099	818765	807610	452737	1261890	282633	104679	264314	2206137	1893679	1656969	250210	62553	158712	44395
2012	330560	318329	342791	427368	1167085	803162	464998	1254940	290288	107514	271473	1417461	1216704	1064616	262130	65533	166273	46510
2013	318560	306773	330347	438876	1160760	798794	477519	1248115	298104	110409	278783	1459342	1252654	1096073	262497	65624	166506	46575
2014	316560	304847	328273	4408470	1160110	194867	4796637	304480	2994432	1109049	2800349	1439677	1235774	1081303	280222	70055	177749	49720
2015	343510	330800	356220	2709650	625915	220736	2948236	344900	1840517	681673	1721224	461514	396149	346631	293805	73451	186365	52130

Figures in US $

17.4 Economic Evaluation of The Study Network (2000 km)

17.4.1 General Introduction

The Case Studies have been used as the basis for developing an overall implementation plan (for maintenance) over the 2000 kilometre Study Route Network. The Case Studies covered some 549 kilometres in detail whilst the Study Route Network covered 1939 kilometres. The Case Study information has been pro-rated from the 549 km to the 1939 km to give an illustrative idea of the maintenance plan over a 2000 km network. This network touches upon 18 subdivisions within KGM.

17.4.2 The Potential Economic Returns

The potential economic returns from the new maintenance strategy have been estimated for the Study Route Network by using the individual Case Study Roads as guides as to the type of returns that could be achieved on the non-case study roads. The 'guide' roads take into account factors such as traffic levels, terrain, difficulties in works operations, capital costs etc. These features could all be described as geographical factors. Then, adjustments have been made to reflect the following differentials:-

- the lane kilometres within the Study Route Network which have to be maintained within the different subdivisions
- the balance of surface treated and asphaltic concrete road surfaces within each of the subdivision study roads
- the relative roughnesses of the roads in the study route in each subdivision, which impacts upon the vehicle operating costs
- the level of road damage that exists within each of the subdivision study roads, as ascertained in the course of the engineering inspections carried out over the 2000 kilometres, and the detailed engineering inspections carried out on selected lengths

The new maintenance strategy for the 2000 kilometre network remains the same as for the individual case studies. This strategy is summarised in the Box below:-

NEW INNOVATIVE CONCEPT FOR MAINTENANCE STRATEGY (APPLICABLE TO THE FULL 2000 KILOMETRE STUDY ROUTE NETWORK)

For Asphalt Concrete Roads -	50mm ten year cycle overlay
For Surface Treated Roads -	First Overlay 150mm of asphalt concrete Second Overlay 50 mm of asphalt concrete ten years later - so road becomes asphalt concrete road

The economic returns from this innovative maintenance strategy are illustrated in the Table 17.4.1.

Table 17.4.1 The Economic Returns - 18 Subdivisions in the Study Route Network -2015

SUBDIVISION	NPV US$ millions	EIRR	B/C RATIO
Antalya	199.57	136.5%	15.9
Burdur	277.44	156.8%	18.3
Afyon	108.17	44.2%	13.7
Bursa	36.15	62.0%	16.4
Iznik	30.80	134.0%	31.1
Bilecik	55.52	49.8%	13.2
Eskisehir	97.74	64.5%	17.1
Polatli	166.63	35.9%	11.1
Kizilcahamam	132.43	36.9%	11.5
Bolu	197.82	120.6%	28.0
Kirikkale	94.67	36.9%	11.5
Corum	238.30	104.15	32.3
Amasya	69.17	110.0%	18.6
Samsun	356.87	125.4%	21.2
Ordu	118.49	81.1%	10.5
Giresun	145.76	102.6%	13.3
Akcaabat	149.27	69.4%	9.0
Rize	143.99	97.6%	12.7

17.5 Priority Lists

The order of priority for the 18 sub divisions are as follows:

Priority ranking	Sub -- Division Name	Sub – Division Number	Length of Road km
1	Burdur	134	138
2	Antalya	132	88
3	Iznik	147	22
4	Samsun	75	137
5	Bolu	41	124
6	Amasya	72	40
7	Çorum	73	159
8	Giresun	104	105
9	Rize	103	109
10	Ordu	77	108
11	Akçaabat	105	113
12	Eskişehir	46	88
13	Bursa	143	31
14	Bilecik	144	78
15	Afyon	31	152
16	Kızılcahamam	42	133
17	Kırıkkale	44	101
18	Polatlı	45	177

CHAPTER 18

RECOMMENDATION

CHAPTER 18 RECOMMENDATIONS

This study has suggested a road maintenance system and methods for the design of slope, drainage and snow & ice control facilities. However, there are a number of areas where we believe certain changes would help to improve the maintenance of roads in Turkey. Therefore, the following points are concluded and recommended:-

1. Maintenance Management Items

For years, the budget for road administration has been restricted and priority has been given to pavement maintenance. Consequently, the maintenance of earthworks and drainage has suffered. Earthworks slips, falling rocks and blocked drainage have become serious problems. All problems must be investigated if a road is to be kept in good condition.

2. Analysis of the Cause of Damage

In the past, repair methods have been chosen without investigating causes of defects. Consequently, many repairs are superficial and the pavement soon fails again. This is uneconomical. Methods of repair must address and rectify the root cause of failures.

3. Uniformity of the Manual

Highway maintenance should be approached on a nation-wide basis with common objectives. This can be achieved, we suggest, by enforcing the use of a common manual for highway administration.

4. Review of Maintenance Budget

Investment in highway infrastructure is very important for the development of any country. Maintenance of smooth traffic flow is important. Consequently an appropriate budget must be allocated to highway administration.

5. Records of Meteorological Data

A full understanding of weather conditions is one of the important factors in planning, administration and design of highways. Therefore it is necessary to keep weather records in the future.

6. Review of Design and Construction including the Supervision system

From our site studies of highway defects, our comments are as follows:-

(1) The maintenance of ditches and piped-drainage is inadequate
(2) Some slope faces are unstable
(3) The compaction of earthworks and pavement layers during construction is inadequate
(4) Earthworks contain large boulders not in accordance with the specification
(5) Temperature control during manufacture and laying of asphalt concrete is deficient.

7. Promotion of Greening on the Road

As part of the maintenance management, the greening on the medium and side walk are important matters for the following reasons:

- The landscape of the roads is improved.
- The driver has good visual conditions.
- The rest space is provided.

APPENDIX

MINUTES OF MEETING

ON

THE INCEPTION REPORT

FOR

THE STUDY

ON

ARTERIAL HIGHWAY MAINTENANCE

IN

THE REPUBLIC OF TURKEY

9th. APRIL, 1997, ANKARA

Mr. YAMAN KÖK
Director General
General Directorate of Highways
Ministry of Public Works
and Settlement

Mr. TAKAO INAMI
Leader,
JICA Study Team
Japan International Cooperation Agency

MINUTES OF MEETING
THE STUDY ON ARTERIAL HIGHWAY MAINTENANCE

The Study Team dispatched by the Japan International Cooperation Agency (JICA) submitted ten (10) copies in English and ten (10) copies in Turkish of the Inception Report to the General Directorate of Highways, Ministry of Public Works and Settlement (KGM) on April 3 1997. At the submission of the report, Mr. Takao INAMI, Leader of the JICA Study Team (The Study Team), and members explained the contents of the report. A meeting to discuss the report was held on April 8 1997.

The meeting was chaired by Mr. Yaman Kök, Director General, General Directorate of Highways, Ministry of Public Works and Settlement with the attendees as shown in Annex 1. The contents of the Inception Report were generally agreed by both sides through the discussion. Major topics discussed during the meeting were as follows:

1. In response to the submission of the Inception Report, KGM assigned the members of the steering committee and counterpart as shown in Annex 2.

2. KGM and the Study Team agreed that the route (approx. 2 000km) for the preliminary road survey will be as indicated on the attached map (Annex 3).

Ankara - Hendek	: 277km
Ankara - Antalya	: 545km
Sivrihisar - Bursa	: 245km
Ankara - Hopa	: 930km
	1997km

3. Both sides agreed that the items to be included in the preliminary road survey shall be as follows:

- Embankment	- Pavement
- Slope	- Shoulder
- Drainage	- Box Culvert
- Pipe Culvert	- Inlet
- Stone Masonry	- Retaining Wall
- Snow & Ice Control Facilities	

4. The study team shall study the slope erosion as slope damage measures.

5. The Government agencies in Turkey which will be involved in the study should provide counterparts, division staff and vehicles when the preliminary road survey and detailed road survey are being carried out by the joint Study Team of JICA and KGM.

6. Both sides agreed that the Study Team shall submit the Final Report as follows:

Main Report including Summary, Appendix and Drawings

In English	10 copies
In Turkish	50 copies

Manual

In English	10 copies
In Turkish	250 copies

7. The Inception Report and the Minutes of Meeting were prepared in both English and Turkish. In case of any divergence arising from the interpretation of the items mentioned above, the English shall prevail.

Annex 1

ATTENDEES OF THE MEETING

	Turkish Side
Mr. Yaman KÖK	Director General, General Directorate of Highways
Mr. Ismail TANYALDIRIK	Deputy of Director General
Mr. Salih IRMAK	Head of Maintenance Department
Ms. Münevver ATASARAL	Dep. Head of Maintenance Department
Mr. Rıza SARIKAYA	Dir. Of Maintanence Div.
Mr. Sabri YILDIZ	Dir. Of Traffic Div.
Mr. Ertan SAİT	Dir. of Bridge Maintenance Div.
Mr. Mustafa KARLIER	Dep. Dir. of Maintenance Div.
Mr. Merih BÜYÜKLÜ	Survey and Education Engineer
Ms. Tijen ÖKTEN	Maintenance Engineer
Mr. Sabri YILDIZ	Dir. Of Traffic Div.
Ms. Müge KAHRAMANGİL	Traffic Researh Chief
Mr. Turgay ÇOLAK	Traffic Survey Engineer
Ms. Tuğba KİPER	Dir. of Fotogrametry and Geodesy Div.
Mr. İsmail TÜMAY	Dir. of Hidhway Design Div.
Mr. Salih AKSOY	Dir. of Soil Mechanics and Tunnels Div.
Mr. M. Aydın ÖNAL	Dir. of Pavement Div.
Mr. Gürkan DEMİREL	Dir of Environmental Impact Assessment
Mr. Güralp SERHAT	Dir. of Planning Div.
Mr. Yaşar MANGALOĞLU	Dir. of Transportation and Cost Analysis Div.
Mr. Tomoyuki ADACHI	JICA Expert
Mr. Yoshiaki KAWAKAMI	JICA Expert
	JICA Study Team
Mr. Akihiko HIROTANI	Project Director
Mr. Takao INAMI	Team Leader
Mr. John COOMBS	Member
Mr. Chai Seng CHIEW	Member
Cem BUDAK	Member
Ms. Aya ASANO	Member
	JICA Advisory Committee
Mr. Toshiharu YASUI	Head of Committee
Mr. Kazuya SASAKI	Member of Committee
	Embassy of Japan
Mr. Satoshi TADA	Second Secretary
	JICA Turkey Office
Mr. Naoyoshi SASAKI	Resident Representative
Mr. Timur SAYRAÇ	Member of Turkish Officer

Annex 2

TURKISH STEERING COMMITTEE AND COUNTERPARTS

Members of Steering Committee

Mr. Ismail TANYALDIRIK	Deputy of Director General
Mr. Salih IRMAK	Head of Maintenance Department
Ms. Münevver ATASARAL	Dep. Head of Maintenance Department
Mr. Rıza SARIKAYA	Dir. Of Maintanence Div.
Mr. Sabri YILDIZ	Dir. Of Traffic Div.
Mr. Ertan SAİT	Dir. of Bridge Maintenance Div.

Members of Counterpart

For Maintenance	
Mr. Rıza SARIKAYA	Dir. Of Maintanence Div.
Mr. Mustafa KARLIER	Dep. Dir. of Maintenance Div.
Mr. Merih BÜYÜKLÜ	Survey and Education Engineer
Ms. Tijen ÖKTEN	Maintenance Engineer
For Traffic	
Mr. Sabri YILDIZ	Dir. Of Traffic Div.
Ms. Müge KAHRAMANGİL	Traffic Researh Chief
Mr. Turgay ÇOLAK	Traffic Survey Engineer
Project Officer	
Ms. Münevver ATASARAL	Dep. Head of Maintenance Department
Senior Highway Engineer	
Ms. Tuğba KİPER	Dir. of Fotogrametry and Geodesy Div.
Mr. İsmail TÜMAY	Dir. of Hidhway Design Div.
Mr. Salih AKSOY	Dir. of Soil Mechanics and Tunnels Div.
Road Maintenance / Rehabilitation Engineer	
Mr. Rıza SARIKAYA	Dir. Of Maintanence Div.
Mr. M. Aydın ÖNAL	Dir. of Pavement Div.
Environmentl Specialist	
Mr. Gürkan DEMİREL	Dir of Environmental Impact Assessment
Construction Planning Specialist	
Mr. Güralp SERHAT	Dir. of Planning Div.
Construction Cost Estimate Specialist	
Mr. Yaşar MANGALOĞLU	Dir. of Transportation and Cost Analysis Div.

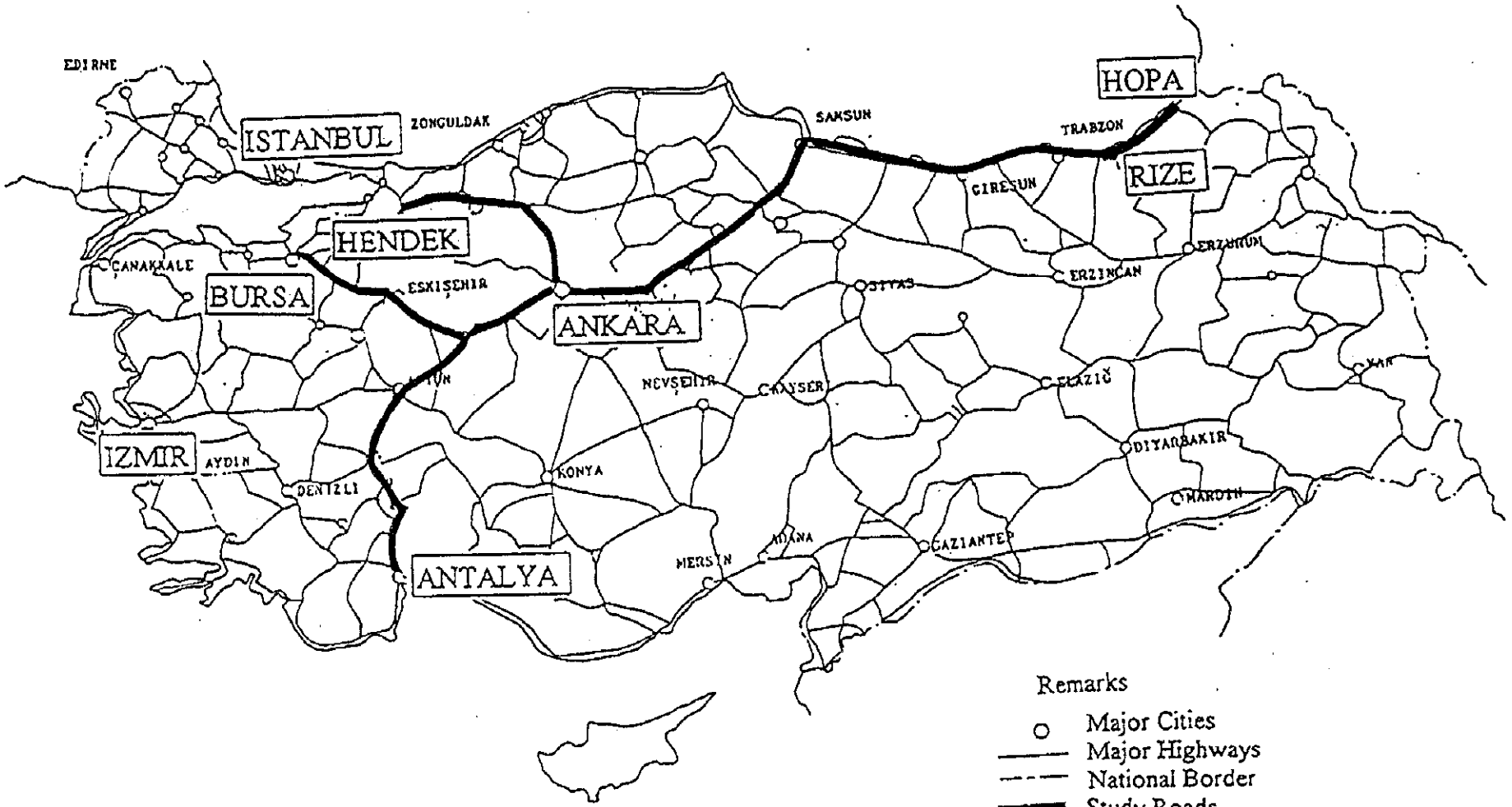
Inspection Specialist

Mr. Hasan YILMAZ	Chief Maintenance Engineer of 4th Div. Ankara
Mr. Zübeyde VARAN	Maintenance Engineer in 4th Div. Ankara
Mr. Ali KAN	Chief of Central Maintenance Branch of 4th Div. Ankara

Person to be get in touch during the site visits

Mr. Lütfü VUR	Chief Engineer of Maintenance of 3th Div. Konya
Mr. Hasan YILMAZ	Chief Engineer of Maintenance of 4th Div. Ankara
Mr. Hasan KAPTAN	Chief Engineer of Maintenance of 7th Div. Samsun
Mr. Necati ÇAKIROĞLU	Chief Engineer of Maintenance of 10th Div.Trabzon
Mr. Mustafa GÜNDOĞAN	Chief Engineer of Maintenance of 13th Div. Antalya
Mr. Veli OFLAZ	Chief Engineer of Maintenance of 14th Div. Bursa

Annex 3



STUDY ROAD

A - 7

MINUTES OF MEETING

ON

THE PROGRESS REPORT

FOR

THE STUDY

ON

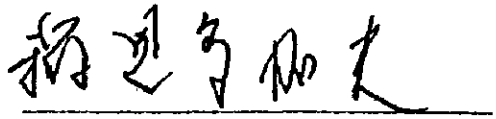
ARTERIAL HIGHWAY MAINTENANCE

IN

THE REPUBLIC OF TURKEY

23 JUNE 1997, ANKARA

Mr. Dinçer YİĞİT
Director General
General Directorate of Highways
Ministry of Public Works
and Settlement



Mr. TAKAO INAMI
Leader, JICA Study Team
Japan International Cooperation Agency

MINUTES OF MEETING
THE STUDY ON ARTERIAL HIGHWAY MAINTENANCE

The Study Team dispatched by the Japan International Cooperation Agency (JICA) submitted ten (10) copies in English and ten (10) copies in Turkish of the Progress Report to the General Directorate of Highways, Ministry of Public Works and Settlement (KGM) on June 23 1997. At the submission of the report, Mr. Takao INAMI, Leader of the JICA Study Team (The Study Team), and members explained the contents of the report. A meeting to discuss the report was held on June 23 1997.

The meeting was chaired by Mr. Dinçer YİĞİT, Director General, General Directorate of Highways, Ministry of Public Works and Settlement with the attendees as shown in Annex 1. The contents of the Progress Report were agreed by both sides. Major topics discussed during the meeting were as follows:

1. KGM requested the Study Team to hold a seminar at two Locations in Turkey. The purpose of the seminar is to explain the study contents. The Study Team agreed that this message would be conveyed to the management of the JICA headquarters in Tokyo.

2. The Study Team requested the KGM to cooperate in the detail survey during the second stage. KGM agreed this request.

3. The Progress Report and the Minutes of Meeting were prepared in both English and Turkish. In case of any divergence arising from the interpretation of the items mentioned above, the English shall prevail.

Annex 1

ATTENDEES OF THE MEETING

Turkish Side

Mr. Dinçer YİĞİT	Director General, General Directorate of Highways
Mr. Ismail TANYALDIRIK	Deputy of Director General
Mr. Salih IRMAK	Head of Maintenance Department
Ms. Münevver ATASARAL	Dep. Head of Maintenance Department
Mr. Rıza SARIKAYA	Dir. Of Maintanence Div.
Mr. Sabri YILDIZ	Dir. Of Traffic Div.
Mr. Ertan SAİT	Dir. of Bridge Maintenance Div.
Mr. Mustafa KARLIER	Dep. Dir. of Maintenance Div.
Mr. Merih BÜYÜKLÜ	Survey and Education Engineer
Ms. Tijen ÖKTEN	Maintenance Engineer
Mr. Sabri YILDIZ	Dir. Of Traffic Div.
Ms. Müge KAHRAMANGİL	Traffic Researh Chief
Mr. Turgay ÇOLAK	Traffic Survey Engineer
Ms. Tuğba KİPER	Dir. of Fotogrametry and Geodesy Div.
Mr. İsmail TÜMAY	Dir. of Hidhway Design Div.
Mr. Salih AKSOY	Dir. of Soil Mechanics and Tunnels Div.
Mr. M. Aydın ÖNAL	Dir. of Pavement Div.
Mr. Gürkan DEMİREL	Dir of Environmental Impact Assessment
Mr. Güralp SERHAT	Dir. of Planning Div.
Mr. Yaşar MANGALOĞLU	Dir. of Transportation and Cost Analysis Div.
Mr. Tomoyuki ADACHI	JICA Expert
Mr. Yoshiaki KAWAKAMI	JICA Expert

JICA Study Team

Mr. Takao INAMI	Team Leader/Maintenance System Planner
Mr. John COOMBS	Road Repair work Planner/Pavement Engineer
Mr. Hiromichi ENOKIDA	Soil/Slope Engineer
Mr. Chai Seng Chiew	Pavement/Drainage Engineer
Dr. Masuyoshi MATSUDA	Snow/Ice Contigency Planner
Dr. William HAYES	Transportation Planner
Mr. David McEWEN	Economic Evaluation Specialist
Mr. Masataka FUJIKUMA	Pavement Engineer

Embassy of Japan

Mr. Satoshi TADA	Second Secretary

JICA Turkey Office

Mr. Naoyoshi SASAKI	Resident Representative
Mr. Timur SAYRAÇ	Member of Turkey Office

MINUTES OF MEETING

ON

THE INTERIM REPORT

FOR

THE STUDY

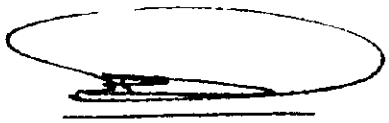
ON

ARTERIAL HIGHWAY MAINTENANCE

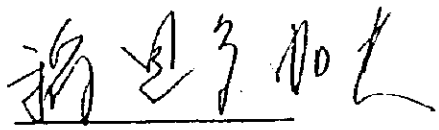
IN

THE REPUBLIC OF TURKEY

9th. OCTOBER, 1997, ANKARA



Mr. İsmail TANYALDIRIK
Deputy Director General
General Directorate of Highways
Ministry of Public Works
and Settlement



Mr. Takao INAMI
Leader, JICA Study Team
Japan International Cooperation Agency

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MINUTES OF MEETING
THE STUDY ON ARTERIAL HIGHWAY MAINTENANCE

The Study Team dispatched by the Japan International Cooperation Agency (JICA) submitted ten (10) copies in English and ten (10) copies in Turkish of the Interim Report to the General Directorate of Highways, Ministry of Public Works and Settlement (KGM) on October 8 1997. At the submission of the report, Mr. Takao INAMI, Leader of the JICA Study Team (The Study Team), and members explained the contents of the report. A meeting to discuss the report was held on October 8 1997.

The meeting held on October 9 1997 was chaired by Mr. İsmail TANYALDIRIK, Director General, General Directorate of Highways, Ministry of Public Works and Settlement with the attendees as shown in Annex 1. The contents of the Interim Report were generally agreed by both sides through the discussion. Major topics discussed during the meeting were as follows:

1. The study team and KGM agreed that the study team and KGM discuss and decide the detailed survey points.

2. The Study Team requested KGM to cooperate in the detailed survey and traffic survey during the second stage. KGM agreed to this request.

3. The Interim Report and the Minutes of Meeting were prepared in both English and Turkish. In case of any of divergence arising from the interpretation of the items mentioned above, the English shall prevail.

Annex 1

ATTENDEES OF THE MEETING

Turkish Side

Mr. İsmail TANYALDIRIK	Deputy of Director General
Mr. Salih IRMAK	Head of Maintenance Department
Ms. Münevver ATASARAL	Dep. Head of Maintenance Department
Mr. Rıza SARIKAYA	Dir. Of Maintanence Div.
Mr. Sabri YILDIZ	Dir. Of Traffic Div.
Mr. Ertan SAİT	Dir. of Bridge Maintenance Div.
Mr. Mustafa KARLIER	Dep. Dir. of Maintenance Div.
Mr. Merih BÜYÜKLÜ	Survey and Education Engineer
Ms. Tijen ÖKTEN	Maintenance Engineer
Mr. Sabri YILDIZ	Dir. Of Traffic Div.
Ms. Müge KAHRAMANGİL	Traffic Researh Chief
Mr. Turgay ÇOLAK	Traffic Survey Engineer
Ms. Tuğba KİPER	Dir. of Fotogrametry and Geodesy Div.
Mr. İsmail TÜMAY	Dir. of Hidhway Design Div.
Mr. Salih AKSOY	Dir. of Soil Mechanics and Tunnels Div.
Mr. M. Aydın ÖNAL	Dir. of Pavement Div.
Mr. Gürkan DEMİREL	Dir of Environmental Impact Assessment
Mr. Güralp SERHAT	Dir. of Planning Div.
Mr. Yaşar MANGALOĞLU	Dir. of Transportation and Cost Analysis Div.
Mr. Tomoyuki ADACHI	JICA Expert
Mr. Yoshiaki KAWAKAMI	JICA Expert

JICA Study Team

Mr. Akihiko HIROTANI	Project Director
Mr. Takao INAMI	Team Leader
Mr. John COOMBS	Member
Mr. Hiromichi ENOKIDA	Member
Mr. Chai Seng CHIEW	Member
Mr. Masataka FUJIKUMA	Member

JICA Advisory Committee

Mr. Kazuya SASAKI	Member of Committee

Embassy of Japan

Mr. Satoshi TADA	Second Secretary

JICA Turkey Office

Mr.Tatsuo YONEBAYASHI	Resident Representative
Mr. Shigeru OTAKE	JICA staff
Mr. Timur SAYRAÇ	JICA staff

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MINUTES OF MEETING

FOR

THE STUDY

ON

ARTERIAL HIGHWAY MAINTENANCE

IN

THE REPUBLIC OF TURKEY

DECEMBER 4, 1997, ANKARA

Mr. YAMAN KÖK
Director General
General Directorate of Highways
Ministry of Public Works
and Settlement

Mr. TAKAO INAMI
Leader, JICA Study Team
Japan International Cooperation Agency

MINUTES OF MEETING
THE STUDY ON ARTERIAL HIGHWAY MAINTENANCE

The Study Team dispatched by the Japan International Cooperation Agency (JICA) presented the study contents to the General Directorate of Highways, Ministry of Public Works and Settlement (KGM) on December 4 1997. At the presentation of the study contents, Mr. Takao INAMI, Leader of the JICA Study Team (The Study Team), and members explained the results of the Study.

The meeting was chaired by Mr. Yaman Kök, Director General, General Directorate of Highways, Ministry of Public Works and Settlement. The contents of the study were generally agreed by both sides through the discussion. Major topics discussed during the meeting were as follows:

1. KGM and the Study Team agreed that the route for the case study and the implementation plan will be as indicated on the attached table (Annex 1). Total length is 1,939km.

2. Both sides agreed the section for the case study (6 sections) and implementation plan (18 sections) on the attached table (Annex 1).

3. Both sides agreed that the maintenance costs will be calculated in US$. The Study Team, however, shall indicate the exchange rate between Turkish Lira and US$.

4. The Minutes of Meeting were prepared in both English and Turkish. In case of any divergence arising from the interpretation of the items mentioned above, the English shall prevail.

Annex 1

Sections for F/S

No.	Division		Sub-Division		Distance (Km)	Section No.	Remarks	Case Study Section
	Name	No.	Name	No.				
1	Antalya	13	Antalya	132	88	650-14, 650-13		
2			Burdur	134	138	650-10, 650-11, 650-12		**
3	Konya	3	Afyon	31	152	650-09, 300-07, 260-01, 260-02		**
4	Bursa	14	Bursa	143	31	200-06		
5			Iznik	147	22	200-06,		**
6			Bilecik	144	78	200-06, 200-07		
7	Ankara	4	Eskisehir	46	88	200-08, 200-09		**
8			Polatli	45	177	200-09, 200-10, 200-11, 200-12, 260-03	Include Ankara Sub. (7km)	
9			Kizlcahamam	42	133	100-12, 750-04, 750-05, 750-06		
10			Bolu	41	124	100-10, 100-11, 100-12	Include Sakarya Sub. (16km)	
11			Kirikkale	44	101	200-13, 200-14,	Include Ankara Sub. (14km)	
12	Samsun	7	Corum	73	159	190-01, 190-02, 785-05, 795-04		
13			Amasya	72	40	795-03, 100-17		**
14			Samsun	75	173	100-17, 795-01, 795-02, 010-16		
15			Ordu	77	108	010-17, 010-18		
16	Trabzon	10	Giresun	104	105	010-19, 010-20		
17			Akcaabat	105	113	010-21, 010-22		
18			Rize	103	109	010-23, 010-24, 010-25		**

1939

MINUTES OF MEETING

ON

THE DRAFT FINAL REPORT

FOR

THE STUDY

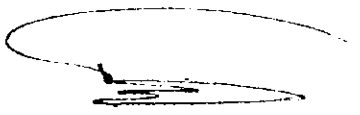
ON

ARTERIAL HIGHWAY MAINTENANCE

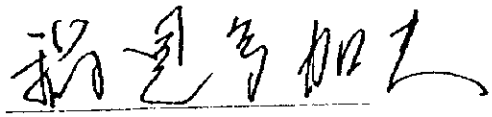
IN

THE REPUBLIC OF TURKEY

15th MAY, 1998, ANKARA



Mr.İsmail TANYALDIRIK
Deputy Director General
General Directorate of Highways
Ministry of Public Works
and Settlement



Mr.Takao INAMI
Leader, JICA Study Team
Japan International Cooperation Agency

MINUTES OF MEETING
THE STUDY ON ARTERIAL HIGHWAY MAINTENANCE

The Study Team dispatched by the Japan International Cooperation Agency (JICA) submitted ten (10) copies in English and ten (10) copies in Turkish of the Draft Final Report to the General Directorate of Highways, Ministry of Public Works and Settlement (KGM) on May 13, 1998. At the submission of the report, Mr. Takao INAMI, Leader of the JICA Study Team (The Study Team), and members explained the contents of the report. A meeting to discuss the report was held on May 14, 1998.

The meeting was chaired by Mr. Ismail TANYALDIRIK, Deputy Director General, General Directorate of Highways, Ministry of Public Works and Settlement with the attendees as shown in Annex 1. The contents of the Draft Final Report were generally agreed by both sides through the discussion. Major topics discussed during the meeting were as follows :

1. KGM requested that the maintenance manuals in Turkish shall be binded B6 size. The study team replied to convey the request to JICA.

2. Japanese side requested the Turkish side submit the written comments on the Draft Final Report to Japanese side until June 30, 1998. Turkish side agreed with this request.

3. The Study Team will submit the Final Report within two (2) months after the receipt of the written comments on the Draft Final Report from Turkish side.

4. Japanese side requested that the Final Report will be open to the public. Turkish side agreed with this request.

5. The Draft Final Report, Final Report and the Minutes of Meeting of the Draft Final Report were prepared in the both English and Turkish. In case of any divergence arising from the interpretation of the document above-mentioned, English shall prevail.

Annex I

ATTENDEES OF THE MEETING

Turkish Side

Mr. İsmail TANYALDIRIK	Deputy of Director General
Mr. Salih IRMAK	Head of Maintenance Department
Ms. Münevver ATASARAL	Dep. Head of Maintenance Department
Mr. Rıza SARIKAYA	Dir. of Maintenance Div.
Mr. Sabri YILDIZ	Dir. of Traffic Div.
Mr. Ertan SAİT	Dir. of Bridge Maintenance Div.
Mr. Mustafa KARLIER	Dep. Dir. of Maintenance Div.
Mr. Merih BÜYÜKLÜ	Survey and Education Engineer
Ms. Tijen ÖKTEN	Maintenance Engineer
Ms. Müge KAHRAMANGİL	Traffic Research Chief
Mr. Turgay ÇOLAK	Traffic Survey Engineer
Ms. Tuğba KİPER	Dir. of Fotogrametry and Geodesy Div.
Mr. İsmail TÜMAY	Dir. of Highway Design Div.
Mr. Salih AKSOY	Dir. of Soil Mechanics and Tunnels Div.
Mr. M. Aydın ÖNAL	Dir. of Pavement Div.
Mr. Gürkan DEMİREL	Dir. of Environmental Impact Assesement
Ms. Nezahat ACAR	Dır. of Planning Div.
Mr. Yaşar MANGALOĞLU	Dır. of Transportation and Cost Analysys Div.
Mr. Yoshiaki KAWAKAMI	JICA Expert
Mr. Hiroshi SAITO	JICA Expert

JICA Study Team

Mr. Takao INAMI	Team Leader
Mr. Hiromichi ENOKIDA	Member
Mr. Tetsuya SATO	Member

JICA Advisory Committee

Mr. Toshiharu YASUI	Head of Committee

Embassy of JAPAN

Mr. Masayuki KANNAN	Second Secretary

JICA Turkey Office

Mr. Tatsuo YONEBAYASHI	Resident Representative

JICA Headquarter Office

Mr. Toru NAITO	JICA staff

APPENDIX 7

Estimated Construction Cost

Route :100-10 Location : 40-41 Subdivision :17

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Pavement (As.Con.)				
*Overlay (T=9cm)	m2	8,81	6.510	57
2. Drainage Structures				
*Toe ditch	m	9,50	700	7
*Undergroun drainage with pits and pipes	m	30,00	700	21
3. Culvert				
*Pipe culvert (D600) high pressurized water washer	m	120,00	30	4
Total				89

Estimated Construction Cost

Route :200-08 Location : 18-19 Subdivision : 46

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Earth Work				
*Soil Excavation	m3	0.90	16 250	15
*Existing Carriageway	m3	7.40	775	6
*Embankment	m3	11.40	19 500	222
2. Slope Work				
*Seed-mix spraying with a gun	m2	10.00	7 150	72
3. Pavement				
*Surface treatment	m2	2.00	7 000	14
*Paved shoulder (t=62cm)	m2	27.30	1 250	34
*Asphaltic kerb	m	3.50	500	2
Total				364

Estimated Construction Cost

Route : 300-07 Location : 35-36 Subdivision : 31

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Earth Work				
*Soil Excavation	m3	0.90	560	1
*Existing Carriageway	m3	7.40	124	1
*Embankment	m3	13.15	1 060	14
2. Pavement				
*Paved shoulder(t=62cm)	m2	27.30	200	5
*Asphaltic kerb	m	3.50	100	0
Total				21

Estimated Construction Cost

Route :200-09 Location : 50-51 Subdivision : 45

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Pavement (As. Con.)				
*Unnecessary to repair				0
Total				0

Estimated Construction Cost

Route :100-12 Location : 25-26 Subdivision :41

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Earth Work				
*Regrading Existing Slope	m2	2.15	12 600	27
2. Slope Work				
*Seed-mix spraying with a gun	m2	10.00	12 600	126
3. Drainage Structure				
*Vertical dicth	m	6.60	42	0
*Crest dicth	m	9.50	300	3
Total				156

Estimated Construction Cost

Route :200-14 Location : 27-28 Subdivision : 44

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Pavement (As. Con.)				
*Overlay (T=5cm)	m2	8.81	7 000	62
Total				62

Estimated Construction Cost

Route :750-05 Location : 31-32 Subdivision :42

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Earth Work				
*Soil Excavation	m3	0.90	2 500	2
*Existing Carriageway	m3	7.40	853	6
*Embankment	m3	11.40	4 750	54
2. Slope Work				
*Seed-mix spraying with a gun	m2	10.00	1 500	15
3. Pavement				
*Paved shoulder (t=62cm)	m2	27.30	1 375	38
*Asphaltic kerb	m	3.50	500	2
4. Structure				
*Gabion mat (H-50cm)	m2	55.00	6 000	330
5.Removal of debris	m	120.00	130	16
Total				463

Estimated Construction Cost

Route :200-13 Location : 33-34 Subdivision : 44

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Drainage Structures				
*Filling (cement mortar)	m3	58.00	30	2
Total				2

Estimated Construction Cost

Route :100-17 Location : 56-57 Subdivision : 72

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Earth Work				
*Soil Excavation	m3	0.90	1 150	1
*Exiting Carriageway	m3	7.40	155	1
*Embankment	m3	11.40	4 200	48
2. Slope Work				
*Seed-mix spraying with a gun	m2	10.00	750	8
3. Pavement				
*Paved shoulder (t=62cm)	m2	27.30	250	7
4. Drainage Structure				
*Crest ditch	m	9.50	100	1
*Toe ditch	m	9.50	100	1
*Underground Drainage with pits and pipes	m	30.00	100	3
Total				69

Estimated Construction Cost

Route :190-01 Location : 11-12 Subdivision : 73

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Pavement (Sur. Tr.)				
*Overay (t=4cm)	m2	6.65	7 000	47
Total				47

Estimated Construction Cost

Route :795-01 Location : 61-62 Subdivision : 76

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Earth Work				
*Existing Carriageway	m3	7.40	7 350	54
2. Pavement (As. Con.)				
*Subbase course (T=40cm)	m2	12.00	7 000	84
*Base course (T=30cm)	m2	11.55	7 000	81
*Bitumen base course (T=20cm)	m2	34.20	7 000	239
*Asphalt concrete binder course (T=10cm)	m2	16.60	7 000	116
*Asphalt concrete wearing course (T=5cm)	m2	8.80	7 000	62
Total				636

Estimated Construction Cost

Route :010-19 Location : 7-8 Subdivision : 77

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Pavement (Sur. Tr.)				
*Overlay (T=5cm)	m2	8.31	7,000	58
2. Structure				
*Stone Mansory Wall (H=3m)	m	195.00	50	10
Total				68

Estimated Construction Cost

Route :010-23 Location : 47-48 Subdivision : 103

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Earth Work				
*Embankment	m3	11.40	2 100	24
2. Structure				
*Stone pitching	m2	65.00	1 350	88
*Rock fill	m3	60.00	6 610	397
Total				508

Estimated Construction Cost

Route :010-19 Location : 25-26 Subdivision : 104

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Earth Work				
*Embankment	m3	11.40	85	1
2. Pavement (Sur. Tr.)				
*Overlay (T=5cm)	m2	8.31	2 000	17
*Concrete Seal (T=10cm)	m3	58.00	15	1
3. Structure				
*Gravity wall concrete	m3	77.00	560	43
*Rock Fill	m3	60.00	350	21
Total				83

Estimated Construction Cost

Route :010-21 Location : 5-6 Subdivision : 105

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Earth Work				
*Embankment	m3	11.40	8	0
2. Pavement (Sur. Tr.)				
*Overlay (T=5cm)	m2	8.31	7 000	58
*Concrete Seal (T=10cm)	m3	58.00	1.5	0
3. Structure				
*Filling (cement mortar)	m3	58.00	70	4
*Rock Fill	m3	60.00	640	38
Total				101

Estimated Construction Cost

Route :650-14 Location : 36-37 Subdivision : 132

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1.Excavation				
* Existing Carriageway	m3	7.40	123	1
2. Pavement (Sur. Tr.--As.Con.)				
* Bitumen base course (T=10cm)	m2	17.10	1 750	30
* Binder course (T=7cm)	m2	11.60	1 750	20
* Wearing course (T=5cm)	m2	8.80	1 750	15
Total				67

Estimated Construction Cost

Route :650-12 Location : 36-37 Subdivision : 134

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Excavation				
*Existing Carrigeway	m2	7.40	35	0
2. Pavement (Sur. Tr.--As.Con.)				
*Binder Course (T=10cm)	m2	16.60	700	12
*Wearing Course (T=5cm)	m2	8.80	700	6
Total				18

Estimated Construction Cost

Route :200-06 Location : 12-13 Subdivision : 143

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Pavement (As. Con.)				
*Overay (T=5cm)	m2	8.81	10 500	93
Total				93

Estimated Construction Cost

Route :200-07 Location : 42-42 Subdivision : 144

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1.Excavating				
*Existing Carriageway	m3	7.40	4 440	33
2. Pavement (As. Con.)				
*Sub-base course (T=10cm)	m2	3.00	10.500	32
*Base course (T=10cm)	m2	3.85	10 500	40
*Asphalt concrete binder course (T=7cm)	m2	11.60	10.500	122
*Asphalt concrete wearing course (T=5cm)	m2	8.80	10 500	92
*Paved shoulder (t=42cm)	m2	21.30	125	3
*Asphalt kerb	m	3.50	100	0
Total				322

Estimated Construction Cost

Route :200-06 Location : 29-30 Subdivision : 147

Item	Unit	Unit Cost (US$)	Quantity	Total (1000 US$)
1. Pavement (As. Con.)				
* Overay (T=8cm)	m2	14.10	10 500	148
Total				148