APPENDICES

Appendix 2.1

Present Conditions of Socio-Economy of Malaysia

A.Table 2.1.1 Gross Domestic Product by Origin of Industry

(Unit : RM million)

Sector	1995	%	2000	%	Average Annual Growth Rate (%)
Primary					
Agriculture, Forestry, Livestock & Fishing	17,115	10.3	18,154	8.7	1.2
Mining & Quarrying	13,643	8.2	13,907	6.6	0.4
Sub-Total	30,758	18.5	32,061	15.3	0.8
Secondary					
Manufacturing	45,174	27.1	69,867	33.4	9.1
Construction	7,411	4.4	6,996	3.3	-1.1
Sub-Total	52,585	31.6	76,863	36.7	7.9
Tertiary					
Electricity, Gas, & Water	5,876	3.5	7,090	3.4	3.8
Transport, Storage & Communication	12,298	7.4	16,643	8.0	6.2
Wholesale & Retail Trade, Hotels & Restaurants	25,304	15.2	31,080	14.9	4.2
Finance, Insurance, Real Estate & Business Services	17,287	10.4	24,643	11.8	7.3
Government Services	11,803	7.1	14,678	7.0	4.5
Other Services	12,780	7.7	15,599	7.5	4.1
Sub-Total	85,348	51.2	109,733	52.4	5.2
(-) Imputed Bank Service Charges	-8,888	-5.3	-14,252	-6.8	9.9
(+) Import Duties	6,823	4.1	4,864	2.3	-6.5
Total	166,626	100.0	209,269	100.0	4.7

Source : Yearbook of Statistics, Malaysia 2000, Department of Statistics, Malaysia.

A.Table 2.1.2 Improvement of The Malaysian Quality of Life Index(1990=100)

Area	Indicator	2000
Income and Distribution	Real Per Capita GNP	110.28
	Gini Co-efficient	93.34
	Incidence of Peverty	130.76
	Average	111.46
Working Life	Unemployment Rate	138.79
	Trade Disputes	130.88
	Man Days Lost Due to Industrial Actious	136.89
	Industrial Accident Rate	124.16
	Average	131.80
Transport and Communications	Private Motocars and Motorcycles	117.26
	Commercial Vehicles	118.62
	Road Development Index	122.90
	Telephones	129.04
	Cellular phones	119.51
	Average	121.47
Health	Male Life Expectancy at Birth	116.77
	Female Life Expectancy at Birth	118.81
	Infant Mortality Rate	128.10
	Doctor - Population Ratio	124.80
	Hospital - Bed Population Ratio	63.68
	Average	110.43
Education	Pre - School Participation Rate	117.96
	Secondary Participation Rate	116.25
	University Participation Rate	114.28
	Literacy Rate	128.10
	Primary School Teacher - Student Ratio	123.05
	Secondary School Teacher - Student Ratio	111.74
	Average	118.83
Housing	Average Housing Price	101.08
	% Low Cost Housing Units to Total Low - Income Household	123.27
	% Housing Units With Piped Water	127.04
	% Housing Units With Electricity	131.59
	Average	120.75
Environment	Air Quality Index	100.98
	% of Clean Rivers	61.48
	% of Forested Land	113.22
	Average	91.90
Family Life	% Divorces	121.36
	Crude Birth Rate	121.72
	Household Size	126.39
	% of Juvenile Crimes	72.70
	Average	110.54
Social Participation	% of Registered Voters	86.94
	Number of Registered Non - Profit Organizations	126.58
	Number of Registered Residents' Associations	125.32
	Average	112.95
Public Safety	Crimes	72.32
	Road Accidents	91.83
	Average	82.07
Culture and Leisure	Membership in Public Library	130.89
	T.V Viewers	114.89
	Domestic Hotel Guests	114.59
	Average	120.10
	MALAYSIA QUALITY OF LIFE INDEX	**112.03**

Source : "The Third Outline Perspective Plan 2001-2010", 3 April 2001, Economic Planning Unit, Prime Minister's Department

A.Table 2.1.3 Achievement in the Restructuring of Society, 1990 - 2000

Indicator	1990	2000
***Ownership of Eqiuty in the Corporate Sector (%)**1)*		
Bumiputra	19.3	19.1
Non - Bumiputra	46.8	40.3
Foreigners	25.4	32.7
Nominee Company	8.5	7.9
Bumiputra Employment by Sectors		
(% of total employment)		
Agricultural and Forestry, Livestock and Fisheries	67.9	61.6
Mining & Quarrying	51.9	57.2
Manufacturing	46.4	49.1
Construction	34.9	37.4
Electricity, Gas and Water	70.2	71.2
Transport, Storage and Communications	49	56
Wholesale, Retail Trade, Hotels and Restaurants	34.5	38.3
Finance, Insurance, Real Estate and Business Services	41.1	45.3
Other Services	64.7	63.5
Bumiputra Employmnet in High Occupational Categories		
(% of total empoyment)		
Professional & Technical	60.5	63.8
Administrative & Managerial	28.7	36.9
***Bumiputra Registrated Professional** *1)*		
(% of each profession)		
Accountant	11.2	15.9
Architect	27.6	28.9
Doctor	27.8	36.7
Dentist	24.3	34.8
Veterinary Surgeon	35.9	42.6
Engineer	13.1	26.5
Surveyor	44.7	47.8
Lawyer	22.3	31.3

Source : "The Third Outline Perspective Plan 2001-2010", 3 April 2001, Economic Planning Unit, Prime Minister's Department
Note :*1)Refers to the year 1999

A.Table 2.1.4(1) Development Composite Index by State (1990=100)

Indicator	Year	More Developed States							
		Total	Johor	Melaka	Negri Sembilan	Perak	Pulau Pinang	Selangor	Federal Territory of Kuala Lumpur
Per Capita GDP	1990	104.4	97.0	100.1	94.9	95.1	106.4	113.4	120.6
	2000	133.8	128.5	131.2	126.8	127.4	140.0	133.7	154.1
Unemployment Rate	1990	106.2	108.0	104.6	106.6	102.2	107.6	110.0	104.2
	2000	133.2	132.5	132.5	131.8	128.4	138.0	130.4	138.7
Urbanization Rate	1990	106.5	100.0	95.7	97.2	102.7	112.7	112.8	124.5
	2000	135.9	129.1	126.0	125.0	134.4	142.9	144.4	149.3
Registered Car & Motorcycle per 1,000 Population	1990	108.2	108.3	104.8	105.3	99.3	117.8	113.7	108.2
	2000	139.9	136.8	138.2	134.9	134.2	148.7	130.3	156.1
Telephone per 1,000 Population	1990	106.6	101.2	99.0	99.7	97.9	108.6	113.3	126.4
	2000	134.2	130.9	130.7	129.9	130.5	140.8	147.8	128.8
Incidence of Poverty	1990	107.2	107.3	105.1	107.9	98.3	108.5	109.6	113.5
	2000	130.3	132.5	127.5	132.5	121.6	132.2	133.3	132.8
Population Provided With Piped Water	1990	108.1	101.2	108.7	105.5	104.1	112.6	110.4	114.2
	2000	142.2	141.1	142.0	142.0	142.9	142.9	142.0	142.9
Population Provided With Electricity	1990	105.0	99.1	107.6	106.8	99.1	106.8	107.6	107.6
	2000	135.9	135.9	135.9	135.9	135.9	135.9	135.9	135.9
Infant Mortality Rate per 1,000 Live Birth	1990	106.0	102.5	107.1	104.3	103.4	108.9	105.9	109.7
	2000	133.4	139.2	125.2	134.0	138.2	136.6	144.4	116.4
No. of Doctor per 1,000 population	1990	105.0	97.4	99.2	100.0	98.3	104.7	101.9	132.9
	2000	133.4	122.6	132.1	126.0	126.3	133.9	147.4	145.5
Economic Development Index	1990	106.3	102.9	100.8	100.7	99.4	110.6	112.6	116.8
	2000	135.5	131.6	131.7	129.7	131.0	142.1	137.3	145.4
Social Development Index	1990	106.2	101.6	105.5	104.9	100.6	108.3	107.1	115.6
	2000	135.1	134.3	132.5	134.1	133.0	136.3	140.6	134.7
Development Composite Index	1990	106.3	102.2	103.2	102.8	100.0	109.5	109.9	116.2
	2000	135.3	132.9	132.1	131.9	132.0	139.2	139.0	140.1
Change Index	2000	29.0	30.7	28.9	29.1	31.9	29.7	29.1	23.9

Source : "Eighth Malaysian Plan 2001-2005",23 April 2001, Economic Planning Unit, Prime Minister's Department

A.Table 2.1.4(2) Development Composite Index by State (1990=100)

Indicator	Year	Less Developed States								Malaysia
		Total	Kedah	Kelantan	Pahang	Perlis	Sabah	Sarawak	Terengganu	
Per Capita GDP	1990	94.6	88.3	84.3	94.2	90.1	96.3	99.2	108.2	100.0
	2000	123.9	120.9	116.8	123.1	123.7	121.2	126.7	142.3	129.5
Unemployment Rate	1990	93.8	102.2	95.4	108.0	101.7	79.9	80.9	88.6	100.0
	2000	118.8	131.1	112.5	124.2	128.4	108.3	111.8	115.2	125.6
Urbanization Rate	1990	93.5	92.8	93.2	91.8	90.0	93.1	95.2	98.4	100.0
	2000	121.8	122.5	121.2	118.6	119.4	120.7	126.4	124.1	130.2
Registered Car & Motorcycle per 1,000 Population	1990	91.8	94.5	89.5	96.3	98.1	84.4	91.0	88.9	100.0
	2000	125.4	127.9	123.8	127.8	128.5	119.6	125.6	124.2	132.6
Telephone per 1,000 Population	1990	93.4	92.0	89.6	93.2	94.7	95.9	96.9	91.6	100.0
	2000	117.8	115.9	115.4	122.4	115.9	115.9	120.1	119.0	126.0
Incidence of Poverty	1990	92.8	87.8	87.9	107.1	100.3	83.5	96.6	86.5	100.0
	2000	115.7	115.3	107.2	127.8	115.7	105.1	125.9	113.2	124.7
Population Provided With Piped Water	1990	91.9	94.5	79.8	98.7	92.3	93.0	87.9	97.2	100.0
	2000	131.2	141.1	115.6	136.5	138.3	111.9	137.4	137.4	135.6
Population Provided With Electricity	1990	95.0	100.9	95.0	103.8	106.8	77.2	79.5	102.1	100.0
	2000	128.1	135.9	135.9	135.9	135.9	107.7	109.1	135.9	132.0
Infant Mortality Rate per 1,000 Live Birth	1990	94.0	100.8	103.1	98.7	97.1	71.2	87.6	99.9	100.0
	2000	125.1	128.8	122.6	121.0	131.3	113.3	140.8	117.9	130.9
No. of Doctor per 1,000 population	1990	95.0	94.7	95.3	96.1	97.2	93.3	93.6	95.0	100.0
	2000	119.4	121.1	122.6	119.9	121.1	114.1	118.0	119.0	126.9
Economic Development Index	1990	93.4	93.9	90.4	96.7	94.9	89.9	92.6	95.2	100.0
	2000	121.7	123.7	117.9	123.2	123.2	117.1	122.1	125.0	128.6
Social Development Index	1990	93.8	95.7	92.2	100.9	98.7	83.6	89.0	96.1	100.0
	2000	123.9	128.5	120.8	128.2	128.5	110.4	126.2	124.7	129.5
Development Composite Index	1990	93.6	94.8	91.3	98.8	96.8	86.8	90.8	95.7	100.0
	2000	122.8	126.1	119.4	125.7	125.8	113.8	124.2	124.8	129.1
Change Index	2000	29.2	31.2	28.1	26.9	29.0	27.0	33.3	29.2	29.0

A.Table 2.1.5 Growth of Imports of Selected Commodities

Commodity Classification (by SITC Section)	199 7		1999	
	Value (RM million)	Share (%)	Value (RM million)	Share (%)
Food	10,083.6	4.6	10,884.8	4.4
Beverage and Tobacco	661.1	0.3	682.7	0.3
Ctude Materials and Inedible	5,496.9	2.5	6,209.0	2.5
Mineral Fuels, Lubricants, etc.	6,413.1	2.9	7,480.4	3.0
Animal and Vegetables Oils and Fats	493.5	0.2	1,057.0	0.4
Chemicals	15,379.0	7.0	18,653.9	7.5
Manufactured Goods	28,729.0	13.0	28,859.8	11.6
Machinery and Transport Equipment	132,930.2	60.2	153,962.4	61.9
Miscellaneous Manufactured Articles	11,615.7	5.3	12,953.4	5.2
Miscellaneous Transactions and Commodities	9,133.4	4.1	8,126.5	3.3
Total	220,935.5	100.0	248,869.9	100.0

Note : SITC stands for the Standard International Trade Classification of the United Nations.
Source : Yearbook of Statistics, Malaysia. Department of Statistics, Malaysia.

A.Table 2.1.6 Growth of Exports of Selected Commodities

Commodity Classification (by SITC Section)	1997		1999	
	Value (RM million)	Share (%)	Value (RM million)	Share (%)
Food	5,304.9	2.4	6,233.0	1.9
Beverage and Tobacco	746.8	0.3	1,047.3	0.3
Ctude Materials and Inedible	10,102.1	4.6	9,917.6	3.1
Mineral Fuels, Lubricants, etc.	17,943.9	8.1	21,825.6	6.8
Animal and Vegetables Oils and Fats	13,000.0	5.9	18,285.0	5.7
Chemicals	7,878.0	3.6	10,363.1	3.2
Manufactured Goods	19,870.6	9.0	24,306.2	7.6
Machinery and Transport Equipment	123,984.1	56.1	200,160.9	62.3
Miscellaneous Manufactured Articles	19,325.5	8.7	26,220.1	8.2
Miscellaneous Transactions and Commodities	2,734.6	1.2	2,822.5	0.9
Total	220,890.5	100.0	321,181.3	100.0

Appendix 2.1.7 Consumer Price Index for Main Groups

	Year	Total	Food	Beverage and Tobacco	Clothing and Footwear	Gross Rent Fuel and Power	Furniture, Furnishing and Household Equipment and Operation	Medical Care and Health Expenses	Transport and Communication	Recreation ,Entertainment, Education and Cultural Services	Miscellaneous Goods and Services
Index	Weight	100.0	34.9	3.6	3.6	21.1	5.6	1.9	17.9	5.8	5.6
	1997	109.9	115.5	106	98.8	110.1	104	110.7	103.8	106.3	111.7
	1998	115.7	125.8	110.6	99.2	114.9	108.1	117.6	103.7	109.8	119.6
	1999	118.9	131.6	119.3	97.2	116.7	109.5	121.2	104.2	112.6	121.4
	2000	120.7	134.1	122.7	95.5	118.4	109.5	123.7	106.3	113.2	122.5
Annual Growth Rate (%)	1998	5.3	8.9	4.3	0.4	4.4	3.9	6.2	(0.1)	3.3	7.1
	1999	2.8	4.6	7.9	(2.0)	1.6	1.3	3.1	0.5	2.6	1.5
	2000	1.5	1.9	2.9	(1.8)	1.4	-	2.0	2.0	0.5	0.9

Source : Yearbook of Statistics, Malaysia. Department of Statistics, Malaysia

A.Table 2.1.8 Historical Performance of Employment by Sector

(Unit: 1,000 persons)

SECTORS	1995	1996	1997	1998	1999	2000	Average Annual Growth Rate (%)
Livestock, Forestry, Livestock and Fishing	1,526.70	1,626.20	1,481.30	1,616.50	1,623.70	1,711.80	2.32
Manufacturing	1,780.50	1,912.10	2,002.50	1,907.80	1,990.70	2,125.80	3.61
Construction	611.30	716.50	793.00	745.90	722.80	798.90	5.50
Wholesale and Retail Trade, Hotels and Restaurants	1,370.70	1,566.70	1,557.90	1,616.00	1,660.00	1,790.10	5.48
Community, Social and Personal Service	1,552.00	1,686.00	1,754.50	1,787.50	1,865.40	1,935.10	4.51
Other sectors	803.40	891.80	959.90	925.90	974.50	960.10	3.63
Total	7,644.60	8,399.30	8,549.10	8,599.60	8,837.10	9,321.80	4.05

Source: Yearbook of Statistics, Malaysia 2000, Department of Statistics, and Malaysia

A.Table 2.1.9 Historical Performance of Share of Employment by Sector

(Unit : %)

SECTORS	1995	1996	1997	1998	1999	2000	Average Annual Growth Rate (%)
Livestock, Forestry, Livestock and Fishing	20.0	19.4	17.3	18.8	18.4	18.4	-1.66
Manufacturing	23.3	22.8	23.4	22.2	22.5	22.8	-0.42
Construction	8.0	8.5	9.3	8.7	8.2	8.6	1.40
Wholesale and Retail Trade, Hotels and Restaurants	17.9	18.7	18.2	18.8	18.8	19.2	1.38
Community, Social and Personal Service	20.3	20.1	20.5	20.8	21.1	20.8	0.45
Other sectors	10.5	10.6	11.2	10.8	11.0	10.3	-0.40
Total	100.0	100.0	100.0	100.0	100.0	100.0	0.00

A.Table 2.1.10 Change of Government Finance

YEAR	1996		2000		Average Annual Growth Rate(%)
ITEMS	Value (RM million)	Share (%)	Value (RM million)	Share (%)	
Federal Government Revenue					
Total Direct Taxes	26,581	45.0	29,808	46.9	2.9
Total Indirect Taxes	21,421	36.3	18,702	29.5	-3.3
Total Non-Tax Revenue	11,008	18.7	14,990	23.6	8.0
Total	59,010	100.0	63,500	100.0	1.9
Federal Government Expenditure					
Operating Expenditure	43,865	75.0	58,206	69.7	7.3
Development Expenditure	14,628	25.0	25,286	30.3	14.7
Total	58,493	100.0	83,492	100.0	9.3
Balance	517		-19,992		

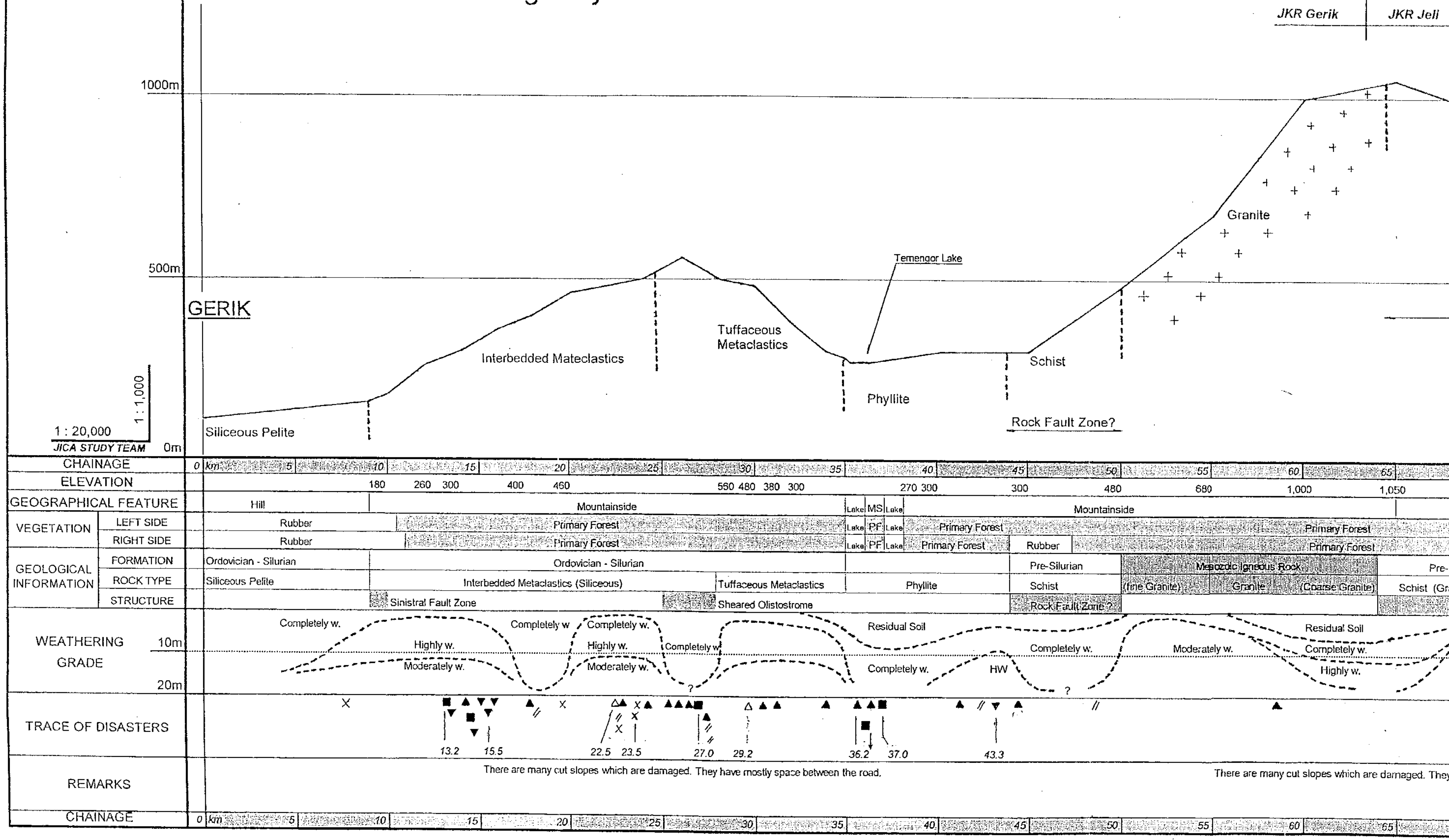
Source : Yearbook of Statistics, Malaysia. Department of Statistics, Malaysia

Appendix 2.4

Schematic Geological Profile of Six (6) Routes

SCHEMATIC GEOLOGICAL PROFILE

- Route 4 East - West Highway -



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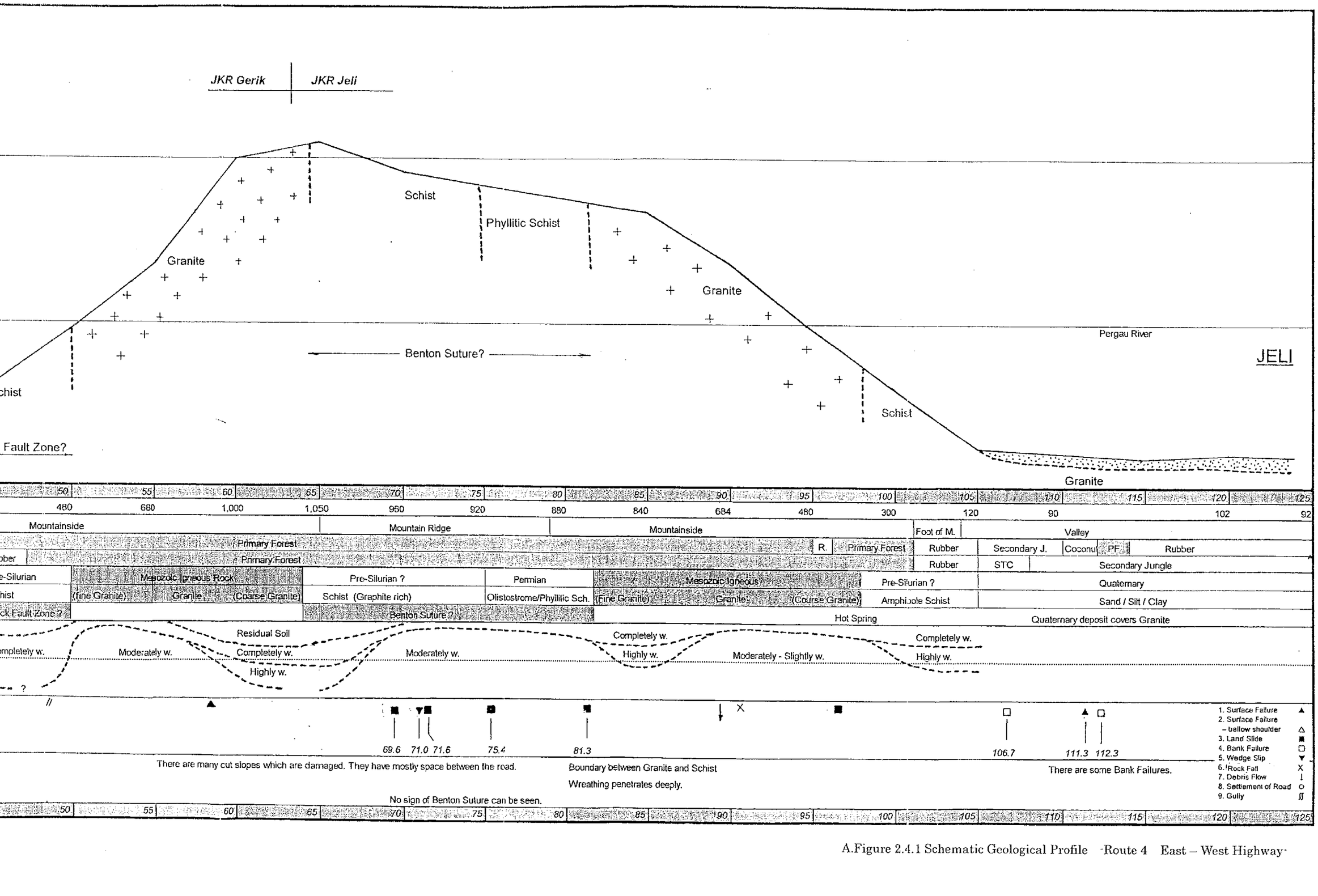
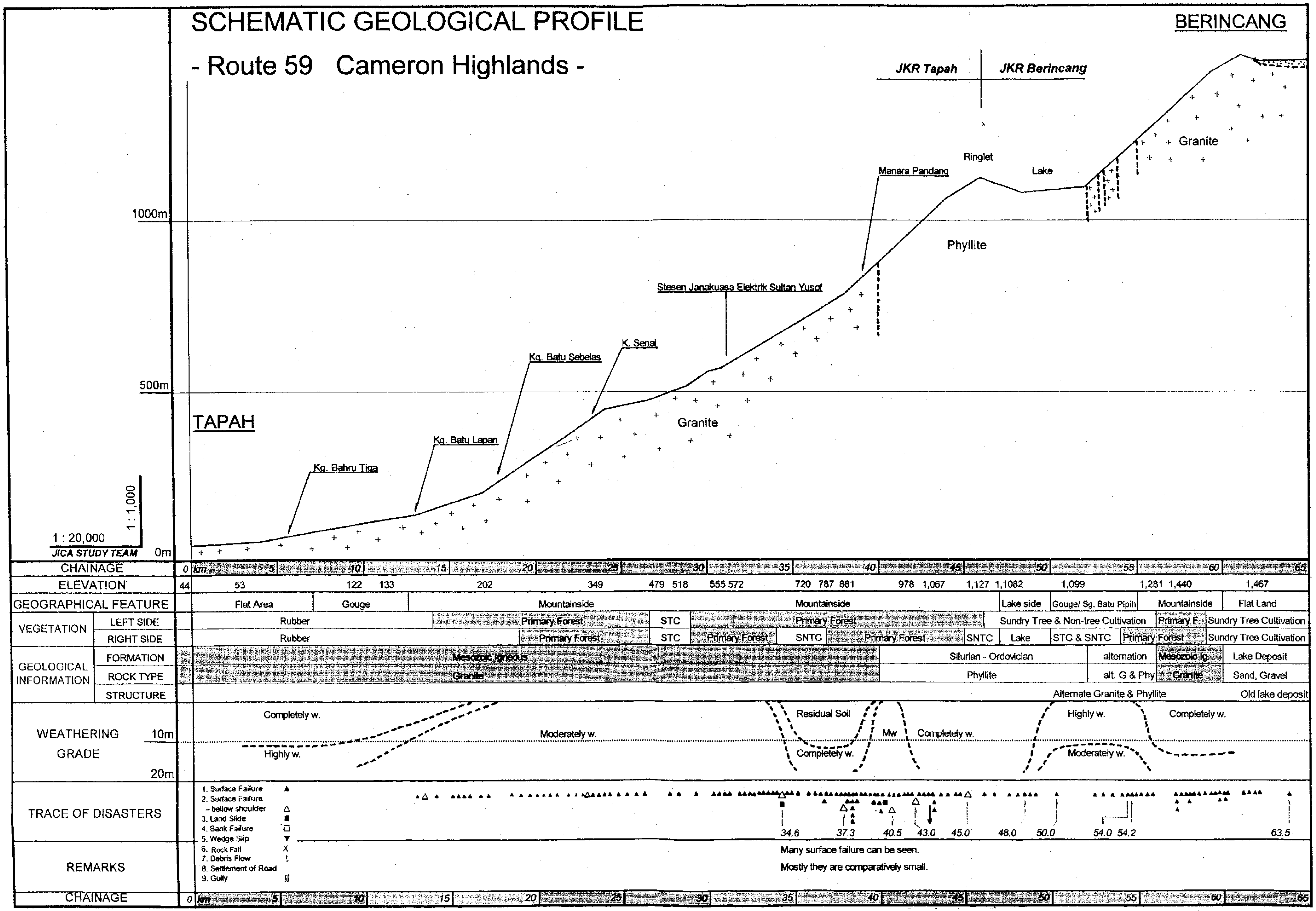
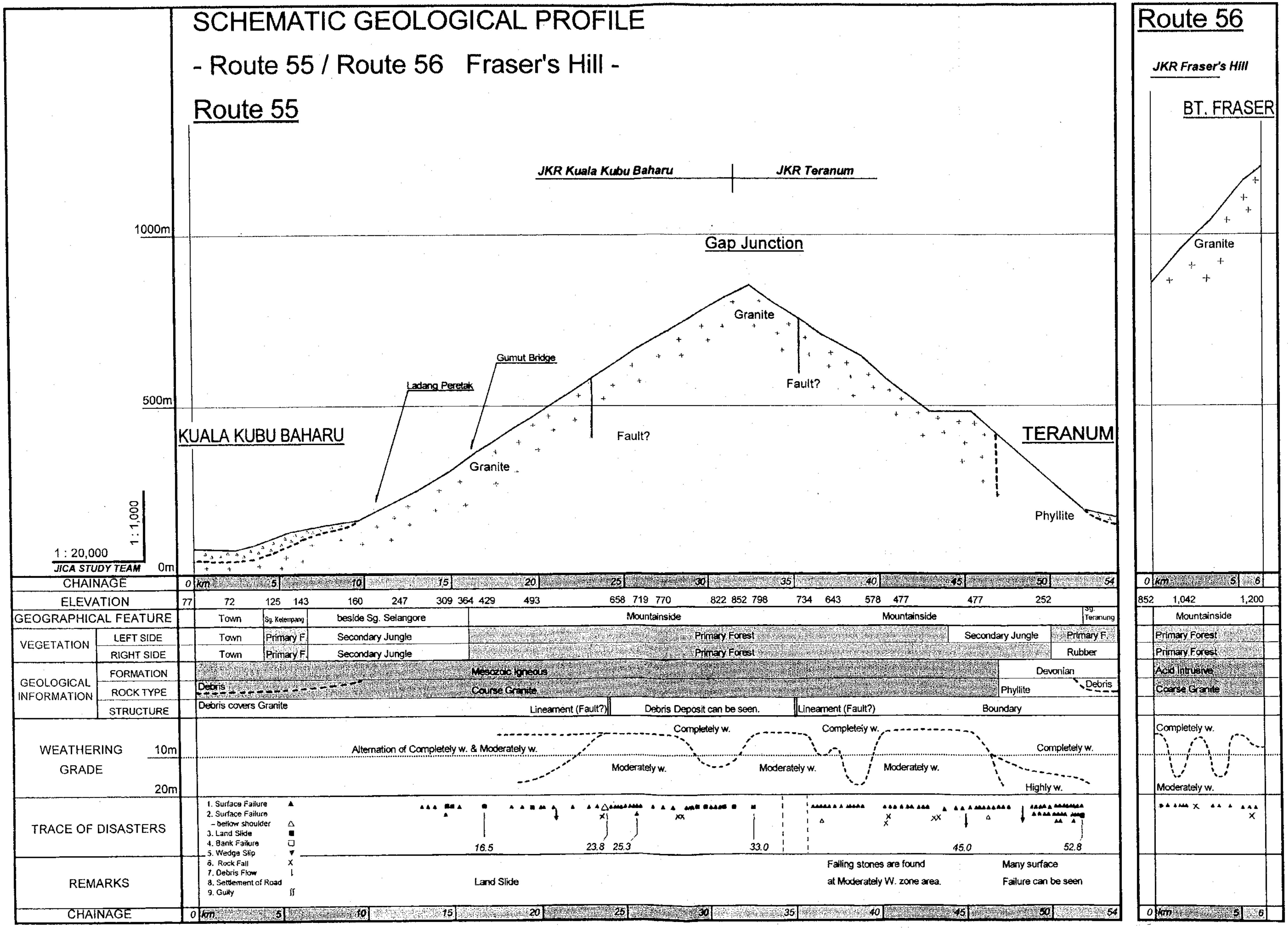


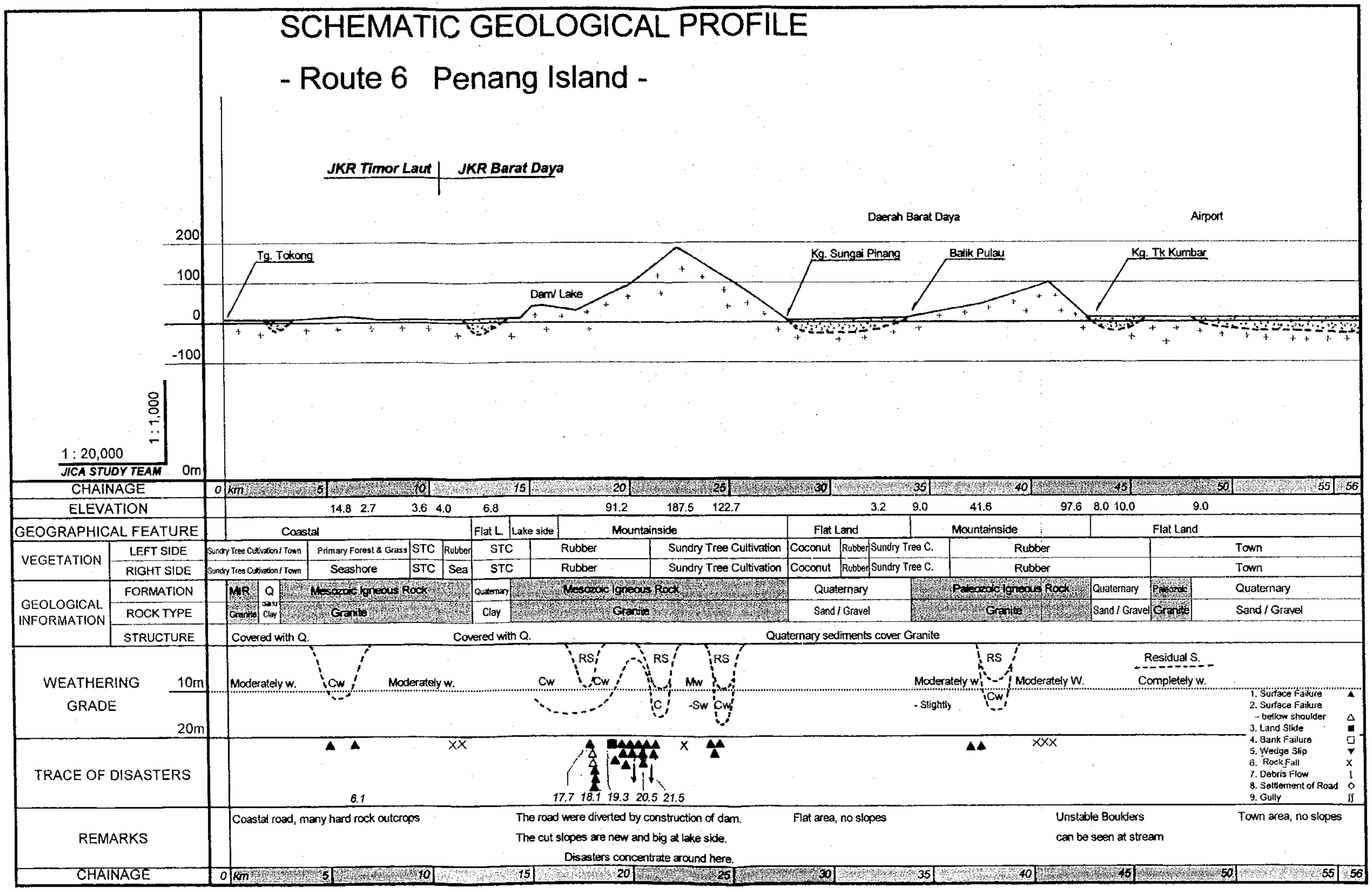
A.Figure 2.4.1 Schematic Geological Profile -Route 4 East – West Highway-



A.Figure 2.4.2 Schematic Geological Profile -Route 59 Cameron Highlands Load-



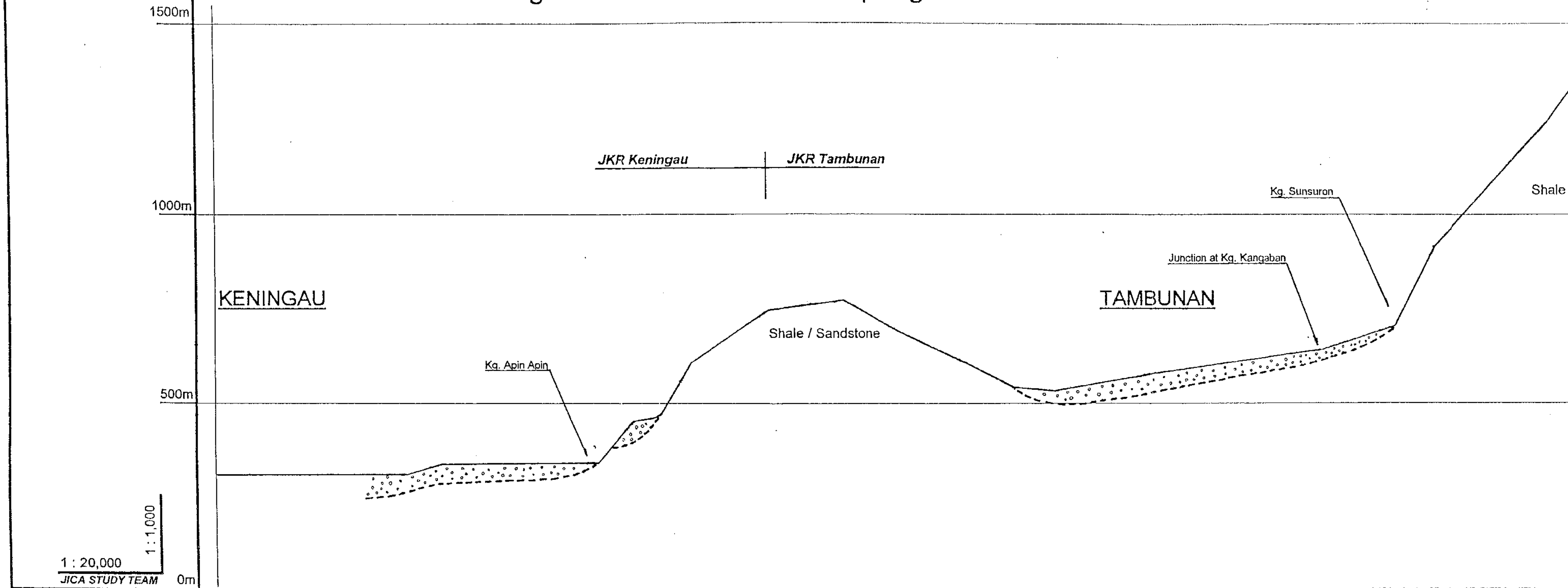
A.Figure 2.4.3 Schematic Geological Profile -Route 55 and 56 Kuala Kubu Bharu – Gap Teranum Road and Gap – Fraser's Hill Road-



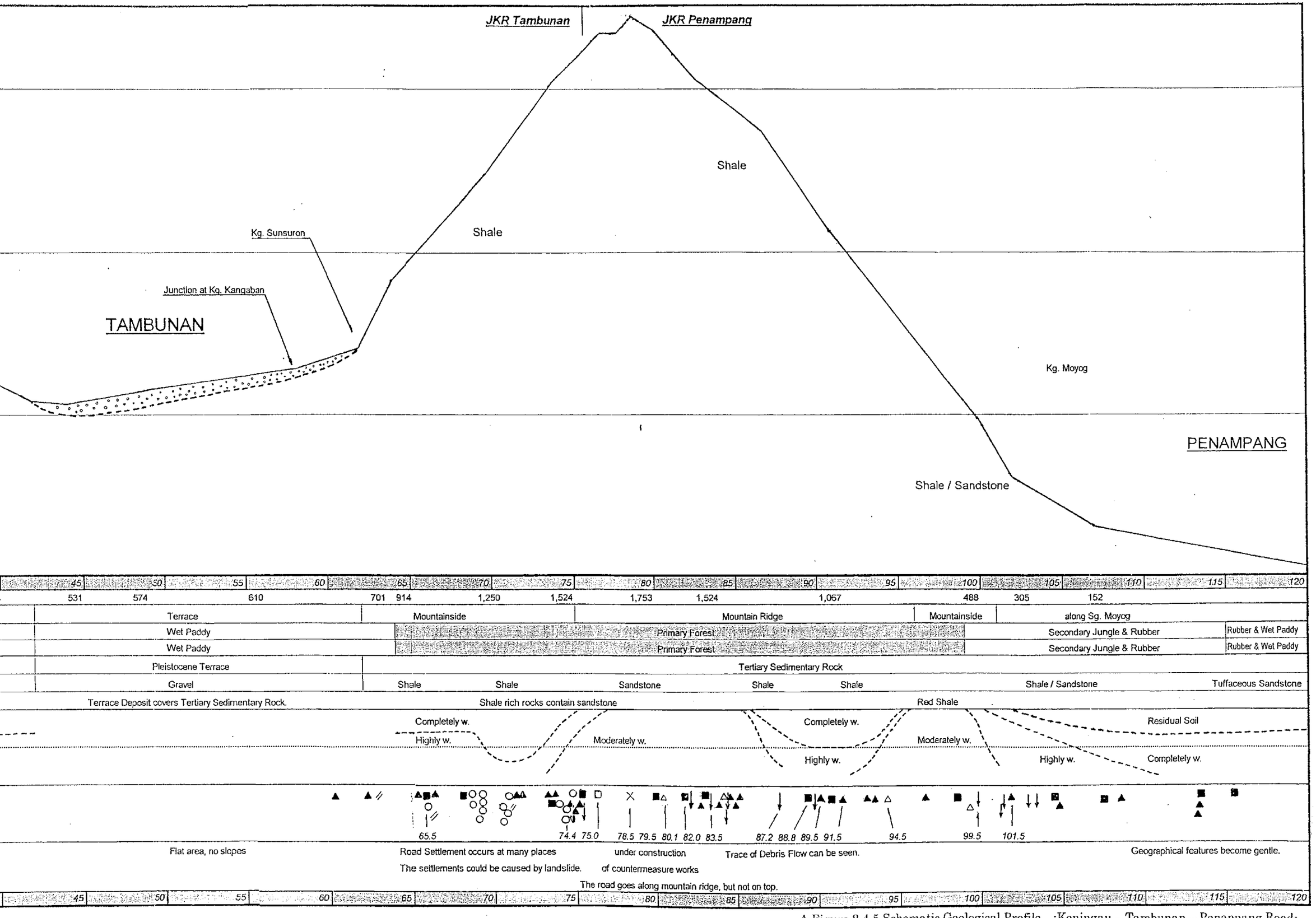
A.Figure 2.4.4 Schematic Geological Profile -Route 6 Penang Road-

SCHEMATIC GEOLOGICAL PROFILE

- Sabah Keningau - Tambunan - Penampang -



CHAINAGE		0 km, 5, 10, 15, 20	25, 30, 35, 40	45, 50, 55, 60	65, 70
ELEVATION		304, 305, 457	604, 745, 687, 594	531, 574, 610	701, 914, 1,250
GEOGRAPHICAL FEATURE		Terrace	Foot of Mountain	Terrace	Mountainside
VEGETATION	LEFT SIDE	Town; Grass & Rubber; Wet Paddy; Grass; Primary Forest & Secondary Jungle	Secondary Jungle	Wet Paddy	
	RIGHT SIDE	Town; Grass & Tubber; Wet Paddy; Grass; Primary Forest & Secondary Jungle	Secondary Jungle	Wet Paddy	
GEOLOGICAL INFORMATION	FORMATION	Pleistocene Terrace	Tertiary Sedimentary Rock	Pleistocene Terrace	
	ROCK TYPE	Gravel	Shale / Sandstone	Gravel	Shale; Sh
	STRUCTURE	Terrace Deposit covers Tertiary Sedimentary Rock.	Weathered Shale & Sandstone	Terrace Deposit covers Tertiary Sedimentary Rock.	Shale r
WEATHERING GRADE	10m		Residual Soil		Completely w.
	20m		Completely w.		Highly w.
TRACE OF DISASTERS		1. Surface Failure ▲ 2. Surface Failure – bellow shoulder △ 3. Land Slide ■ 4. Bank Failure □ 5. Wedge Slip ▼ 6. Rock Fall X 7. Debris Flow ↓ 8. Settlement of Road O 9. Gully ∫∫ 22.5	26.0		65.5
REMARKS		Flat area, no slopes	Hill area has some slope disasters	Flat area, no slopes	Road Settlement occurs at The settlements could be c
CHAINAGE		0 km, 5, 10, 15, 20	25, 30, 35, 40	45, 50, 55, 60	65, 70



A.Figure 2.4.5 Schematic Geological Profile -Keningau – Tambunan – Penanpang Road-

Appendix 2.5

Selection of Case Study Route

A.Table 2.5.1 Comparison of Natural and Slope Conditions, and Road Design Standards among Six Alternative Routes

		[1]	[2]	[3]	[4]	[5]	[6]
	Route Name	East-West Highway	Cameron Highlands Road	Gap-Fraser's Hill Road	Kuala Kubu Baharu-Gap-Teranum	Penang Road	Penampang-Tambunan-Keningau Road
	Route number	Federal Route 4	Federal Route 59	Federal Route 56	Federal Route 55	Federal Route 6	Federal Route 500
	Length (km)	124 km	65 km	6 km	54 km	56 km	120 km
Natural Conditions	1) geology (type, structure, weathering, groundwater)	Granite and Schist	Granite/ Phyllite (partly)	Granite	Granite is dominant /Phyllite (partly)	Granite	Sedimentary Rock (but no granite)
	2) topography (altitude, gradient, valley density etc)	Gentle EL 100-1,500m	Steep-- Gentle (top) EL 50--1,500m	Steep EL 900-1,200m	Steep El 100--850m	Gentle EL 0--200m	Steep-- Gentle EL 40--1,700m
	3) hydrology (rainfall and other meteorological condt.)	2,300mm/yr Wet (Jun-Dec)	2,400mm/yr Wet (Oct-Nov)	2,300mm/yr Wet (Jun-Dec)	2,300mm/yr Wet (Jun-Dec)	3,000mm/yr Wet (May-Nov)	2,200mm/yr Very wet (July)
	4) groundwater; surface water and drainage conditions	Dry at ridge/ Wet around stream	many streams crosses road	many streams crosses road	many streams crosses road	Generally dry	generally high ground-water level (Pg-Tn)
	5) vegetation; land use	Rain forest	Rain forest	Rain forest	Rain forest	Rain forest (mountain side)	Rain forest (P-T) Paddy/vege (T-K)
Slope Conditions	6) slope failure type	Almost all types of failure, incl landslide, and rock mass failure	Many of residual soil collapse are anticipated.	Many of residual soil collapse are anticipated.	Many of residual soil collapse are anticipated.	Many of residual soil collapse, and rock fall are anticipated.	Almost all types of failure incl. landslide, and rock mass failure
	7) embankment	Potentially unstable fill slopes can be seen.	Potentially unstable fill slopes can be seen.	Potentially unstable fill slopes can be seen.	Potentially unstable fill slopes can be seen.	Potentially unstable fill slopes can be seen.	Potentially unstable fill slopes can be seen.
	8) debris flow	Potential debris flow should be carefully studied.	Potential debris flow should be carefully studied.	Potential debris flow should be carefully studied.	Potential debris flow should be carefully studied.	Potential debris flow should be carefully studied.	Potential debris flow should be carefully studied.
	9) *present countermeasure works*	Although most of slopes are treated, some additional countermeasure is recommended.					
Road Design Standard	10) Geometric Design Criteria	R5	R2	R2	R1	R2	R4
	11) Design Speed (km/h)	60-100km/h	40-60km/h	40-60km/h	20-40km/h	40-60km/h	60-90km/h
	12) Width (m)	3.50m/lane	3.2m/lane	2.75m/lane	5.0m/lane	3.75m/lane	3.25m/lane
	13) number of lane	2	2	2	1	2	2
	14) minimum radius (m) in Plain minimum radius (m) in Rolling minimum radius (m) in Mountain	375m 230m 105m	85m 50m 30m	85m 50m 30m	85m 50m 30m	85m 50m 30m	230m 125m 85m
	15) Completed Year	1982	before 50's	before 50's	before 50's	before 50's	early 80's

A.Table 2.5.2 Comparison of Current Management Operation among Six Alternative Routes

No.			1		2		3	4		5		6		
Route Name			East-West Highway		Cameron Highlands Road		Gap-Fraser's Hill Road	Kuala Kubu Baharu-Gap-Teranum Road		Penang Road		Penampang-Tambunan-Keningau Road		
Office			Jeli	Genk	Beringang	Tapah	Fraser's Hill	Kuala Kubu Baharu	Teranum	Timur Laut	Barat Daya	Penampang	Tambunan	Keningau
Management OperationStaffing	Staff	1) Total No of staff of office	34	40	20	30	60	60	60	60	90	60	60	60
		2) No. of staff for road work	24	25	8	12	30	30	30	10	50	30	30	30
		3) No. of staff for road maintenance	10(10)	15(15)	4(2)	6(3)	10(4)	10(4)	10(4)	5(2)	10(4)	10(4)	10(4)	10(4)
		4) Technical experience (for engineering)	V.Good	V.Good	Good	Good	Good	Good	Good	V. Good	Good	Good	Good	Good
		5) Technical Capability (for computer)	Fair	Fair	Fair	Fair	Good	Good	Good	Good	Good	Good	Good	Good
	Budget of 2000	1) Total amount of annual budget for office	10.7 mil	15.0 mil	1.0 mil	2.0 mil	20 mil	20 mil	20 mil	160 mil	20 mil	30 mil	30 mil	40 mil
		2) Annual budget for road work			0.5 mil	1.0 mil	10 mil	10 mil	10 mil	10 mil	5.0 mil	15 mil	15 mil	20 mil
		3) Annual budget for road maintenance	4.0 mil	5.0 mil	0.3 mil	1.0 mil	5.0 mil	5.0 mil	5.0 mil	3.0 mil	2.0 mil	8.0 mil	8.0 mil	12 mil
		4) Annual budget for slope related work	5.0 mil	9.0 mil	0.1 mil	0.2 mil	3.0 mil	3.0 mil	3.0 mil	0.5 mil	0.15 mil	7.0 mil	7.0 mil	8.0 mil
		5) Actual performance for slope work	Good	Good	NA	NA	Good	Good	Good	Fair	Fair	Fair	Fair	Fair
	Normal mainte- nance operation	1) Daily patrol performance	V.Good	V.Good	Good	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
		2) Availability of patrol record	V.Good	V.Good	No	No	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair
		3) Regular (periodical) inspection performance	V.Good	V.Good	Good	Good	Good	Good	Good	V. Good	V.Good	Good	Good	Good
		4) Availability of inspection report	V.Good	V.Good	Yes	Yes	Good	Good	Good	Good	V.Good	Good	Good	Good
	Crisis Management	Assessment of emergency response; traffic control, road clearance and so on.	V.Good	V.Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Data avail- ability	Disaster	1) Occurrence of past three years	Often		Sometimes		Often			Sometimes		Often		
	Disaster record	2) Availability of data on past disasters	V.Good	V.Good	No	No	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair
	Other data	3) Availability of past data of slope maintenance work	V.Good	V.Good	No	No	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Privatisation Plan *(reference)*			Road maintenance works to be privatised as of 1/3/2001, but excluding SLOPE MAINTENANCE									No privatisation plan soon.		
Recommendation by JICA Study Team			In respect of number and capability of staff, budget, and actual performance of slope maintenance work, and availability of past disaster record, [1] East - West Highway can be recommended as best choice of case study route.											

Note : *1) The figures in parenthesis are the No. of staffs for slope maintenance which are included in the the total no. of staffs of maintenance.

A.Table 2.5.3 Comparison of Socio-Economic Indicators among Six Alternative Routes

[Reference Data]

No.		①	②	③	④	⑤	⑥
Route Name		East-West Highway	Cameron Highlands Road	Gap-Fraser's Road	Kuala Kubu Baruh-Gap-Teranum Road	Penang Road	Penampang-Tambunan-Keningau Road (Sabah)
Route No.		Federal Route 4	Federal Route 59	Federal Route 56	Federal Route 55	Federal Route 6	State Road
Length(km)		124	65	6	54	56	120
Traffic Volume (Vehicles of All Types:16hours/2 directions):1998*1)		1,393	4,206	380	945	7,493	2,257
Population (1,000):2000*2)							
a.Alongside District of the Survey Route		135.9	207.5	196.5	196.5	608.3	191.0
b.Outside District of the Survey Route		504.6	1,031.7	1,127.9	1,127.9	-	518.4
Total		640.5	1,239.2	1,324.4	1,324.4	608.3	709.4
Agriculture(area in ha. for major crops) 1999*3)							
a Alongside District of the Survey Route		52,266.4	79,734.0	78,266.0	78,266.0	6,346.5	10,696.0
b Outside District of the Survey Route		468,991.4	317,484.0	327,594.9	327,594.9	-	17,164.0
Total		521,257.8	397,218.0	405,860.9	405,860.9	6,346.5	27,860.0
Industry in State Inc the Survey Route							
a.No. of Establishments*4)		4,459	4,986	10,009	10,009	2,105	2,468
b Gross Value Outputs (RM Million)*4)		15,784	21,088	126,884	126,884	47,024	10,003
Development Potential							
a Average Annual Growth Rate of Population(%)*5)							
2000/2010		1.6	0.6	2.0	2.0	0.7	4.1
2010/2020		1.8	0.5	1.7	1.7	0.6	3.1
2000/2020		1.7	0.5	1.8	1.8	0.7	3.6
b Average Annual Growth Rate of Traffic Volume(%)*6)							
1992/1998		3.1	1.0	4.7	5.9	4.5	1.1
Economic Evaluation "With-Without" method was applied. 1 Benefit : (1)Time saving for traffic suspension(24hours), (2) Recovery costs from slope disaster and (3) Cost of accidents	EIRR (%)	38.3	30.4	38.2	28.6	36.7	14.5
	B/C	1.22	1.16	1.26	1.15	1.33	1.02
	NPV (RM 1,000)	8,224	1,771	263	584	3,382	451

Source:*1) "Road Traffic Volume Malaysia"1998, Highway Planning Unit, Ministry of Works, Malaysia
*2) Department of Statistics, Malaysia
*3) "Crop Hectarenge Statistics 1999", Director General of Agriculture, Department of Agriculture Aug. 2000 for peninsula and "Yearbook of Statistics Sabah 1999", Department of Statistics, Sabah Branch for Sabah
*4) "State/District Data Bank, Malaysia, 1999", Department of Statistics, Malaysia
*5) Department of Statistics, Malaysia
*6) "Road Traffic Volume Malaysia"1998, Highway Planning Unit, Ministry of Works, Malaysia

A.Table 2.5.4 Comparison of Traffic Volume among Six Alternative Routes

No.	[1]			[2]	[3]	[4]			[5]					[6]
Route Name	East-West Highjway			Cameron Highlands Road	Gap-Fraser's Road	Kuala Kubu Baharu-Gap-Teranum Road			Penang Road					Tambunan-Keningau Road (Sabah)
Route No.				Federal Route 59	Federal Route 56	Federal Route 55			Federal Route 6					Federal Route 4
Station No.	AR803	DR603	Average	AR107		BR703	CR701	Average	PR202	PR203	PR204	PR205	Average	HR103
<Location of Station>	E of Gerik	W of Jeli		E of Tapah		E of KKB	W of Tmm		[W of Bridge]	South-east	South-west	West		W of Tmbn
Average of March and November Counts (Vehicle/16 Hours/two directions)														
Motor Car & Taxis	700	1,582	1,333	1,910	180	739	361	440	36,858	14,996	1,381	1,964	16,522	636
Small Van &Utilities	162	458	374	352	41	182	83	104	3,022	1,189	287	374	1,421	535
Medium Lorries	172	315	275	461	45	132	89	98	1,664	1,534	333	344	1,090	394
Heavy Lorries	125	183	166	115	29	92	58	65	310	242	14	19	172	369
Buses	32	81	67	107	11	34	21	24	4,375	2,052	498	280	2,118	11
Motor Cycles	202	698	558	1,260	74	467	147	214	31,263	14,465	2,947	4,586	15,431	101
Total	1,393	3,317	2,773	4,206	380	1,646	759	945	77,493	34,477	5,460	7,567	36,755	2,046
Percentage Distribution for the Average (%)														
Motor Car & Taxis	50.2	47.7	48.1	45.4	47.5	44.9	47.5	46.6	47.6	43.5	25.3	26.0	45.0	31.1
Small Van &Utilities	11.6	13.8	13.5	8.4	10.9	11.1	10.9	11.0	3.9	3.4	5.3	4.9	3.9	26.2
Medium Lorries	12.4	9.5	9.9	11.0	11.7	8.0	11.7	10.4	2.1	4.4	6.1	4.5	3.0	19.2
Heavy Lorries	9.0	5.5	6.0	2.7	7.6	5.6	7.6	6.9	0.4	0.7	0.3	0.3	0.5	18.0
Buses	2.3	2.4	2.4	2.5	2.8	2.1	2.8	2.6	5.6	6.0	9.1	3.7	5.8	0.5
Motor Cycles	14.5	21.1	20.1	30.0	19.4	28.4	19.4	22.7	40.3	42.0	54.0	60.6	42.0	4.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Annual Average Growth Rate(%) [1992-1998]	3.08	13.08	11.66	0.95	4.66	7.95	4.66	5.86	[0.46]	6.85	6.62	4.66	2.48	0.61

Note: There is no available data for Gap-Fraser's Road. The traffic volume is tentatively one half of traffic volume of station No. CR701.

Source:"Road Traffic Volume Malaysia"1998, Highway Planning Unit, Ministry of Works, Malasia

Appendix 3.3

Slope Inspection Sheets

SLOPE INSPECTION SHEET input **FORM A**
GENERAL SLOPE DATA

General Slope Data

Most Likely Failure Type	*1. Collapse / Rock Fall 2. Rock Mass Failure 3. Landslide 4. Debris Flow 5. Embankment Failure 6. No Action Needed (Form A only)*		
Chainage	*Start* km - *End* km	Type of Slope	*Cut / Embankment / Natural*
Side of Road	*Right / Left*	Distance from Road Centre-Line	m
JKR Slope ID		Date Inspected	/ /
Field ID		Inspected by	
Route Name		Date Checked	/ /
District Name / State Name	/	Checked by	
Realignment Event (Description)	*Yes / No (if 'yes', describe)*		
Disaster Record			

Location Map (1:50,000)

Date Entered in SIMS	/ /
Entered by	

A.Figure 3.3.1 Inspection Sheet Form A

SLOPE INSPECTION SHEET		input FORM B SLOPE SKETCH	
JKR Slope ID :	Chainage: Start km - End km	Side of Road : Right / Left	Date:

A.Figure 3.3.2 Inspection Sheet Form B

SLOPE INSPECTION SHEET		input FORM C PHOTOGRAPH	
JKR Slope ID :	Chainage: Start km - End km	Side of Road : Right / Left	Date:

A.Figure 3.3.3 Inspection Sheet Form C

SLOPE INSPECTION SHEET input **FORM D**
SLOPE FEATURE

JKR Slope ID :	Chainage: Start km - End km	Side of Road : *Right / Left*	Date:

GEOMETRY	Height of Slope	m	No. of Berms		
	Angle of Slope (range)	- deg	Width of Berms	m	
	Average Angle of Slope	deg	Berm Height	m	
GEOLOGY	Soil Name (if soil)	*Gravel / Sand / Silt / Clay / Peat / other ( )*			
	Geological Name – Sedimentary	*Sandstone / Mudstone / Siltstone / Conglomerate / Limestone / Chert / Shale / Alternation of Sandstone & Mudstone / other ( )*			
	Geological Name – Igneous	*Rhyolite / Dacite / Andesite / Basalt / Granite / Granodiorite / Diorite / Gabbro / Ultrabasic Rocks / Tuff / Pyroclastic / other ( )*			
	Geological Name – Metamorphic	*Slate / Phillite / Schist / Marble / Hornfels / Gneiss / other ( )*			
	Weathering Grade	*I, II, III, IV, V, VI*	Composition Ratio of Rock : Soil (%)		
	Discontinuities Type	*1, 2, 3, 4, 5, 6, 7, 8*	*Rock : Soil = :*		
EROSION	Sheet Erosion	*Severe (>40%)*	*/ Moderate (10%-40%)*	*/ Minor (<10%)*	
	Rill Erosion	*Severe (0.2-0.5m depth)*	*/ Moderate (<0.2m depth)*	*/ Minor*	
	Gully Erosion	*Severe (>one berm)*	*/ Moderate (one berm)*	*/ Minor*	
	Fretting Erosion	*Severe (>40%)*	*/ Moderate (10%-40%)*	*/ Minor (<10%)*	
COVER / EXISTING COUNTERMEASURE	Type	*Trees / Shrubs / Grass / Gunite / Dental Concrete / Others ( )*			
	Engineering Features		Percentage covered	%	
	Gabions	*H= m, L= m*	*Rock Bolts*	m^2	
	Crib Wall	*H= m, L= m*	*Netting*	m^2	
	Concrete Wall	*H= m, L= m*	*Soil Nail*	m^2	
	Masonry	*H= m, L= m*	*Piles*	*m interval, m extension*	
	Others		*Comments*		
DRAINAGE	Roadside Drains	*Good Condition / Needs Desilting / Needs Repair / Not Present*			
	Cascade Drains	*Good Condition / Needs Desilting / Needs Repair / Not Present*			
	Berm Drains	*Good Condition / Needs Desilting / Needs Repair / Not Present*			
	Cut-Off Drains	*Good Condition / Needs Desilting / Needs Repair / Not Present*			
	Horizontal Drains	*Good Condition / Needs Desilting / Needs Repair / Not Present*			
	Culvert Passageway	*Good Condition / Needs Desilting / Needs Repair / Not Present*			
	Culvert Inlet	*Good Condition / Needs Desilting / Needs Repair / Not Present*			
	Culvert Outlet	*Good Condition / Needs Desilting / Needs Repair / Not Present*			
	Culvert Wingwalls	*Good Condition / Needs Desilting / Needs Repair / Not Present*			
	Culvert ID				
	Hydrological Condition	Seepage from Slope Face or Ground?: *Yes / No*			
		Natural Surface Runoff?: *Yes / No*	Ponding Water Nearby?: *Yes / No*		
	Comments				
PAVEMENT	Cracks?:	*Yes / No*	Depression?:	*Yes / No*	
	Cracks Sealed?:	*Yes / No*	Shoulder Depression?:	*Yes / No*	
	Shoulder Cracks?	*Yes / No*	Cause of Cracks?:	*Pavement / Slope failure*	

INSTRUMENTATION (type & condition, if any)	*Inclinometer*	*Piezometer*	*Tensiometer*	*Rain Gauge*	*Pressure G.*	*Others( )*
	Good / Bad	*Good / Bad*	*Good / Bad*	*Good / Bad*	*Good / Bad*	*Good / Bad*

A.Figure 3.3.4 Inspection Sheet Form D

SLOPE INSPECTION SHEET input **FORM E1**

COLLAPSE / ROCK FALL

JKR Slope ID :	Chainage: Start km - End km	Side of Road : *Right / Left*	Date:

Condition of Slope

				✔	tick one
TOPOGRAPHY	Alluvium Slope		*Yes*		2
			No		0
	Trace of Collapse		*Yes*		1
			No		0
	Clear Knick Point or Overhang		*Yes*		1
			No		0
	Concave Slope or Debris Slope		*Yes*		1
			No		0
GEOMETRY Select Higher Point of A or B	A : Soil Slope H : Height of Soil i : Angle of Slope	*H > 30m*			30
		H ≤ 30m *i > 45 deg*			24
		15m ≤ H < 30m *i ≤ 45 deg*			20
		H < 15m *i ≤ 45 deg*			10
	B : Rock Slope H : Height of Rock	*H > 50m*			30
		30 m ≤ H < 50m			26
		15 m ≤ H < 30m			20
		H <15m			10
MATERIAL Select A and B	A : Soil Character Swelling Clay Contents		*Conspicuous*		8
			Slightly		4
			No Swelling Clay		0
	B : Rock Quality Sheared Rock, Weathered Rock		*Conspicuous*		8
			Slightly		4
			Not Available		0
GEOLOGICAL STRUCTURE	Daylight Structure (Planar, Wedge)		*Yes*		8
			No		0
	Soft Soil over Base Rock				6
	Hard Rock over Weak Rock				4
	Others				0
DEFORMATION	Slope Deformation Gully Erosion, Rill Erosion, Sheet Erosion, Fretting Erosion, Rock Fall, Exfoliation, Swelling		*Visible*		10
			Obscure		8
			No Slope Deformation		0
	Deformation at Adjacent Slope *Rock Fall, Collapse, Crack, Swelling, Other deformation*		*Visible*		5
			Obscure		3
			No Slope Deformation		0
SURFACE CONDITION	Condition of Surface	*Unstable*			8
		Moderate			6
		Stable			0
	Ground Water	*Natural Spring*			6
		Water Seepage			3
		Dry			0
	Cover	*No-vegetation, Grass*			4
		Complex (Grass + Structure)			3
		Structure			1
	Surface Drainage	*Available (good)*			0
		Available (need repair)			2
		Not Available			1
			Score		

Countermeasure

	✔	tick one
Effective		-20
Partially Effective		-10
Not effective or No Countermeasure		±0
Hazard Score		

A.Figure 3.3.5 Inspection Sheet Form E1

SLOPE INSPECTION SHEET input **FORM E2**
ROCK MASS FAILURE

JKR Slope ID :	Chainage: Start km - End km	Side of Road : Right / Left	Date:

Condition of Slope

				✔	tick one
TOPOGRAPHY	Slope Type	Convex Slope			4
		Debris Sediment			3
		Concave Slope			1
		Other			0
	Knick Point	Visible			7
		Moderate			4
		No Knick Point			0
GEOMETRY	Angle of Slope	Overhang			4
		> 60°			2
		< 60°			0
	Height of Slope	> 100m			10
		50 < H ≤ 100m			7
		30< H ≤ 50m			4
		< 30m			2
GEOLOGICAL CONDITION	Scale of Open Crack	Large	≥ 20 mm		25
		Small	< 20mm, ≥ 5mm		15
		No Open Crack	< 5mm		0
	Upper Part : Hard Rock / Lower Part :Soft Rock				6
	Upper Part : Soft Rock / Lower Part : Hard Rock				4
	Wholly Soft Rock				4
	Wholly Hard Rock				2
	Others				0
GEOLOGICAL STRUCTURE	Crack	Regular Cracks : interval > 1 m			18
		Regular Cracks : interval ≤ 1 m			12
		Irregular			6
	Daylight Structure or Non-Daylight Structure (Fault, Joint, Crack, Bedding)	Daylight			15
		Non-Daylight			5
		No Plane			0
DEFORMATION	Trace of Small Collapse or Small Rock Fall	Yes			7
		No			0
SURFACE CONDITION	Spring or Seepage on Slope	Yes			2
		No			0
	Surface Drainage	Available (good)			0
		Available (need repair)			2
		Not Available			1
			Score		

Countermeasure

	✔	tick one
Effective		-20
Partially Effective		-10
Not effective or No Countermeasure		±0
Hazard Score		

A.Figure 3.3.6 Inspection Sheet Form E2

SLOPE INSPECTION SHEET input **FORM E3**

LANDSLIDE

JKR Slope ID :	Chainage: Start km - End km	Side of Road : *Right / Left*	Date:

Condition of Slope

			✔	tick one
TOPOGRAPHY	History of Landslide	*Yes*		10
		No		0
	Anomaly Disturbed Contour Lines Geographical Features like Scarp at Top of Slope	*Obvious*		40
		Partially		30
		Uncertain		10
GEOLOGICAL STRUCTURE	Fault, Sheared Zone			10
	Alteration Zone			10
	Daylight Structure			6
	Non-Daylight Structure			3
	Intrusive Structure, Cap Rock Structure			3
	Others			0
GEOLOGICAL CONDITION	Shale or Schist			3
	Others			2
DEFORMATION	Bulging at Toe	*Yes*		8
		No		0
	Depression or Subsidence	*Yes*		8
		No		0
	Cracks on Surface, Diagonal Tension, Shear Cracking	*Yes*		8
		No		0
	Deformation of Countermeasure	*Yes*		8
		No		0
SURFACE CONDITION	Spring, Natural Waterpath	*Yes*		3
		No		0
	Surface Drainage	*Available (good)*		0
		Available (need repair)		2
		Not Available		1
		Score		

Countermeasure

	✔	tick one
Effective		-20
Partially Effective		-10
Not effective or No Countermeasure		±0
Hazard Score		

A.Figure 3.3.7 Inspection Sheet Form E3

	SLOPE INSPECTION SHEET			input **FORM E4** DEBRIS FLOW
JKR Slope ID :	Chainage: Start km - End km		Side of Road : Right / Left	Date:

Condition of Slope

			✔	tick one
TOPOGRAPHY	Contributory Area of Occurrence (Gradient of Stream ≥15deg)	≥ 0.50 km²		15
		0.15 ≤ A < 0.50 km²		10
		< 0.15 km²		5
	Extreme Steep Gradient of Stream	≥ 40°		15
		30° ≤ θ < 40°		10
		< 30°		0
	Area of Slope Gradient more than 30° in Source Area	≥ 0.20 km²		13
		0.08 ≤ A < 0.20 km²		8
		< 0.08 km²		4
COVER IN SOURCE AREA	Area of Grassland and Bush	≥ 0.20 km²		13
		0.02 ≤ A < 0.20 km²		8
		< 0.02 km²		0
	Existence of Earth Works/ Ponds/ Logging activity/Seepage	Yes		10
		No		0
DEFORMATION IN SOURCE AREA	Existence of New Crack, Scarp	Yes		10
		No		0
	History of Collapse	Yes		15
		No		0
TRACE	Trace of Debris Flow	Yes		9
		No		0
		Score		

Countermeasure

	✔	tick one
Effective		-20
Partially Effective		-10
Not effective or No Countermeasure		±0
Hazard Score		

A.Figure 3.3.8 Inspection Sheet Form E4

SLOPE INSPECTION SHEET input **FORM E5**

EMBANKMENT FAILURE

JKR Slope ID :	Chainage: Start km - End km	Side of Road : *Right / Left*	Date:

Condition of Slope

			✔	tick one
GEOMETRY	Angle of Slope	*> 45 deg*		10
		> 33 deg, ≤ 45 deg		5
		≤ 33 deg		0
BASE GROUND	*Unstable Toe*			8
	Poor Subsoil			5
	Alluvium			5
	Stable Toe			0
	Uncertain			3
FILL MATERIAL	*Sandy Soil*			5
	Clayey Soil			0
	Gravel			0
	Unknown			3
GROUND WATER AND SURFACE WATER	Wet at Toe of Fill Slope	*Yes*		8
		No		0
	Trace of Water Flow on Slope Surface	*Yes*		8
		No		0
	Seepage from Fill Slope	*Yes*		8
		No		0
	Surface Drainage	*Need Repair*		5
		Not Available		3
		Good		0
CONDITION OF CULVERT	Insufficient or No Culvert	*Yes*		10
		No		0
	Insufficient Treatment at End of Culvert	*Yes*		7
		No		0
	Bending or Reduction of Culvert	*Yes*		5
		No		0
DEFORMATION	Cracks, Creeping	*Yes*		10
		No		0
	Surface Erosion	*Yes*		8
		No		0
	Existence of Repaired Portion	*Yes*		5
		No		0
	Swelling on Slope	*Yes*		3
		No		0
		Score		

Countermeasure

	✔	tick one
Effective		-20
Partially Effective		-10
Not effective or No Countermeasure		±0

Hazard Score	

A.Figure 3.3.9 Inspection Sheet Form E5

SLOPE INSPECTION SHEET input **FORM F**

PROPOSED COUNTERMEASURE & CONSEQUENCE

JKR Slope ID :	Chainage: Start / End km - km	Side of Road : *Right / Left*	Date:

Proposed Countermeasure

Countermeasure	Amount	Remarks

Comments

Consequence Data

✔ tick one

Services, Public Utilities if gas, oil, telecom, electric or water pipelines are available, mark "Yes"		*Yes*		2
		No		0
Danger to Building Occupants only mark "Yes", if distance from toe of slope ~ 2H (H : Height of Slope)		*Yes*		2
		No		0
Volume of Traffic (AADT = Annual Average Daily Traffic)		*> 1,000 AADT*		2
		200 - 1,000 AADT		1
		< 200 AADT		0
Angle β (road at centre-line to crest or embankment toe)		*> 30°*		1
		≤ 30°		0
Failure Size (a) Cut Slope (m^2) (b) Embankment (m^3)		*(a) > 3,000 or (b) > 1,000*		1
		(a) ≤ 3,000 or (b) ≤ 1,000		0
Construction Period of Temporary Diversion		*> 1 day*		1
		≤ 1 day		0
Length of Alternative Roads		*> 50km*		1
		≤ 50 km		0
		Consequence Score		

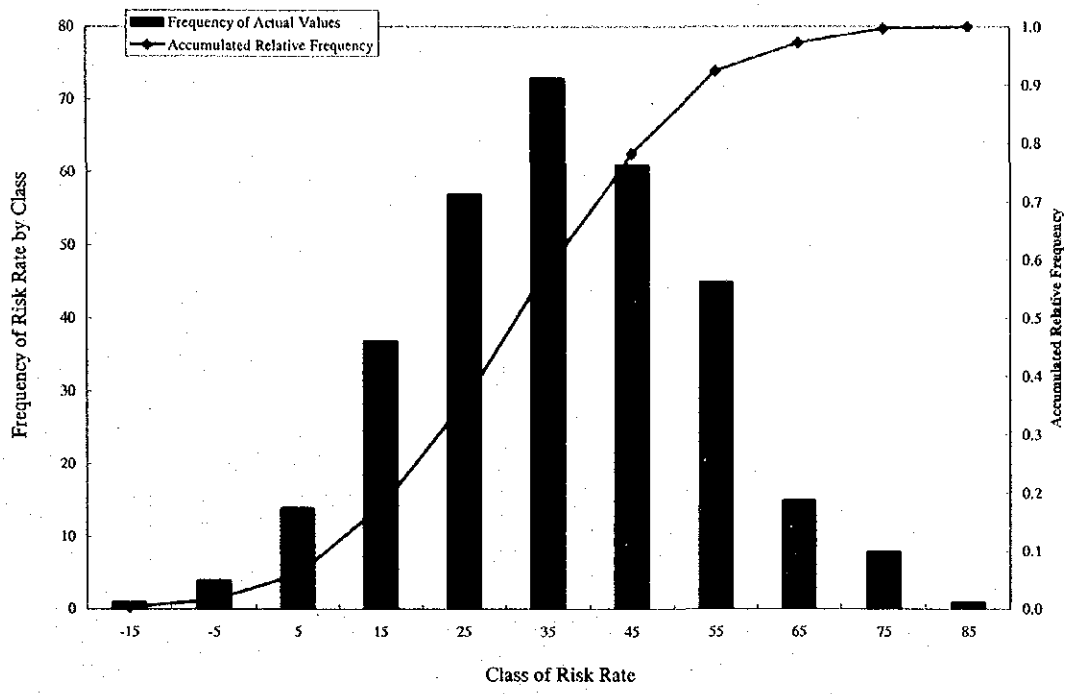
Local Information

Building Type	*Residential / Hotel / Commercial / Hospital / Factory / School / Others( )*			
Vegetation / Cultivation	*Primary Forest / Secondary Jungle / Grass / Rubber / Oil Palm / Coconut / Paddy Field / Others ( )*			
Rainfall Information	Annual Average		(mm)	
	Monthly Average	*Maximum*	(mm)	
			Month	
		Minimum	(mm)	
			Month	
	Daily	Maximum	(mm)	
			Month	
	Nearest Station			

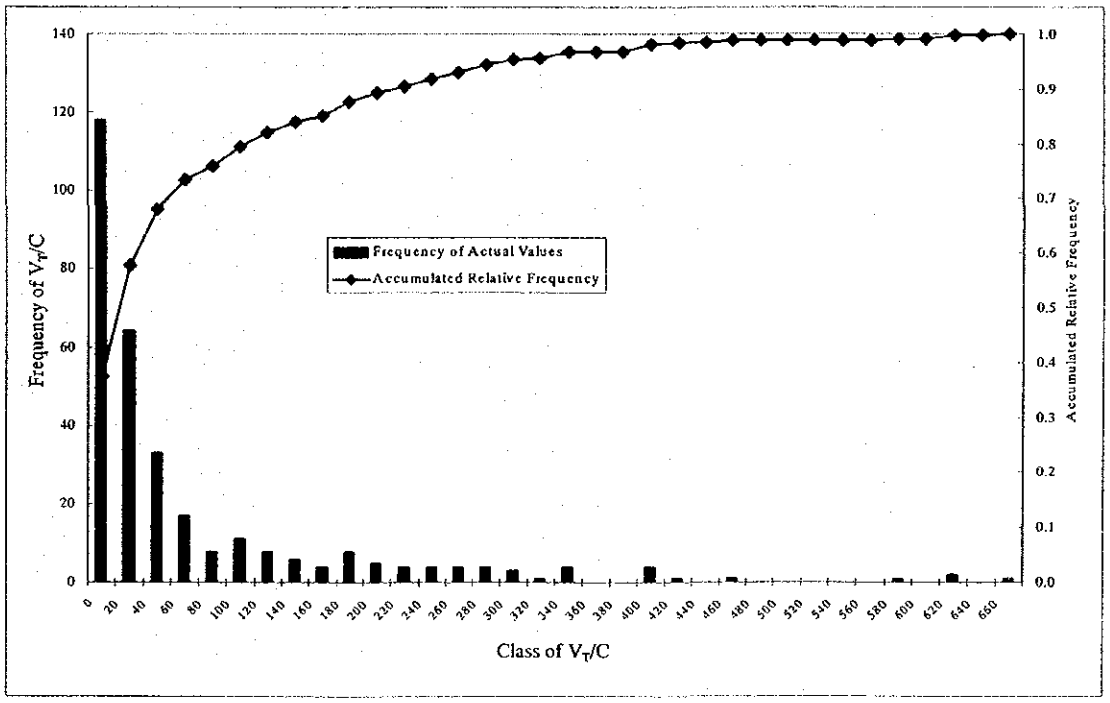
A.Figure 3.3.10 Inspection Sheet Form F

Appendix 5.3

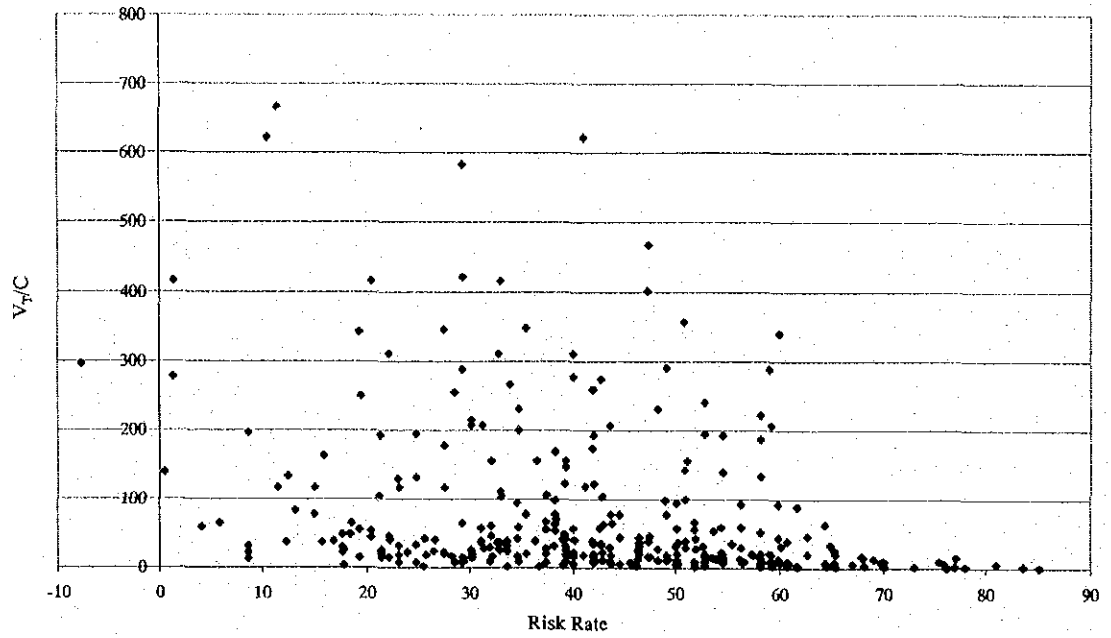
Consideration of Economic Analysis



A.Figure 5.3.1 Histogram of Frequency of Risk Rate by Class



A.Figure 5.3.2 Histogram of Frequency of V_T/C by Category



A.Figure 5.3.3 Relation between Total Score and V_T/C

A.Table5.3.1(1) Formulas of Calculation for Benefits/Cost and Input Data Sources

Contents of Damages (Benefits) & Formulas		Variables	Explanation of Variables	Necessary Data (Inc. Processed&Assumed Variables)	Data Source	Responsibility of Data Collection and Management		Character of Data(Variables)	
						Case-Study (East-West Highways)	All Routes (JKR)	Raw Data (R)	To Be Processed/ Assumed/ Forecast (P)
1 Direct Damages									
Basic and Common Data				1. Type of Slope	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
				1. Type of Slope Failure	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
				3. Total Quantity of Failed Materials by Type of Slope Failure(Potential)	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
				4. Possible Quantity of Failed Materials (If the potential Quantity of failed materials are huge)	Site Technical Engineer	JICA Study Team	JKR(HQ&District Office)	R	
D_1	Damages for Human Body in Vehicle								
$D_1=I \times N$		I:	Damages per Person (RM)						
		N:	No. of Persons Involved in the Disaster (person)						
$N=H \times P$		H:	Weighted Average Passenger per Vehicle (Pass /Vehicle)	1. Capacity by Vehicle Type(pass-ranger/vehicle)	JKR/JICA Study Team)	JKR(JICA Study Team)	JKR(HQ&District Office)		P
				2. Sectional Traffic Volume by Vehicle Type	Survey Report of Traffic Volume by JKR	JICA Study Team	JKR(HQ&District Office)	R	
				3. Weight(%) of Sectional Traffic Volume by Type of Vehicle	To be calculated	JICA Study Team	JKR(District Office)		P
		P:	Probability(No. of Vehicle%) of Being Involved in the Disaster (No. of Vehicle)		To be calculated	JICA Study Team	JKR(District Office)		P
$P=(L_1, L_2)/L_3$		L_1:	Road Width to be Influenced by Slope Failure (m)		To be calculated	JICA Study Team	JKR(District Office)		P
		L_2:	Distance Until Stopping After Braking (m)		Assumption	JICA Study Team	JKR(HQ&District Office)		P
		L_3:	Average Distance Between Vehicle(of vehicle)		To be calculated	JICA Study Team	JKR(District Office)		P
$L_1=\sqrt{Q}$		Q:	Possible Quantity of Failed Materials(m3) ; Depth(Height) of Failed Mud and Debris=1 m	2. Possible Quantity of Failed Materials (If the potential Quantity of failed materials are huge)	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
		$\sqrt{Q}$:	Length of Possible Quantity of Failed Materials		To be calculated	JICA Study Team	JKR(District Office)		P
$L_3=AR \times AS$		AR:	Average Running Time Between Vehicles(sec/vehicle)		To be calculated	JICA Study Team	JKR(District Office)		P

A.Table5.3.1(2) Formulas of Calculation for Benefits/Cost and Input Data Sources

Contents of Damages (Benefits) & Formulas		Variables	Explanation of Variables	Necessary Data (Inc. Processed&Assumed Variables)	Data Source	Responsibility of Data Collection and Management		Character of Data(Variables)	
						Case-Study (East-West Highways)	All Routes (JKR)	Raw Data (R)	To Be Processed/ Assumed/ Forecast (P)
		AS:	Average Speed(km/hr)		Assumption	JKR(JICA Study Team)	JKR(District Office)		P
	$AR=SD/TD$	SD:	Total Second per Day(24 x 60=24 x 60 x 60)		To be calculated	JICA Study Team	JKR(District Office)		P
		TD:	Total Sectional Traffic Volume per Day	1. Present(2002)	Survey Report of Traffic Volume by JKR (1997)	JICA Study Team	JKR(HQ&District Office)	R	
					* The Traffic volume in 2002 will be Forecast	JICA Study Team	JKR(HQ&District Office)		P
				2. Future (2022)	To be forecast	JICA Study Team	JKR(HQ&District Office)		P
	$I=I_1+I_2$	I_1:	Damages by Injury(RM/person)	2. Unit Value of Damages by Injury by Type of Slope Failure					
				(1) Present	To be calculated	JKR/JICA Study Team)	JKR(HQ)		P
				(2) Future	To be forecast on the last year of evaluation (2022)	JICA Study Team	JKR(HQ)		P
		I_2:	Damages by Death(RM/person)						
	$I_2=PGNI \times (L/2)$	$PGNI$:	Per Capita GNI (RM/person)	2. Unit Value of Damages by Death by Type of Slope Failure					
				(1) Present Per Capita National Income for current year (2000)	Dept. of National Statistics	JICA Study Team	JKR(HQ)	R	
				(2) Future : Per Capita National Income (2022)	To be forecast	JICA Study Team	JKR(HQ)		P
		L:	Average Life Span(Year)		Assumption on the basis of population statistics	JICA Study Team	JKR(HQ)		P
D_2	Damages for Human Body in Building								
	1. Method-1: If there are many buildings within the area of two times of toe of height of slope								
	$Pb \times Db \times r_1$	Pb :	Total Number of Person in Building of All Types of Building (person)	1. No. of Building by Type	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
				2. No. of Persons in Building by Type	Assumption by JICA Study Team	JICA Study Team	JKR(HQ)		P
		Db :	Damages per Person by Possible Quantity of Failed Materials Outside Road and by Type of Slope Failure(RM/Person)	1. Type of Slope Failure	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
				2. Unit Value of Damages by Injury by Type of Slope Failure	The same data as of the Damages for Human Body in Vehicle (D_1)				
				(1) Present	JKR		JKR(HQ)		

A.Table 5.3.1(3) Formulas of Calculation for Benefits/Cost and Input Data Sources

Contents of Damages (Benefits) & Formulas		Variables	Explanation of Variables	Necessary Data (Inc. Processed& Assumed Variables)	Data Source	Responsibility of Data Collection and Management		Character of Data(Variables)	
						Case Study (East-West Highways)	All Routes (JKR)	Raw Data (R)	To Be Processed/ Assumed/ Forecast (P)
				(1) Future	To be forecast on the last year of evaluation (2022)		JKR(HQ)		
				2. Unit Value of Damages by Death by Type of Slope Failure	The same data as of the Damages for Human Body in Vehicle(D2)				P
				(3) Present Per Capita National Income for current year (2000)	Dept. of National Statistics	JICA Study Team	JKR(HQ)	R	
				(3) Future : Per Capita National Income (2021)	To be Forecast	JICA Study Team	JKR(HQ)		P
	$Q=\sqrt{Q}\times(\sqrt{Q}-rw)$	Q' :	Possible Quantity of Failed Materials Outside of Road = Area Outside of Road to Be Influenced by Slope Failure						
		Q:	Possible Quantity of Failed Materials(m3)	Possible Quantity of Failed Materials(m3)	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
		rw:	Width of Area Outside of Road(m)	3. Width of Area Outside of Road	To be calculated	JICA Study Team	JKR(District Office)	R	
		$\sqrt{Q}$:	Length of Possible Quantity of Failed Materials		To be calculated	JICA Study Team	JKR(District Office)		P
		$\sqrt{Q}-rw$:	Road Length of Failed Materials		To be calculated	JICA Study Team	JKR(District Office)		P
	$rw=Nl\times rl$	Nl:	No of Lane	1.No. of Lane	Assumption	JICA Study Team	JKR(District Office)	R	
		rl:	Road width of One Lane		Assumption	JKR(JICA Study Team)	JKR(HQ&District Office)	R	P
	$r_1=Q/Aru$	r_1:	Rate of Being Involved by Slope Failure		To be calculated	JKR(JICA Study Team)	JKR(HQ)		P
		Q :	Possible Quantity of Failed Materials Outside of Road = Area Outside of Road to Be Influenced by Slope Failure		Already calculated				
	$Aru=Ls\times 2H$	Aru:	Probable Area with Length of 2 Times of Height of Slope(m^2)						
		Ls:	Length of Slope	1. Chainage by Slope	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
		H:	Height of Slope	2.Height of Slope	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
	2. Method-2: If there are very few buildings within the area of two times of toe of height of slope								
	$Pb\times Db\times r_1$	Pb :	Total Number of Persons in Building of All Types of Building (persons)	1. Score of Danger in Building Components	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
				2. No. of Persons in All Types of Buildings	Arrangement by JICA Study Team	JICA Study Team	JKR(HQ)		P

A.Table 5.3.1(4) Formulas of Calculation for Benefits/Cost and Input Data Sources

Contents of Damages (Benefits) & Formulas		Variables	Explanation of Variables	Necessary Data (Inc. Processed& Assumed Variables)	Data Source	Responsibility of Data Collection and Management		Character of Data(Variables)	
						Case Study (East-West Highways)	All Routes (JKR)	Raw Data (R)	To Be Processed/ Assumed/ Forecast (P)
		Db :	Damages per Person by Possible Quantity of Failed Materials Outside Road and by Type of Slope Failure(Unit/Person)	1. Type of Slope Failure	Assumption	JICA Study Team	JKR(HQ)		P
				2. Unit Value of Damages by Injury by Type of Slope Failure	The same data as of the Damages for Human Body in Vehicle (D2)				
				(1) Present	JKR		JKR(HQ)		P
				(2) Future	To be Forecast on the last year of evaluation (2022)		JKR(HQ)		P
				2. Unit Value of Damages by Death by Type of Slope Failure	The same data as of the Damages for Human Body in Vehicle(D2)				P
				(3) Present Per Capita National Income for current year (2000)	Dept. of National Statistics	JICA Study Team	JKR(HQ)	R	
				(2) Future : Per Capita National Income (2021)	To be forecast	JICA Study Team	JKR(HQ)		P
	$Q=\sqrt{Q}\times(\sqrt{Q}-rw)$	Q' :	Possible Quantity of Failed Materials Outside of Road = Area Outside of Road to Be Influenced by Slope Failure						
		Q:	Possible Quantity of Failed Materials(m3)	Possible Quantity of Failed Materials(m3)	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
		rw:	Width of Area Outside of Road(m)	3. Width of Area Outside of Road	To be calculated	JICA Study Team	JKR(District Office)	R	
		$\sqrt{Q}$:	Length of Possible Quantity of Failed Materials		To be calculated	JICA Study Team	JKR(District Office)	R	P
		$\sqrt{Q}-rw$:	Road Length of Failed Materials		To be calculated	JICA Study Team	JKR(District Office)		P
	$rw=Nl\times rl$	Nl:	No of Lane	1.No. of Lane	Assumption	JICA Study Team	JKR(District Office)	R	
		rl:	Road width of One Lane		Assumption	JKR(JICA Study Team)	JKR(HQ&District Office)		P
	$r_1=Q/Aru$	r_1:	Rate of Being Involved by Slope Failure		To be calculated	JKR(JICA Study Team)	JKR(HQ)		P
		Q :	Possible Quantity of Failed Materials Outside of Road = Area Outside of Road to Be Influenced by Slope Failure		Already calculated				
	$Aru=Ls\times 2H$	Aru:	Probable Area with Length of 2 Times of Height of Slope(m^2)						
		Ls:	Length of Slope	4. Chainage by Slope	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
		H:	Height of Slope	5.Height of Slope	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
D_3	**Damages for Vehicle**								
	$PV\times RV\times P$	PV:	Weight Average Price per Vehicle(JM/Vehicle)	1. Price of Vehicle By Type		JICA Study Team	JKR(HQ)	R	
				2. Average Depreciation Rate	Assumption	JICA Study Team	JKR(HQ)		P

A.Table 5.3.1(5) Formulas of Calculation for Benefits/Cost and Input Data Sources

Contents of Damages (Benefits) & Formulas		Variables	Explanation of Variables	Necessary Data (Inc. Processed&Assumed Variables)	Data Source	Responsibility of Data Collection and Management		Character of Data(Variables)	
						Case Study (East-West Highways)	All Routes (JKR)	Raw Data (R)	To Be Processed/ Assumed/ Forecast (P)
				3. Weight(Vo) of Vehicle by Type	To be calculated	JICA Study Team	JKR(HQ)		P
				4. Value of Commodity by Type of Vehicle					
				(1) Passenger Car					
				The Rate of Value of Commodity by Vehicle Type	Assumption	JICA Study Team	JKR(HQ)		P
				(2) Freight Car (Truck)					
				a. Capacity of Tonnage	Assumption	JICA Study Team	JKR(HQ)		P
				b. Average Loading Factor	Assumption	JICA Study Team	JKR(HQ)		P
				c. Weight(Vo) by Type of Vehicle	Assumption	JICA Study Team	JKR(HQ)		P
		RV_i:	Damage Rate of Value per Vehicle by Type of Slope Failure	i. Type of Slope	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
				3. Damage Rate per Vehicle	Assumption	JICA Study Team			P
		P_i:	Fatal ability(No. of Vehicle) of Being Involved in the Disaster (No. of Vehicle)	The Same Data as of " Damages for Human Body in Vehicle	To be calculated	JICA Study Team	JKR(HQ)		P
D_4	Damages for Assets of Buildings								
	1. Method-1: If there are many buildings within the area of two times of toe of height of slope								
	$TVb \times r_1 \times r_2$	TVb:	Total Value of All Types of Building(RM)	(1) Construction Cost of Building by Type(Including Infrastructure(Dam, Irrigation Facilities and etc.)					
				a. Average Construction Cost per m^2 by Type of Building (Infrastructure)	Dept. of Housing	JICA Study Team	JKR(HQ)	R	
				b. Average Depreciation Rate	Assumption	JICA Study Team	JKR(HQ)		P
				c.Average Value of Movables					
				(a) Rate of Value of Movables to the Cost of Building	Assumption	JICA Study Team	JKR(HQ)		P
				(2) No. of Building by Type	Slope Inspection Sheet	JICA Study Team	JKR(HQ)	R	

A.Table 5.3.1(6) Formulas of Calculation for Benefits/Cost and Input Data Sources

Contents of Damages (Benefits) & Formulas		Variables	Explanation of Variables	Necessary Data (Inc. Processed&Assumed Variables)	Data Source	Responsibility of Data Collection and Management		Character of Data(Variables)	
						Case Study (East-West Highways)	All Routes (JKR)	Raw Data (R)	To Be Processed/ Assumed/ Forecast (P)
		r_1:	Rate of Being Involved by Slope Failure	Already calculated in D_3					P
		r_2:	Rate of Damages of All Buildings by Possible Quantity of Fallen Materials Outside Road and by Type of Slope Failure		Assumption	JICA Study Team	JKR(HQ)		P
	2. Method-2: If there are very few buildings within the area of two times of toe of height of slope								
	$TVb \times r_1 \times r_2$	TVb:	Total Value of All Types of Buildings(RM)	Roughly Estimated Total Value of All Types of Buildings	Assumption	JICA Study Team	JKR(HQ)		P
		r_1:	Rate of Being Involved by Slope Failure	Already calculated in D_3					P
		r_2:	Rate of Damages of All Buildings by Possible Quantity of Fallen Materials Outside Road and by Type of Slope Failure		Assumption	JICA Study Team	JKR(HQ)		P
D_5	Damages for Agricultural Products								
	1. Method-1: If there are available data within the area of two times of toe of height of slope								
	$TVp \times RIA$	TVp:	Potential Total Value of Agricultural Products to be Damaged						
		RIA:	Rate of Influenced Area to Total Agricultural Area						
		Cv_k:	Value by Kinds of Crops	(1) Area by Kinds of Crops	Slope Inspection Sheet			R	
	$Tvp = \sum_{i}^{n} (Cv_i \times dr_i)$			(2) Productivity by Kinds of Crops(Yield) : Ton/ha	Food Crops:Dept. of Agriculture Industrial Crops: FELDA	JICA Study Team	JKR(District Office)	R	
				(3) Farmgate Price (Gross Income) per Ton By Kinds of Crops(RM/ton)				R	
				(4) Production Cost Per Ton(RM/ton)				R	
				(5) Net Income by Kinds of Crops (RM/ton)				R	
		dr_i:	Damage Rate by Kinds of Crops		Assumption	JICA Study Team	JKR(HQ)		P
	$RIA=IA/TA$	IA:	Influenced Area (Possible Quantity of Fallen Materials to give Damage on Agricultural Area=Q')	Already calculated in D_3					
		TA:	Total Agricultural Area		Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	

A.Table 5.3.1(7) Formulas of Calculation for Benefits/Cost and Input Data Sources

Contents of Damages (Benefits) & Formulas	Variables	Explanation of Variables	*Necessary Data (Inc. Processed& Assumed Variables)*	Data Source	Responsibility of Data Collection and Management		Character of Data(Variables)	
					Case Study (East-West Highways)	All Routes (JKR)	Raw Data (R)	To Be Processed/ Assumed/
2. Method-2: If there are no available data within the area of two times of toe of height of slope								
$TVp \times RIA \times dr_i$	TVp:	Potential Total Value of Agricultural Product to be Damaged	Roughly Estimated Total Value of All Types of Holdings	Assumption	JICA Study Team	JKR(HQ)		P
	RIA:	Rate of Influenced Area to Total Agricultural Area						
	dr_i:	Damage Rate by Kinds of Crops		Assumption	JICA Study Team	JKR(HQ)		P
$RIA=IA/TA$	IA:	Influenced Area (Possible Quantity of Failed Materials to give Damage on Agricultural Issue(Q'))	Already calculated in D_1					
	TA:	Total Agricultural Area	Total Agricultural Area	Assumption	JICA Study Team	JKR(District Office)		P
			Existence of Cash Crops (If there are "Padi-bur, Oil Palm, Coconut, Wet Paddy (1, or 0)	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
D_2	**Damages for Recovery Works**							
$D_2 = Q \times (a + r)$	a:	Unit Cost for Removal of Failed Materials (RM/m³)		Assumption	JKR (JICA Study Team)	JKR(HQ)		P
	r:	Unit Cost for Transport (Temporary) Repair of Failed Mud and Debris (RM/m³)		Assumption	JKR (JICA Study Team)	JKR(HQ)		P
	Q :	Total Possible Quantity of Failed Materials(m³)	Total Possible Quantity of Failed Materials(m³)	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
2 Indirect Damages								
D_{2-1}	**Damages by Alternative Roads**							
$D_{2-1} = T \times \sum_{i=1}^{n} D_{2-1}^{i}$	T:	Period During Road Closure(day)	Already calculated in D_2					
	i:	Type of Vehicle	Type of Vehicle	Survey Report of Traffic Volume by EPU	JICA Study Team	JKR(HQ)	R	
	n:	No. of Vehicle Type	No. of Vehicle Type	Survey Report of Traffic Volume by EPU	JICA Study Team	JKR(HQ)	R	
	D_{2-1}^{i}:	Damages by Alternative Roads per Day by Vehicle Type						
$T=(Q \times a)/q + T_0$	a :	Ratio of Quantity of Failed Materials to be Removed to Recover from Traffic Blocking to the Total Quantity of Failed Mud and Debris		Assumption	JICA Study Team	JKR(HQ)		P
	q:	Quantity of Failed Materials to be Removed Per Day(m³) (0.5hr/day)		Assumption	JKR(JICA Study Team)	JKR(HQ)		P

A.Table 5.3.1(8) Formulas of Calculation for Benefits/Cost and Input Data Sources

Contents of Damages (Benefits) & Formulas	Variables	Explanation of Variables	*Necessary Data (Inc. Processed& Assumed Variables)*	Data Source	Responsibility of Data Collection and Management		Character of Data(Variables)	
					Case Study (East-West Highways)	All Routes (JKR)	Raw Data (R)	To Be Processed/ Assumed/ Forecast (F)
	T_0 :	The Time for Preparation for Recovery Work (2-Hours 0.08-0.33day)		Assumption	JICA Study Team	JKR(HQ)		P
$\alpha_{1-4} = (TV_0^1 + TV_1^1)/2 \times (c_1^1 - c_0^1)$	TV_0^1 :	Sectional Traffic Volume in the Normal Condition by Vehicle Type Existing Roads(Vehicle/Day)	Sectional Traffic Volume in the Normal Condition by Vehicle Type: Existing Roads(Vehicle/Day)	Survey Report of Traffic Volume by EPU	JICA Study Team	JKR(HQ)	R	
	TV_1^1 :	Sectional Traffic Volume in the Occurrence of Disaster by Vehicle Type Alternative Roads(Vehicle/Day)	Sectional Traffic Volume in the Occurrence of Disaster by Vehicle Type: Alternative Roads(Vehicle/Day)	To be calculated	JICA Study Team	JKR(HQ)	R	
	c_0^1 :	Generalized Transport Cost in the Normal Condition by Vehicle Type (RM/vehicle)		To be calculated	JICA Study Team	JKR(HQ)		P
	c_1^1 :	Generalized Transport Cost in the Occurrence of Disaster by Vehicle Type (RM/vehicle)		To be calculated	JICA Study Team	JKR(HQ)		P
$TV_1^1 = (1.0 - \lambda) \times TV_0^1$	λ :	Ratio of Going Up Travel(Transport) in the Occurrence of Disaster		Assumption	JICA Study Team	JKR(HQ)		P
$C_0^1 = TT_0^1 \times \alpha^1 + TD_0 \times \beta^1$	TT_0^1 :	Travel Time in the Normal Condition by Vehicle Type(hr/unit) for the existing roads		To be calculated	JICA Study Team	JKR(HQ)		P
	TD_0 :	Travel Distance in the Normal Condition (km) for the existing roads		To be calculated	JICA Study Team	JKR(HQ)		P
	α^1 :	Unit Time Value by Vehicle Type (RM/Vehicle-Minutes)	1. Sectional Traffic Volume by Vehicle Type		JICA Study Team			
			(1) Present(2002)	Survey Report of Traffic Volume by EPU (1998)			R	
				* The Traffic volume in 2002 will be forecast	JICA Study Team	JKR(HQ)		P
			2. Future(2003)	To be Forecast	JICA Study Team	JKR(HQ)		
			a. Average Growth Rate of Traffic Volume	Survey Report of Traffic Volume by EPU (past ten years)	JICA Study Team	JKR(HQ)	R	
			b. Average Growth Rate of ONI(GDP)	Dept. of National Statistics (If new value will be forecast)	JICA Study Team	JKR(HQ)	R	
			(2) Capacity (Passenger-Ton) by Vehicle Type	Survey Report of Traffic Volume by EPU	JICA Study Team	JKR(HQ)	R	
			(3) Average Loading Factor by Vehicle Type	Assumption	JICA Study Team	JKR(HQ)		P
			(4) Unit of Time Value	To be calculated	JICA Study Team	JKR(HQ)		P
			a. Passenger: Income/Work-Passenger					

A.Table 5.3.1(9) Formulas of Calculation for Benefits/Cost and Input Data Sources

Contents of Damages (Benefits) & Formulas		Variables	Explanation of Variables	Necessary Data (Inc. Processed&Assumed Variables)	Data Source	Responsibility of Data Collection and Management		Character of Data(Variables)	
						Case-Study (East-West Highways)	All Routes (JKR)	Raw Data (R)	To Be Processed/ Assumed/ Forecast (P)
				(a) Per Capita National Income	Dept. of National Statistics (Latest value will be forecast)	JICA Study Team		R	
				(b) Working Hours	To be calculated	JICA Study Team			P
				c. Freight : Interest Rate /Day					
				(d) Average Interest Rate of Deposit in Bank	Major Banks	JICA Study Team	JKR(HQ)	R	
		β^t	Unit Vehicle Operating Cost by Vehicle Type(RM/Vehicle-km)		JKR(HQ)	JICA Study Team	JKR(HQ)		P
	$C_1^t = TT_1^t \times \alpha^t + TD_1 \times \beta^t$	TT_1^t :	Travel Time in the Occurrence of Disaster by Vehicle Type(minute) for Alternative Roads		To be calculated	JICA Study Team	JKR(HQ)		P
		TD_1 :	Travel Distance in the Occurrence of Disaster(km) for Alternative Roads		To be calculated	JICA Study Team	JKR(HQ)		P
				1 Score of Loss q% of Alternative Roads (1 to 5)	Slope Inspection Sheet	JICA Study Team	JKR(HQ)	R	
				2. Probability of Alternative Routes (Year-1);Pa/Q (If Score of Inspection Sheet for Alternative Routes=1, the Figure is always "1")	Assumption	JICA Study Team	JKR(HQ)	R	
D_{2-2}	**Damages for Construction of By-Pass**								
	$D_{2-2}=Lbp \times b$	Lbp:	Length of By-Pass(s) (30km/section)		Assumption	JKR(JICA Study Team)	JKR(HQ)		P
		b:	Construction Cost of By-Pass (RM/km)	1.Construction Cost of By-Pass (RM/km)	JKR	JKR(JICA Study Team)	JKR(HQ)	R	
D_{2-3}	**Damages in Case of No Alternative Roads and No. Construction of By-Pass**								
	(Damages by Road Closure)	TV_1^t :	Sectional Traffic Volume in the Occurrence of Disaster by Vehicle Type Alternative Roads(Vehicle/Day)	Already calculated in D_{2-2}					P
	$T \times 16 \times 0.6 \times \sum_{t=1}^{3} (TT_1^t \times \alpha^t)$	α^t :	Unit Time Value by Vehicle Type(RM/vehicle-Minutes)	Already calculated in D_{2-2}					P
		T:	Period Road Closure(days)	Already calculated in D_{2-2}					P
D_3	**Damages for Business Income and Others**								
	$D_3 = (\sum_{i=1}^{2} D_i) \times \omega$	ω :	Ratio to Total Damages of (D_2, D_3) [This formula will be reviewed later]		Assumption	JICA Study Team	JKR(HQ)		P
Annual Average Damages(Benefits)									
	$AB=Rp \times TD$	AB:	Annual Average Benefit						
	$Rp=1/Yosf$	Rp:	Return Period of Slope Failure		To be calculated	JICA Study Team	JKR(HQ)		P
		TD:	Total Damages (D_1-D_3)		To be calculated	JICA Study Team	JKR(HQ)		P

A.Table 5.3.1(10) Formulas of Calculation for Benefits/Cost and Input Data Sources

Contents of Damages (Benefits) & Formulas		Variables	Explanation of Variables	Necessary Data (Inc. Processed&Assumed Variables)	Data Source	Responsibility of Data Collection and Management		Character of Data(Variables)	
						Case-Study (East-West Highways)	All Routes (JKR)	Raw Data (R)	To Be Processed/ Assumed/ Forecast (P)
		$Yosf$:	Year of Occurrence of Slope Failure	1. Probability of Occurrence of Slope Failure	To be calculated	JICA Study Team	JKR(District Office)	R	
				2. Total Scores for Risk Rating	Slope Inspection Sheet	JICA Study Team	JKR(District Office)	R	
Conversion of Financial Countermeasure Cost to Economic Cost									
	Methodology: A								
	(1) Fc=FMc+FLc	Fc:	Financial Cost	Financial Cost	Slope Inspection Sheet	JICA Study Team	JKR(HQ&District Office)	R	
		FMc:	Financial Materials Cost						
	a.FMc=Fc x mc	FLc:	Financial Labor Cost						
	b.FLc=Fc x lc	mc:	Rate of Materials Cost		Assumption	JKR(JICA Study Team)	JKR(HQ)		P
		lc:	Rate of Labor Cost		Assumption	JKR(JICA Study Team)	JKR(HQ)		P
	(2) Ec=EMc+ELc	Ec:	Economic Cost						
		EMc:	Economic Materials Cost						
		ELc:	Economic Labor Cost						
	a.EMc=[FMc x (1-((tax)/100)] x scf	tax:	Tax (%)		Assumption(Ministry of Finance)	JKR(JICA Study Team)	JKR(HQ)		P
		scf:	Standard Conversion Factor		Assumption	JKR(JICA Study Team)	JKR(HQ)		P
	b.ELc =FLc x[(ru x cu)+(1-ru)x1]	ru:	Rate of Unskilled Labor Cost		Assumption	JKR(JICA Study Team)	JKR(HQ)		P
		cu:	Conversion Factor for Unskilled Labor Cost		Assumption	JKR(JICA Study Team)	JKR(HQ)		P
	Methodology: B *[Simplified Conversion]* *Ec=Fc x acf*								
	acf= [mc x (1-(tax)/100) x scf +lc x[(ru x cu)+(1-ru)x1]	acf:	Average Conversion Factor		To be calculated	JICA Study Team	JKR(HQ)		P

A.Table 5.3.2(1) Socio-Economic Input Data Including Assumed Data of Economic Analysis for the East-West Highways (Case-Study Route)

No.	Name of Data	Assumed Data	Related Benefit and Cost
I	Economic Bednefit		
1	Transport Capacity by Vehicle Type(passenger/vehicle)	See A.Table 5.3.2(3)	Damages for Human Bodies in Vehicle
2	Sectional Traffic Volume by Vehicle Type(Present:2002)	See A.Table 5.3.2(4)	
3	Average No. of Persons by Building Type	See A.Table 5.3.2(5)	
4	The Damages to Human Body by Quantity of Failed Mud and Debris	See A.Table 5.3.2(6) &(7)	
5	The Damages to Human Body by Possible Amounts of Failed Materials Outside of Road	See A.Table 5.3.2(8) &(9)	
6	Probability of Occurrence of Damages to Humanbody	See A.Table 5.3.2(10) &(11)	
7	Average Growth Rate of Traffic Volume	3.08%	
8	Average Growth Rate of GNI(GDP)	5.37%	
9	Sectional Traffic Volume by Vehicle Type(Future:2022)	See A.Table 5.3.2(4)	
10	Distance Until Stopping After Braking	40m	
11	Average Speed by Vehicle Type	40km/hour (11m/sec)	Damages for Human Bodies in Vehicle&Building & Damages by Alternative Roads
12	Unit Value of Damages of Injury by Type of Slope Failure(Present:2002)	15,000 RM(Light); 33000 RM(Serious)	
13	Unit Value of Damages of Injury by Type of Slope Failure(Future:2022)	36,000 RM(Light); 80,000 RM(Serious)	
14	Unit Value of Damages of Death by Type of Slope Failure(Present:2002)	506,000 RM	
15	Unit Value of Damages of Death by Type of Slope Failure(Future:2022)	1,220,000 RM	
16	Per Capita National Income(Present: : 2002)	14,452 RM	
17	Per Capita National Income(Future : :2022)	34,854 RM	
18	Average Life Span of Passenger	70 Year	Damages for Human Bodies in Vehicle
19	Average Year of Passenger	35 Year	
20	No. Persons in Building by Type of Building	See A.Table 5.3.2(5) &(11)	Damages for Human Bodies in Building
21	*No. of Lane in Average(both ways)*	2	
22	Road width of One Lane in Average	6m	
23	Price of Vehicle By Type	See A.Table 5.3.2(3)	Damages for Vehicle
24	Average Depreciation Rate by Vehicle Type		
24	The Rate of Value of Commodity by Passenger Vehicle Type		
25	Capacity of Tonnage by Type of Truck	See A.Table 5.3.2(12)	
25	Average Loading Factor by Vehicle Type	See A.Table 5.3.2(3) &(12)	
26	Damage Rate of Value per Vehicle by Failure Volume Outside Road and by Type of Slope Failure	See A.Table 5.3.2(13) &(14)	
27	Average Construction Cost per m^2 by Type of Building (Infrastructure)	See A.Table 5.3.2(15)	Damages for Assets of Buildings Alongside Roads
28	Average Depreciation Rate of Building		
29	Rate of Value of Movables to the Total Value of Building		
30	Rate of Damages of All Buildings by Quantity of Failed Materials Outside Road and by Type of Slope Failure	See A.Table 5.3.2(16) &(17)	
31	Roughly Estimated Total Value of All Types of Buildings	See A.Table 5.3.2(18)	

A.Table 5.3.2(2) Socio-Economic Input Data Including Assumed Data of Economic Analysis for the East-West Highways (Case-Study Route)

No.	Name of Data	Assumed Data	Related Benefit and Cost
32	Farmgate Price (Gross Income) per Ton By Kinds of Crops(RM/ton)	See A.Table 5.3.2(19)	Damages for Assets of Buildings Alongside Roads
33	Production Cost Per Ton(RM/ton)		
34	Net Income by Kinds of Crops (RM/ton)		
35	Damage Rate by Kinds of Crops	See A.Table 5.3.2(20)&(26)	
36	Average Yield of Agricultural Products	See A.Table 5.3.2(21)&(27)	
37	Unit Cost for Removal of Failed Materials (RM/m^3)	2 RM/m^3 for Cut Slope; 20 RM/m3	Damages for Recovery Works
38	Cost for Emergent (Temporary) Repair o(RM/m3)	2 Times of Countermeasure Cost	
39	Period During Road Closure	See A.Table 5.3.2(22)	Loss Time During Road Closure(Damages by Road Closure)
40	The Time for Preparation for Recovery Works	0.125days(3 hour)	
41	Ratio of Giving Up Travel(Transport) in the Occurrence of Disaster	0.2	
42	Unit Time Value by Vehicle Type(RM/vehicle·Minutes):2002	See A.Table 5.3.2(23)&(25)	Damages by Alternative Roads
43	Unit Time Value by Vehicle Type(RM/vehicle·Minutes):2022	See A.Table 5.3.2(26)	
44	Passenger: Income/Hour/Passenger:2002	7.3RM/hour/ passenger	
45	Passenger: Income/Hour/Passenger:2022	17.7RM/hour /passenger	
46	Working Hours	(365-14-52.14 x2) x 8 =1,974hours/Year	
47	Average Interest Rate of Deposit in Bank	4%/Year	
48	Unit Vehicle Operating Cost by Vehicle Type(RM/Vehicle·km)	See A.Table 5.3.2(27)	
49	Length of By-Pass	20m	Damages for Construction of By-Pass
	Construction Cost of By-Pass (RM/m)		
50	a. Cut Slope	200RM/m	
51	b. Embankment	2,000RM/m	
52	Ratio of Damages for Business Income to Total Damages	5%	Damages for Business Income and Others
53	Probability of Occurrence of Slope Failure(Return Period)	See A.Table 5.3.2(28)	Annual Average Damages(Benefits)
II	Economic Cost		
1	Rate of Materials Cost to the Total Cost	0.7	Cost of Materials
2	Rate of Labor Cost to the Total Cost	0.3	Cost of Labor
3	Standard Conversion Factor	0.997	Economic Cost of Materials
4	Rate of Unskilled Labor Cost to the Total Labor Cost	0.2	Cost of Unskilled Labor
5	Conversion Factor for Unskilled Labor Cost	0.75	Economic Cost of Unskilled Labor
6	Average Conversion Factor for Total Financial Cost	0.948	Total Economic Cost

A.Table 5.3.2(3) Average Passenger, Prices and Commodity Value by Vehicle Type

No.	Type of Vehicle	Capacity (Person/ Vehicle)	Average Loading Factor (%)	Average Passenger (Person/Vehicle)	Average Prices (New) (RM/Vehicle)	Average Rate of Depreciation	Average Prices (Actual) (RM/Vehicle) [A]	Average Commodity Value (RM/Vehicle) [B] *1)	Total Average Value (RM/Vehicle) [A]+[B]
Passeger Car									
1	Car & Taxi	4	50	2	60,000	0.5	30,000	3,528	33,528
2	Small Vans & Utilities	10	50	5	60,000	0.5	30,000	176,400	206,400
3	Buses	40	60	24	150,000	0.5	75,000	8,820	83,820
4	Motor Cycles	2	50	1	10,000	0.5	5,000	1,764	6,764
Freight Car(Truck)				0			0		
1	Small Van & Utilities	2	50	1	60,000	0.5	30,000	176,400	206,400
2	Medium Lorries	2	50	1	70,000	0.5	35,000	352,800	387,800
3	Heavy Lorries	2	50	1	120,000	0.5	60,000	882,000	942,000

Source : The Road Maintenance Unit of Road Branch , JKR

Note : 1. *1) Assumption for average commodity value,

(1) Passenger Car

- Car & Taxi : 1/50 of small vans and utilities
- Small Vans & : The same value to be used for estimation of time value
- Buses : 1/20 of small vans and utilities
- Motor Cycles : 1/100 of small vans and utilities

(2) Freight Cars(Truck)

- Small Van : The same value to be used for estimation of time value
- Medium Lorries : The same value to be used for estimation of time value
- Heavy Lorries : The same value to be used for estimation of time value

A.Table 5.3.2(4) Annual Average Daily Sectional Traffic Volume by Vehicle Type

Year	Passenger Car					Freight Car (Truck)				Total
	Car & Taxi	Small Vans & Utilities	Buses	Motor Cycles	Sub-Total	Small Vans & Utilities	Medium Lorries	Heavy Lorries	Sub-Total	
1998	805	93	37	232	1,166	93	198	144	435	1,601
2002	908	105	42	262	1,316	105	224	163	491	1,808
2022	1,666	192	76	480	2,415	192	411	299	902	3,316

A.Table 5.3.2(5) Average No. of Persons by Building Type

Type of Buiding	Average Person per Building (person/buiding)
Residential	3
Commercial	5
Factory	15
Hospital	20
School	100
Hotel	30

Note : The figures are tentative

A.Table 5.3.2(6) The Damages to Human Body by Failure Volume(1)

[Rock Fall & Rock Avalanche]

Quantity of Failed Materials Outside of Road (m^3)	Degree of Damages	Damages by Injury (RM/person)	Damages by Death (RM/person)
$Q \leq 0.25$	Slight Injury	15,000	0
$Q \leq 0.5$	Heavy Injury	33,000	0
$Q>0.5$	Death	33,000	505,821

Note : The values are the same as of Table 7-1&2

A.Table 5.3.2(7) The Damages to Human Body by Failure Volume(2)

[Another Type of Slope Failure: Collapse, Landslide, Debris Flow & Embankment Failure]

Quantity of Failed Materials Outside of Road (m^3)	Degree of Damages	Damages by Injury (RM/person)	Damages by Death (RM/person)
$Q \leq 50$	Slight Inhury	15,000	0
$Q \leq 100$	Heavy Injury	33,000	0
$Q>100$	Death	33,000	505,821

Note : The values for damages are the same as of rock fall and rock avalanche.

A.Table 5.3.2(8) The Damages to Human Body by Failure Volume Outside of Road(1)

[Rock Fall & Rock Avalanche]

Quantity of Failed Materials Outside of Road (m^3)	Degree of Damages	Damages by Injury (RM/person)	Damages by Death (RM/person)
$Q \leq 10$	Slight Injury	15,000	0
$Q \leq 50$	Heavy Injury	33,000	0
$Q> 50$	Death	33,000	505,821

Note : The values are the same as of Table 7-1&2

A.Table 5.3.2(9) The Damages to Human Body by Failure Volume Outside of Road(2)

[Another Type of Slope Failure: Collapse, Landslide, Debris Flow & Embankment Failure]

Quantity of Failed Materials Outside of Road (m^3)	Degree of Damages	Damages by Injury (RM/person)	Damages by Death (RM/person)
$Q \leq 100$	Slight Inhury	15,000	0
$Q \leq 500$	Heavy Injury	33,000	0
$Q> 500$	Death	33,000	505,821

Note : The values for damages are the same as of rock fall and rock avalanche.

A.Table 5.3.2(10) Probability of Occurrence of Damages to Humanbody

[Rock Fall & Rock Avalanche]

Quantity of Mud and Debris (m^3)	Degree of Damages	Damages by Injury (RM/person)	Damages by Death (RM/person)
$Q \leq 0.25$	Slight Injury	0.10	0.00
$Q \leq 0.5$	Heavy Injury	0.20	0.00
$Q> 0.5$	Death	0.72	0.04

Note : Probability is the same for the damages to human body ouside of roads but category must be used in Table 6

A.Table 5.3.2(11) Probability of Occurrence of Damages to Humanbody

[Another Type of Slope Failure: Collapse, Landslide, Debris Flow & Embankment Failure]

Quantity of Mud and Debris (m^3)	Degree of Damages	Damages by Injury (RM/person)	Damages by Death (RM/person)
$Q \leq 50$	Slight Inhury	0.10	0.00
$Q \leq 100$	Heavy Injury	0.20	0.00
$Q > 100$	Death	0.72	0.04

Note : Probability is the same for the damages to human body ouside of roads but category must be used in Table 7

A.Talbe 5.3.2(12) Capacity and Average Loading factor of Tonnage by Type of Truck

Type of Vehicle	Capacity (Ton/ Vehicle)	Average Loading Factor (%)	Average Tons (Ton/Vehicle)
Small Vans & Utilities	6	60	3.6
Medium Lorries	12	60	7.2
Heavy Lorries	30	60	18.0

A.Table 5.3.2(13) The Damage Rate of Value per Vehicle by Possible Quantity of Failed Materials

[Rock Fall & Rock Avalanche]

Quantity of Mud and Debris (m^3)	Degree of Damages	Damage Rate of Value (%)
$Q \leq 0.25$	Slight	20
$Q \leq 0.5$	Heavy	30
$Q > 0.5$	Very Heavy	80

A.Table 5.3.2(14) The Damage Rate of Value per Vehicle by Possible Quantity of Failed Materials

[Another Type of Slope Failure: Collapse, Landslide, Debris Flow & Embankment Failure]

Quantity of Mud and Debris (m^3)	Degree of Damages	Damage Rate of Value (%)
$Q \leq 50$	Slight	20
$Q \leq 100$	Heavy	30
$Q > 100$	Completely Broken	80

A.Table 5.3.2(15) Average Value of Building by Type

Type of Building	Constuction Cost (RM/m2)	Average Area of Building (m2)	Total Construction Cost (RM)	Average Depreciation Rate (%)	Average Value of Building (RM)	The Rate of Value of Movables to Value of Building	Average Value of Movables (RM)	Total Average Value of Building (RM)
	(B)	(C)	(C)'	(D)	(E)	(F)	(G)	(H)
			(B) x (C)'		(C)' x(D)/100		(E) x (F)	(E)+(G)
Residential	857	175	150,000	50	75,000	1.0	75,000	150,000
Commercial	1,250	200	250,000	50	125,000	1.5	187,500	312,500
Factory	1,250	400	500,000	50	250,000	2.0	500,000	750,000
Hospital	5,000	2,000	10,000,000	50	5,000,000	3.0	15,000,000	20,000,000
School	2,000	2,000	4,000,000	50	2,000,000	1.5	3,000,000	5,000,000
Hotel	6,667	3,000	20,000,000	50	10,000,000	3.0	30,000,000	40,000,000

Source : The Road Maintenance Unit of Road Branch, JKR

A.Table 5.3.2(16) The Damage Rate of All Types of Buildings by Quantity of Failed Materials Outside of Road

[Rock Fall & Rock Avalanche]

Quantity of Failed Materials Outside of Road (m^3)	Degree of Damages	Damage Rate of Value (%)
$Q' \leq 10$	Slight	20
$Q' \leq 50$	Heavy	50
$Q' > 50$	Very Heavy	100

A.Table 5.3.2(17) The Damage Rate of All Types of Buildings by Quantity of Failed Materials Outside of Road

[Another Type of Slope Failure: Collapse, Landslide, Debris Flow & Embankment Failure]

Quantity of Failed Materials Outside of Road (m^3)	Degree of Damages	Damage Rate of Value (%)
$Q' \leq 100$	Slight	20
$Q' \leq 500$	Heavy	50
$Q' > 500$	Very Heavy	100

A.Table 5.3.2(18) Total Value of All Types of Buildings

Assumed No. of Building (Residential)	5
No. of Persons	3
Average Value per Building	150,000
Total Values	750,000

Source : JICA Study Team

A.Table 5.3.2(19) Average Value of Agricultural Products by Crops

(Unit ; RM/ton)

Kinds of Crops	Farm Gate Price (Gross Income)	Product Costs	Net Income
Rubber	5,000	4,000	1,000
Oil Palm	6,000	5,000	1,000
Coconut	80,000	6,000	74,000
Wet Paddy	3,000	2,500	500
Others	6,000	4,500	1,500
Total	100,000	22,000	78,000

A.Table 5.3.2(20) Damage Rate by Crops

Kinds of Crops	Damage Rate (%)
Rubber	30
Oil Palm	30
Coconut	30
Wet Paddy	100
Others	60

A.Table 5.3.2(21) Average Yield of Agricultural Products

kg/ha	2,000
kg/m^2	0.2
RM/kg	1.5

A.Table 5.3.2(22) Relation between Failure Volume and Loss Time

Failure Volume (Q: M3)	Loss Time [hour (day)]
Q<200	6(0.25)
200<Q<5,000 M3	24(1.0)
Q>5,000 M3	48(2.0)

A.Table 5.3.2(23) Time Value By Type of Vehicle in the Normal Condition (Passenger):2002

No.	Type of Vehicle	Unit Time Value (RM/Hour/ Passenger)	Capacity (Person/Vehicle)	Average Loading Factor (%)	Average Passenger (Person/Vehicle)	Time Value per Vehicle : (RM/minute)
1	Car & Taxi	7.32	4	50	2	0.24
2	Small Vans & Utilities	7.32	10	50	5	0.61
3	Buses	7.32	40	60	24	2.93
4	Motor Cycles	7.32	2	50	1	0.12

A.Table 5.3.2(24) The Tonnages of Commodity by Type of Vehicle (Passenger) :2002

No. of Route	Name of Route	Type of Vehicle	Unit	Agricultural Production	Manufactured Food staffs	General Goods	Others	Total
		Composition of Commodity	%/vehicle	30	30	25	15	100
Federal Route 4	East-West Highway	Small Vans & Utilities	ton/vehicle	1.1	1.1	0.9	0.5	3.6
		Medium Lorries	ton/vehicle	2.2	2.2	1.8	1.1	7.2
		Heavy Lorries	ton/vehicle	5.4	5.4	4.5	2.7	18.0
		Total	ton/vehicle	8.6	8.6	7.2	4.3	28.8

A.Table 5.3.2(25) The Time Value of Commodity by Type of Vehicle : 2002

No. of Route	Name of Route	Type of Vehicle	Unit	Agricultural Production	Manufactured Food staffs	General Goods	Others	Total	*Time Value per Vehicle: (RM/minute)*
		Composition of Commodity	%/vehicle	30	30	25	15	100	
Federal Route 4	East-West Highway	Small Vans & Utilities	RM/vehicle	10,800	54,000	90,000	21,600	176,400	0.01
		Medium Lorries	RM/vehicle	21,600	108,000	180,000	43,200	352,800	0.03
		Heavy Lorries	RM/vehicle	54,000	270,000	450,000	108,000	882,000	0.07
		Total	RM/vehicle	86,400	432,000	720,000	172,800	1,411,200	0.11

Unit Time Value of Commodity: $\frac{\text{(Short Term Interest Rate per Annum)}}{(365X24)}$

= 0.04 /(8760)= 0.0000045662 (RM/Hour)

A.Table 5.3.2(26) Time Value By Type of Vehicle in the Normal Condition (Passenger) : 2022

No.	Type of Vehicle	Unit Time Value (RM/Hour/ Passenger)	Capacity (Person/Vehicle)	Average Loading Factor (%)	Average Passenger (Person/Vehicle)	Time Value per Vehicle : (RM/minute)
1	Car & Taxi	17.66	4	50	2	0.59
2	Small Vans & Utilities	17.66	10	50	5	1.47
3	Buses	17.66	40	60	24	7.06
4	Motor Cycles	17.66	2	50	1	0.29

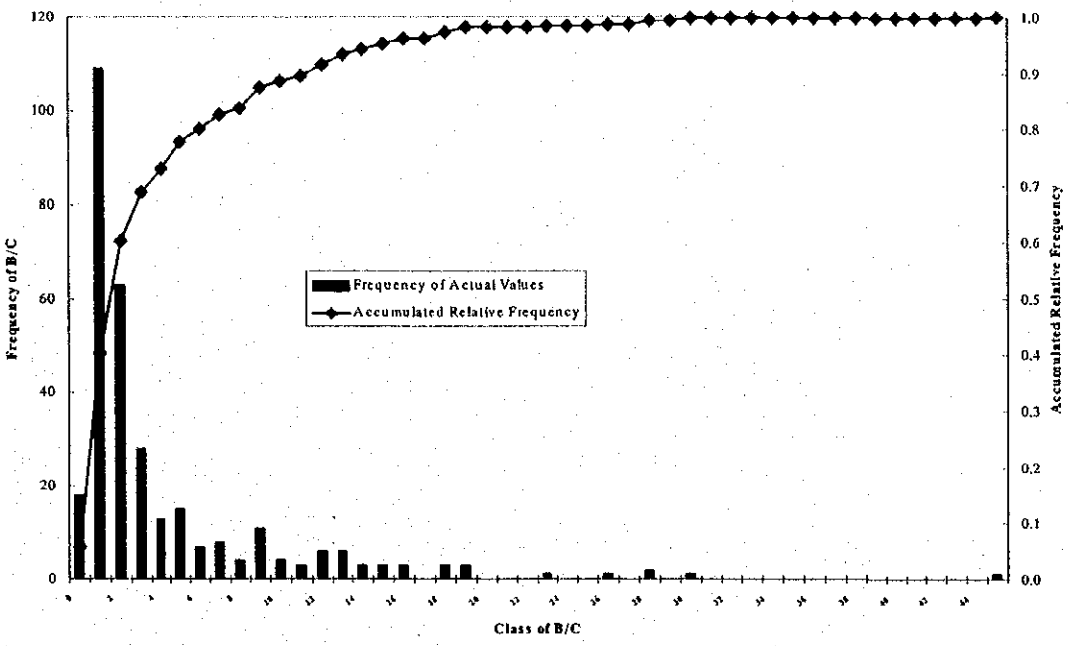
A.Table 5.3.2(27) Unit Vehicle Operating Cost in the Normal Condition by Vehicle Type(RM/Vehicle·km):

No.	Type of Vehicle	Speed: (km/hour)	Unit Operating Cost: (RM/Vehicle·km)
Passenger			
1	Car & Taxi	40	0.80
2	Small Vans & Utilities	40	0.40
3	Buses	40	2.00
4	Motor Cycles	40	0.20
Freight			
1	Small Vans & Utilities	40	0.40
3	Medium Lorries	40	1.00
4	Heavy Lorries	40	1.50

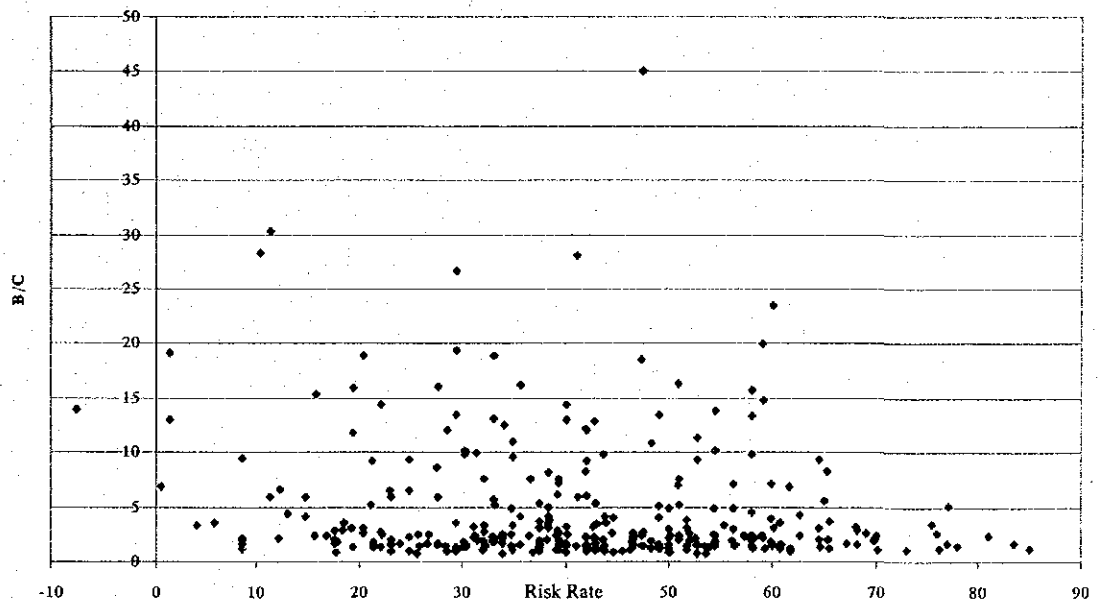
Note: The speed could be changed on the condition of roughness and pavement of road.

A.Table 5.3.2(28) Classification of Return Period of Slope by Risk Ranking

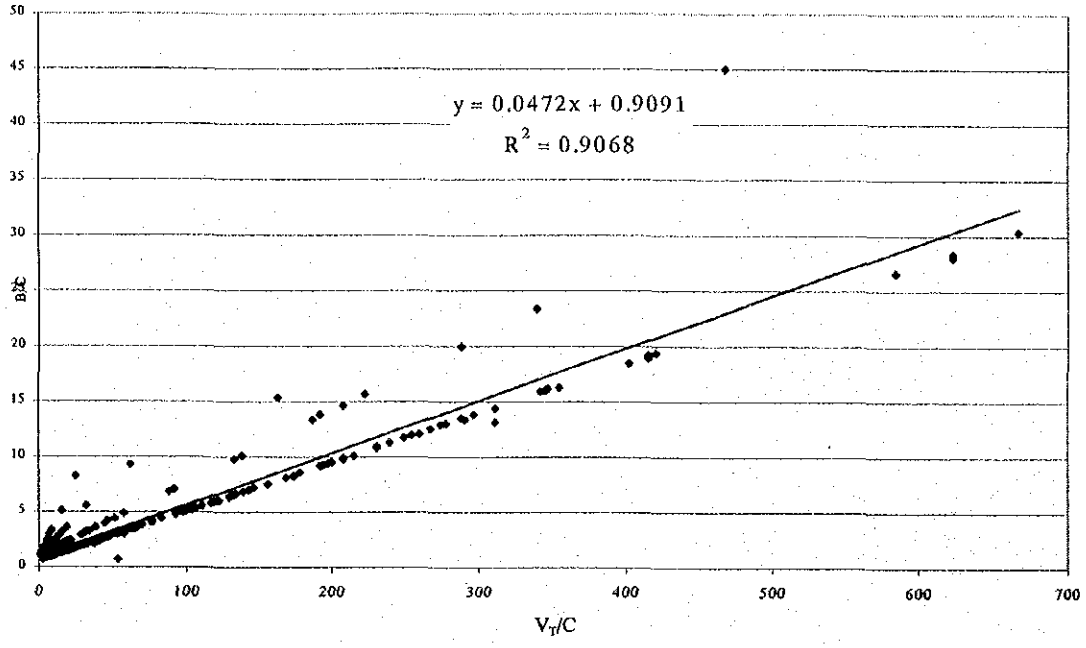
Classification of Score (S)	Risk Ranking	Probability of Occurrence Year
S<55	Low	30
$55 \leq S < 65$	Moderate	20
$65 \leq S < 75$	High	10
$75 \leq S$	Very High	5



A.Figure 5.3.4 Histgram of Frequncy of B/C by Class



A.Figure 5.3.5 Relation between Risk Rate and B/C



A.Figure 5.3.6 Relation between V_T/C and B/C

Appendix 6.1

Existing Organization and Human Resources

A.Table 6.1.1 Expected Functions for Road Maintenance & Slope Disaster Management for Federal Roads of Related Agencies (1)

Related Agencies	Expected Functions
Ministry of Finance	-Study and final approval for annual budget of road maintenance allocation submitted by JKR through MOW
Ministry of Works	-Intermediate control and approval of budget for road maintenance allocation submitted by the Road Maintenance Unit
Under Economic Planning Unit (EPU) and Prime Minister's Department	-Study and approval of project cost estimated submitted by JKR
Head Quarter of JKR (Road Maintenance Unit)	-Administration, management & controlling all the systems used by this section such as SPREES, SMS, MEHMS
	-Monitoring of federal roads maintenance & rehabilitation including slopes.
	-Controlling budget officer for road maintenance.
	-Preparation of slope mandatory inspection program.
	-Planning of implementation of slope repair countermeasure.
	- Monitoring of routine slope inspection conducted by the District offices
	- Preparation and execution of training program for slope inspection nationwide.
	- Risk management(Instruction of counter measures to the District and State Offices when the slope disaster happened)
	- Handling of complaints from road users
State Office (Road Maintenance Section)	(For Paved Federal Roads)
	- UPPJ (Road Maintenance Unit in each State) supevise the federal roads maintenance works to be implemented by three private contractors after privatisation.
State Office (Road Maintenance Section)	- Providing information for data base for the systems such as SPRS, SMS and MEHMS
	- Reporting to the State Offices with regard to information for monitoring of federal roads maintenance & rehabilitation including slopes.
	- Handling of state wide complaints from road users

Source : JICA Study Team & The Road Maintenance Unit

Note :Category of Degree of Sufficiency : A=80-100%; B=50-80%; C=less than 50%; D=Not be Expected

A.Table 6.1.1 Expected Functions for Road Maintenance & Slope Disaster Management for Federal Roads of Related Agencies (2)

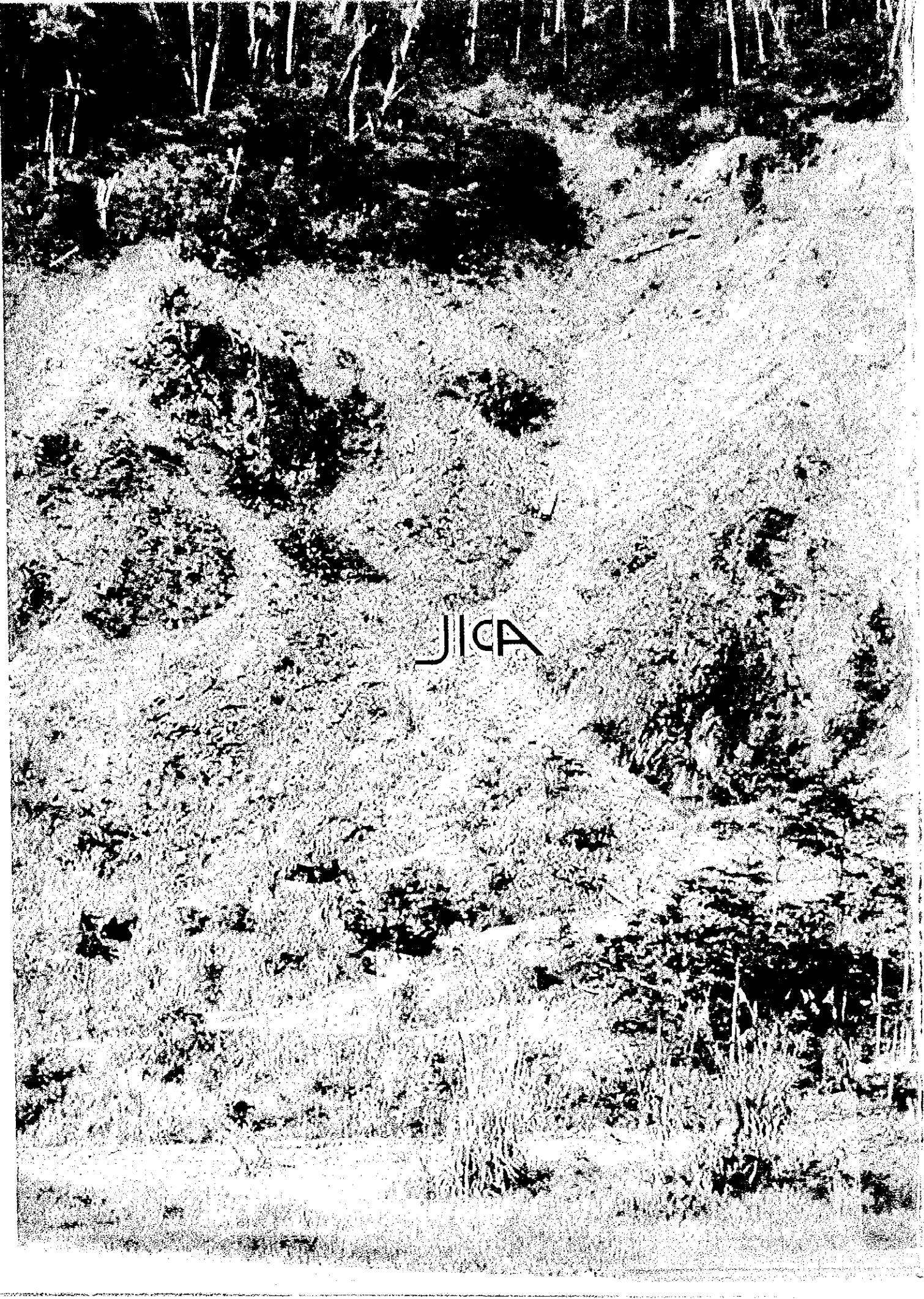
Related Agencies	Expected Functions
State Office (Road Maintenance Section)	- Supervising federal roads maintenance & rehabilitation including slopes to be conducted by the District Offices(Only for Unpaved Federal Roads of Peninsula Malaysia and all federal roads in Sabah&Sarawak and Labuan)
	- Monitoring the execution of risk management to be conducted by the District offices on the basis of diagnosis for disaster prevention with cooperation with the private contractors.
	- Coordinating and submitting to HQ the budget for road maintenance submitted by the District Offices
	- Monitoring or Supervising the mandatory (routine and periodical) slope inspection to be executed by the private contractor
	- Monitoring or Supervising implementation of counter measure works against slope failure to be executed by the private contractor
	- Risk management in emergency by cooperation with the District Officres (reporting the conditions of disaster to JKR, control of traffic, forming of rescue group) and private three companies for road maintenance..
	- Monitoring the recovery works from slope failure to be executed by private three contractors through their supervision by District Offices.
District Office (Road Maintenance Section)	(For Unpaved Federal Roads of Peninsula Malaysia and all federal roads in Sabah&Sarawak and Labuan)
	- Providing information for data base for the systems such as SPRS, SMS and MEHMS (SIMS to be proposed by JICA)
	- Reporting to State Offices with regard to information for monitoring of federal roads maintenance & rehabilitation including slopes.
	- Handling of district wide complaints from road users
	Federal roads maintenance & rehabilitation including slopes to be conducted by the District Offices(Only for Unpaved Federal Roads of Peninsula Malaysia and all federal roads in Sabah&Sarawak and Labuan)
	- Supervising the mandatory (routine and periodical) slope inspection by patrol on the basis of diagnosis for slope disaster prevention to be conducted mainly by the private contractors
	- Execution of risk management on the basis of diagnosis for disaster prevention with cooperation with the private contractors.
	- Submitting the budget to the State Offices with regard to maintenance cost including routine, recovery and countermeasure works
	- Implementation of counter measure works against slope failure to be executed by the private contractor
	- Risk management in emergency by cooperation with the State Officres(reporting the conditions of disaster to HQ, control of traffic, forming of rescue group) and private three companies for road maintenance
	- Supervising the recovery works from slope failure to be executed by private three contractors

Source : JICA Study Team & The Road Maintenance Unit

A.Table 6.1.1 Expected Functions for Road Maintenance & Slope Disaster Management for Federal Roads of Related Agencies (3)

Related Agencies	Expected Functions
Private Consultants	- Soil investigation and design for countermeasures of failed slope
	- Detailed Inspection for slope disaster prevention by Geologist of Geotechnical Engineer (outsourced by JKR)
	- Integrated evaluation for necessity of counter measures and preparation of diagnosis for disaster prevention with cooperation of institute like IKRAM
	- Preparation of investigation report for slope disaster prevention
Private Contractors	(Three Contractors for Paved Federal Roads)
	- Implementation of routine and periodical road maintenance
	- Implementation of daily and periodical inspection for slope disaster prevention
	- Emergency Recovery works for failed slope
	- Implementation for counter measure works against slope failure
	(Other Contractors for Unpaved Federal Roads of Peninsula Malaysia and all federal roads in Sabah&Sarawak and Labuan)
	- Emergency recovery works for failed slope
	- Implementation of routine and periodical road maintenance
	- *Implementation of daily and periodical inspection for slope disaster prevention*
	- Recovery works from slope failure
	- Implementation for counter measure works against slope failure
Institute	- Integrated evaluation for necessity of counter measures and preparation of diagnosis for disaster prevention with cooperation of JKR(District, State and Head Quarter)
	- Execution of training and seminar
	- *Examination, certification and qualification test for slope disaster management*
Other Government Agencies	- Provision of meteorological information to JKR (Ministry of Meteorology)
	- Rescue works when the slope disaster happened
University/College	- Provision of basic engineering knowledge such as geology, environment, economics, engineer and so on
SMART (Special Malaysian Disaster Assistance and Rescue Team)	- Rescue works when the disaster happened
Local Volunteer Group	- Rescue works when the disaster happened

Source : JICA Study Team & The Road Maintenance Unit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