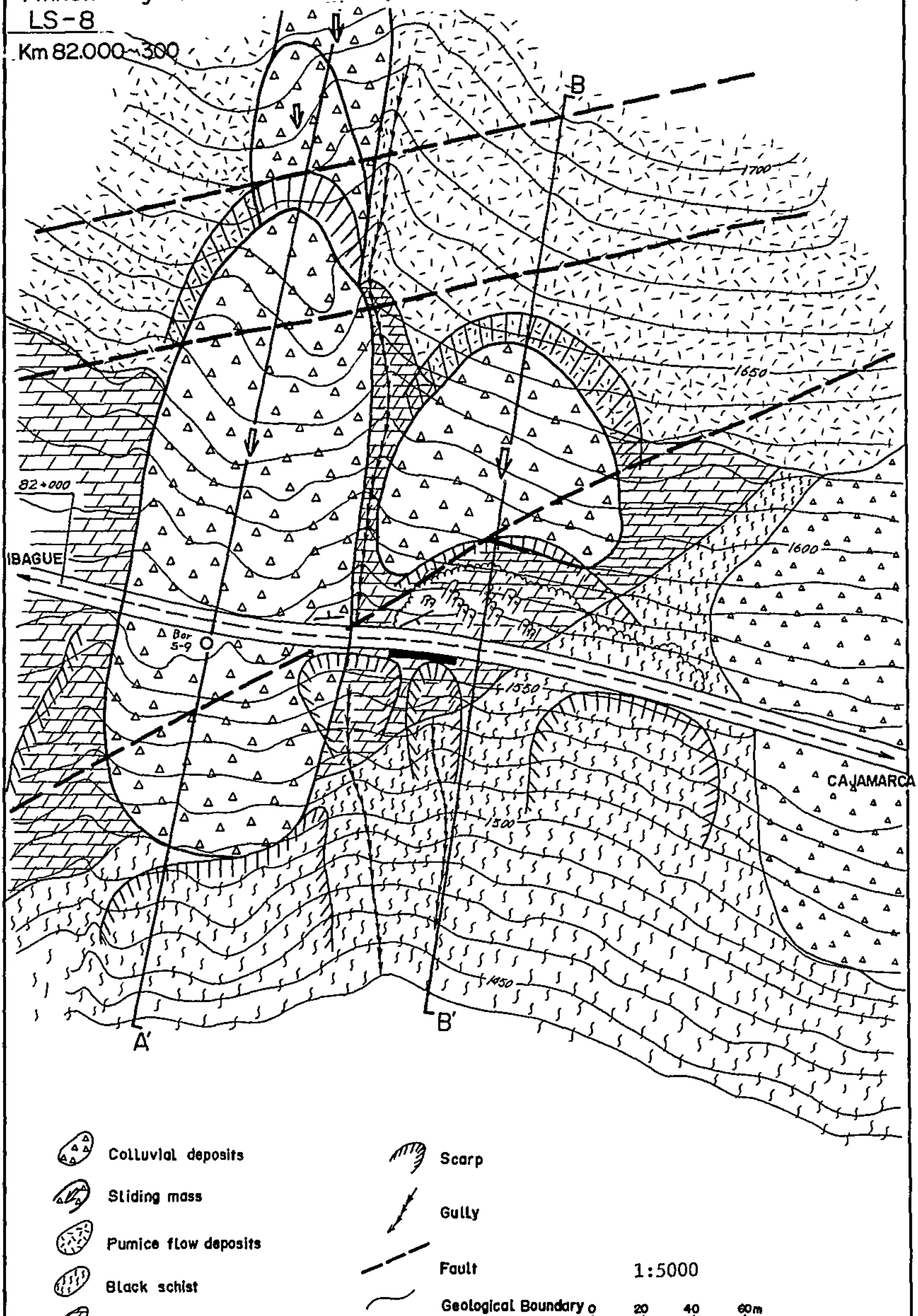
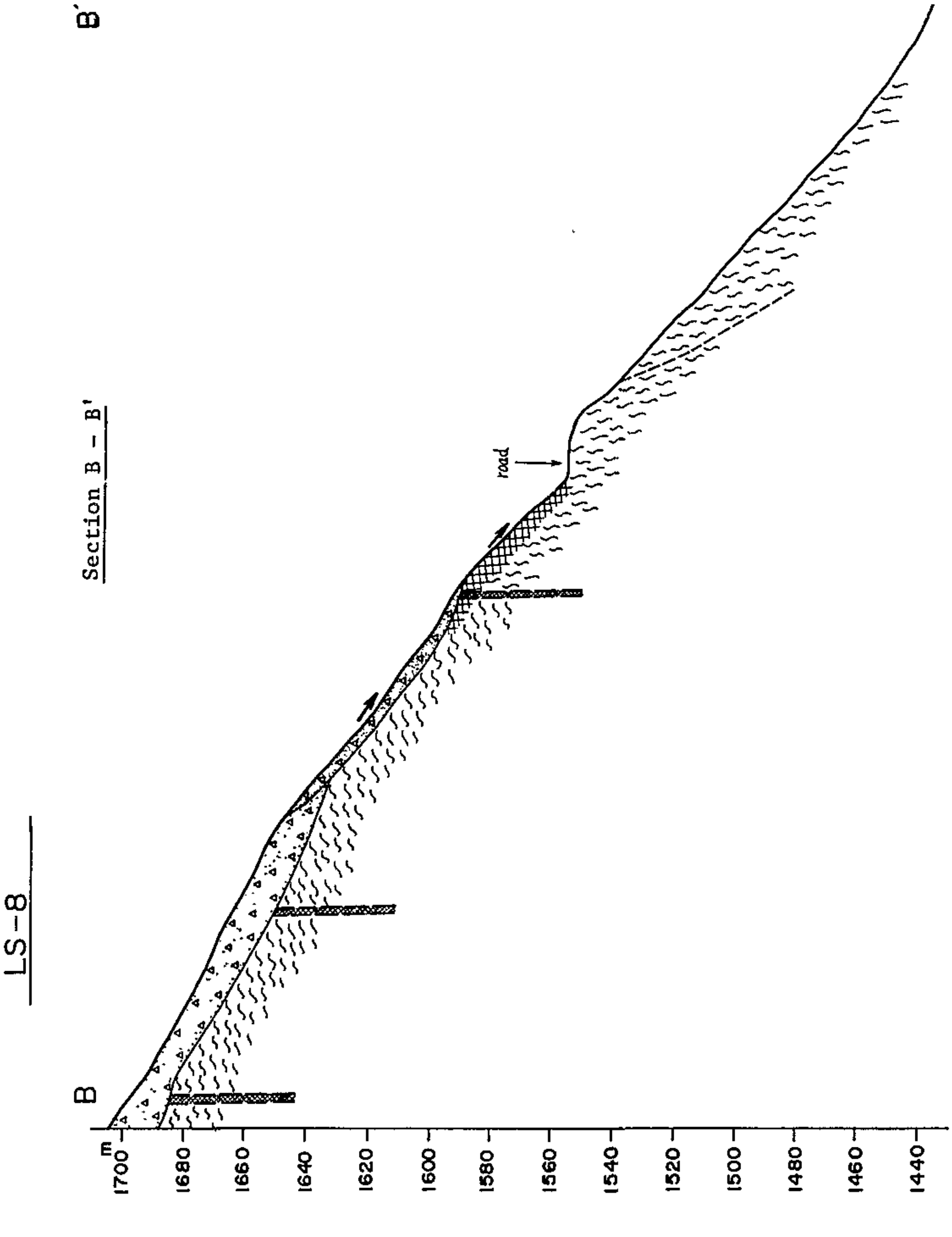
Annex Fig. 6-9 Plan & Cross Section of Critical Landslide Area (1)

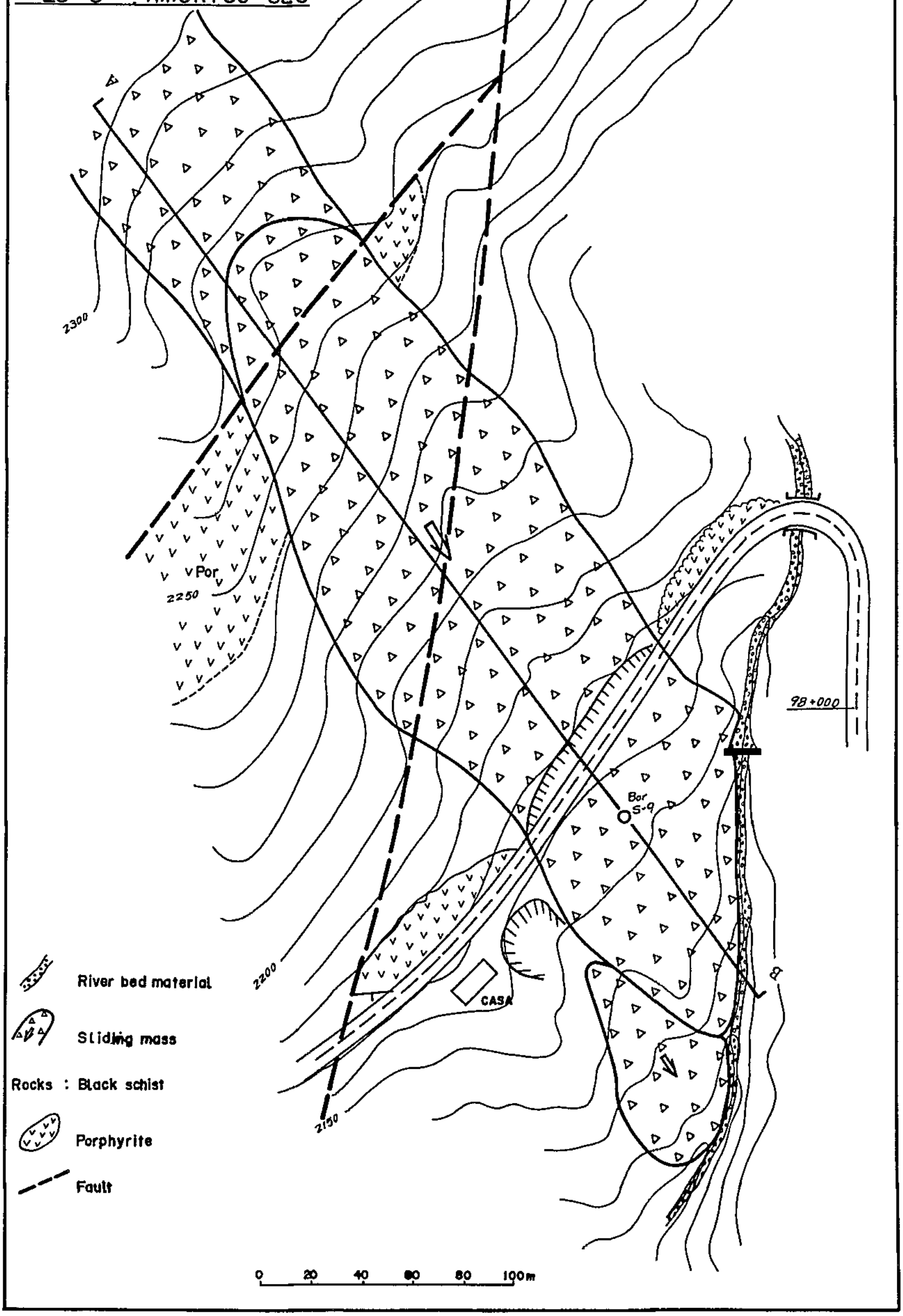


Annex Fig. 6-9 Plan & Cross Section of Critical Landslide Area

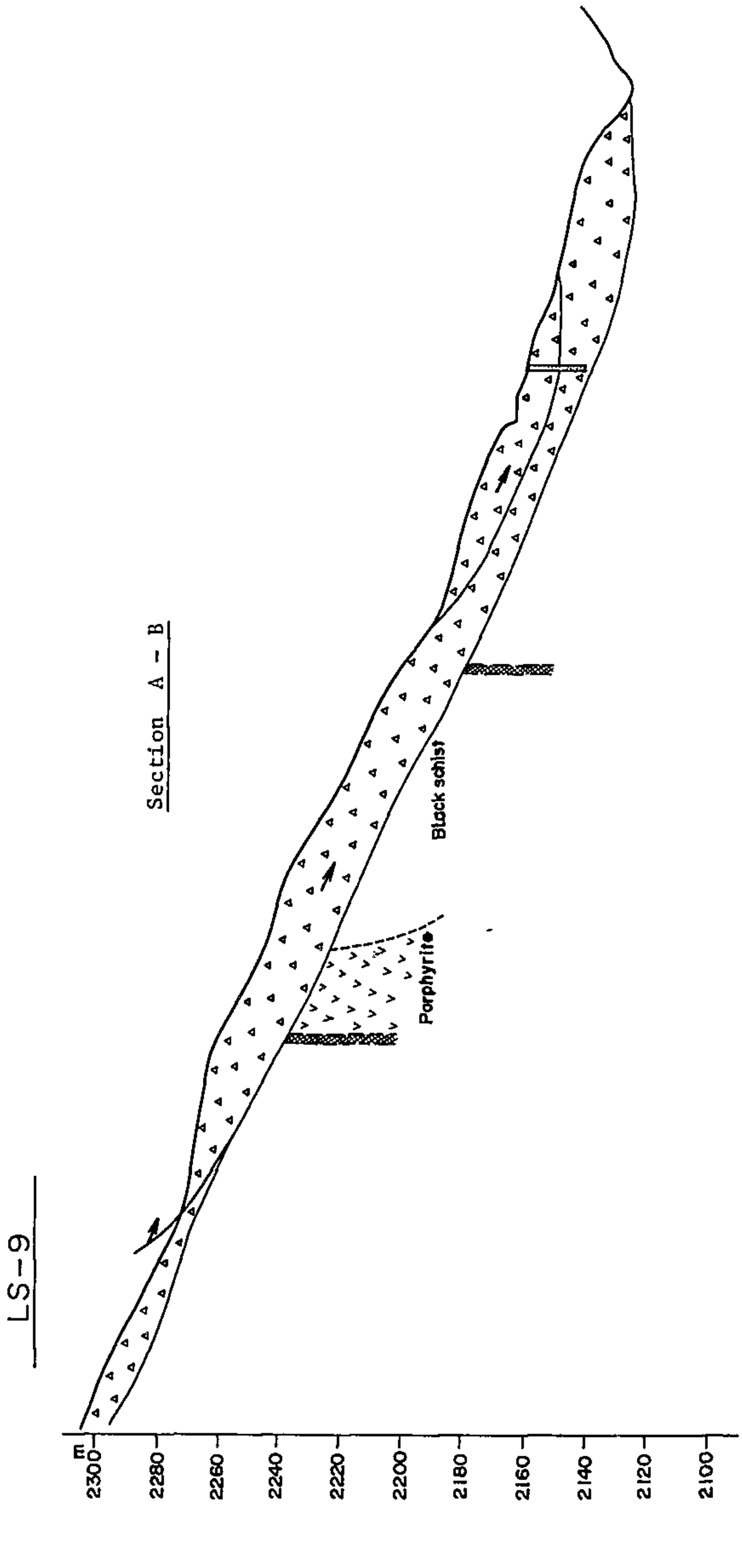


Annex Fig. 6-10 Plan & Cross Section of Critical Landslide Area

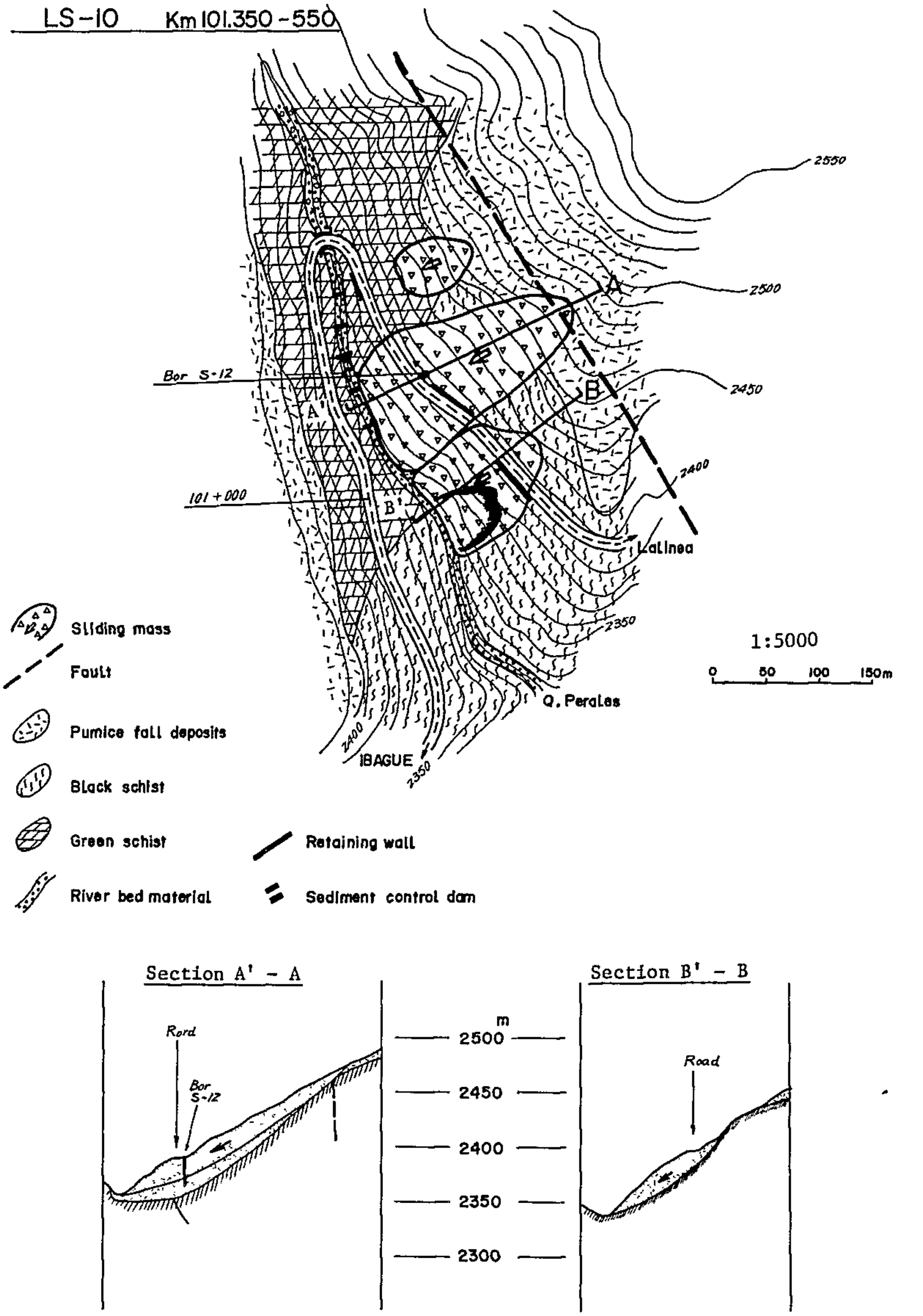
LS-9 Km97.730~820



Annex Fig. 6-10 Plan & Cross Section of Critical Landslide Area

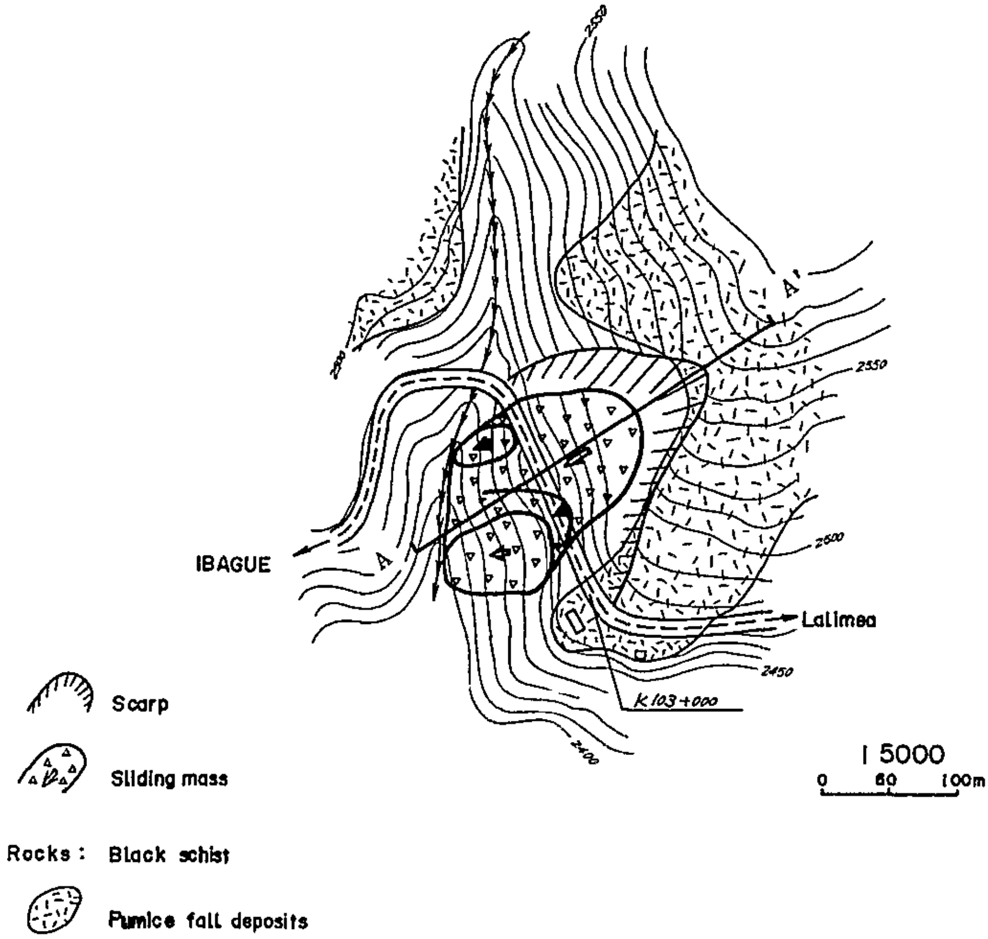


Annex Fig. 6 - 11 Plan & Cross Section of Critical Landslide Area

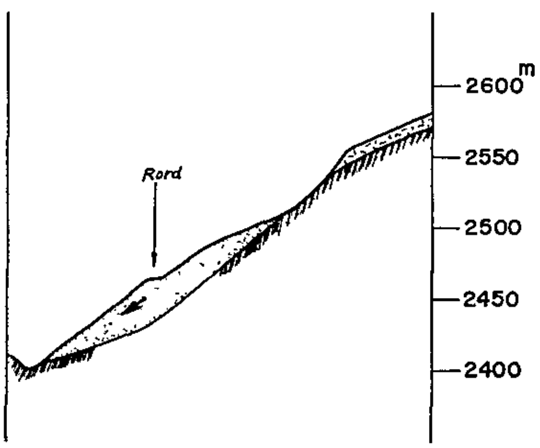


Annex Fig. 6 - 12 Plan & Cross Section of Critical Landslide Area

LS-11 Km 102.860 ~ 980

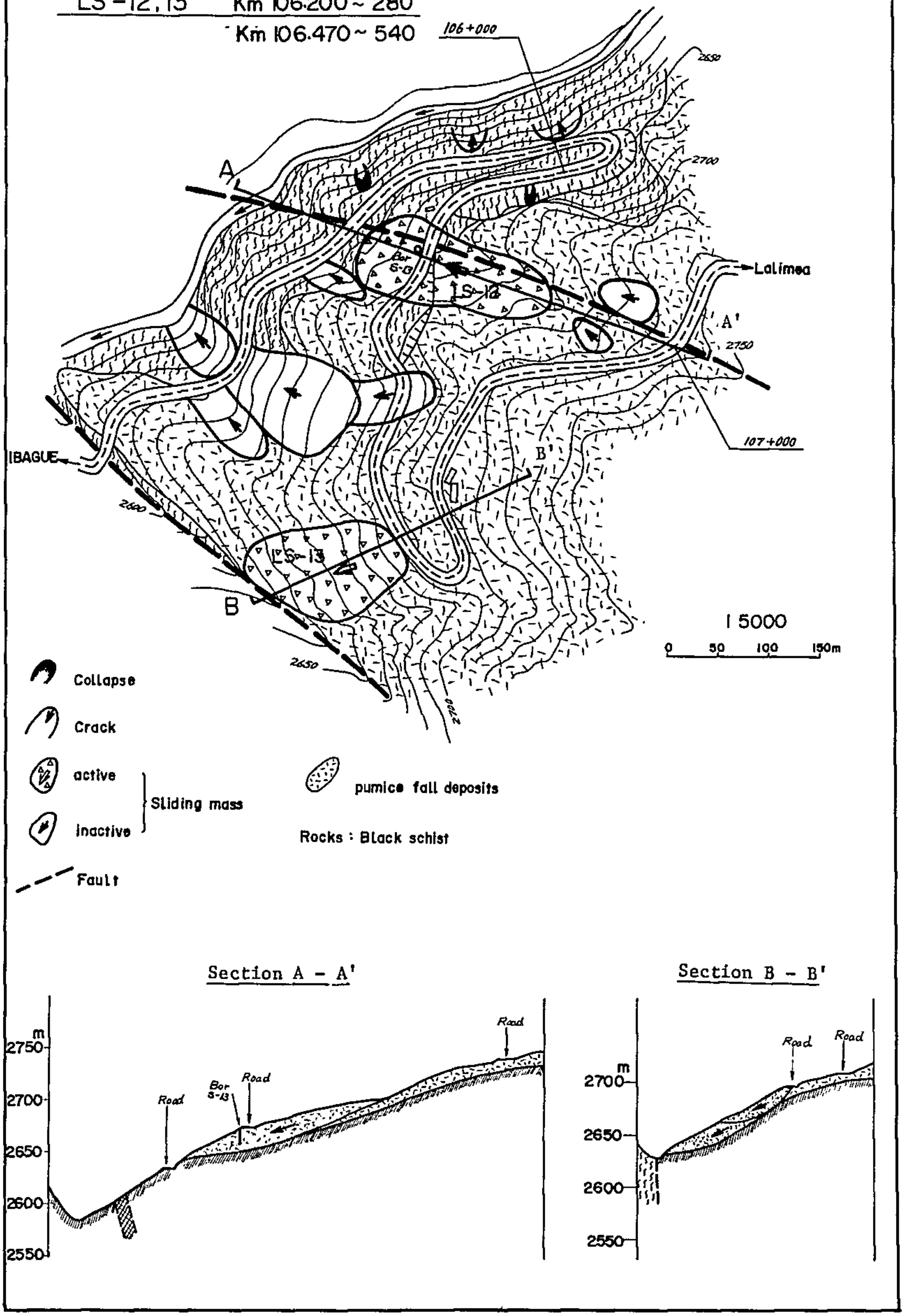


Section A - A'



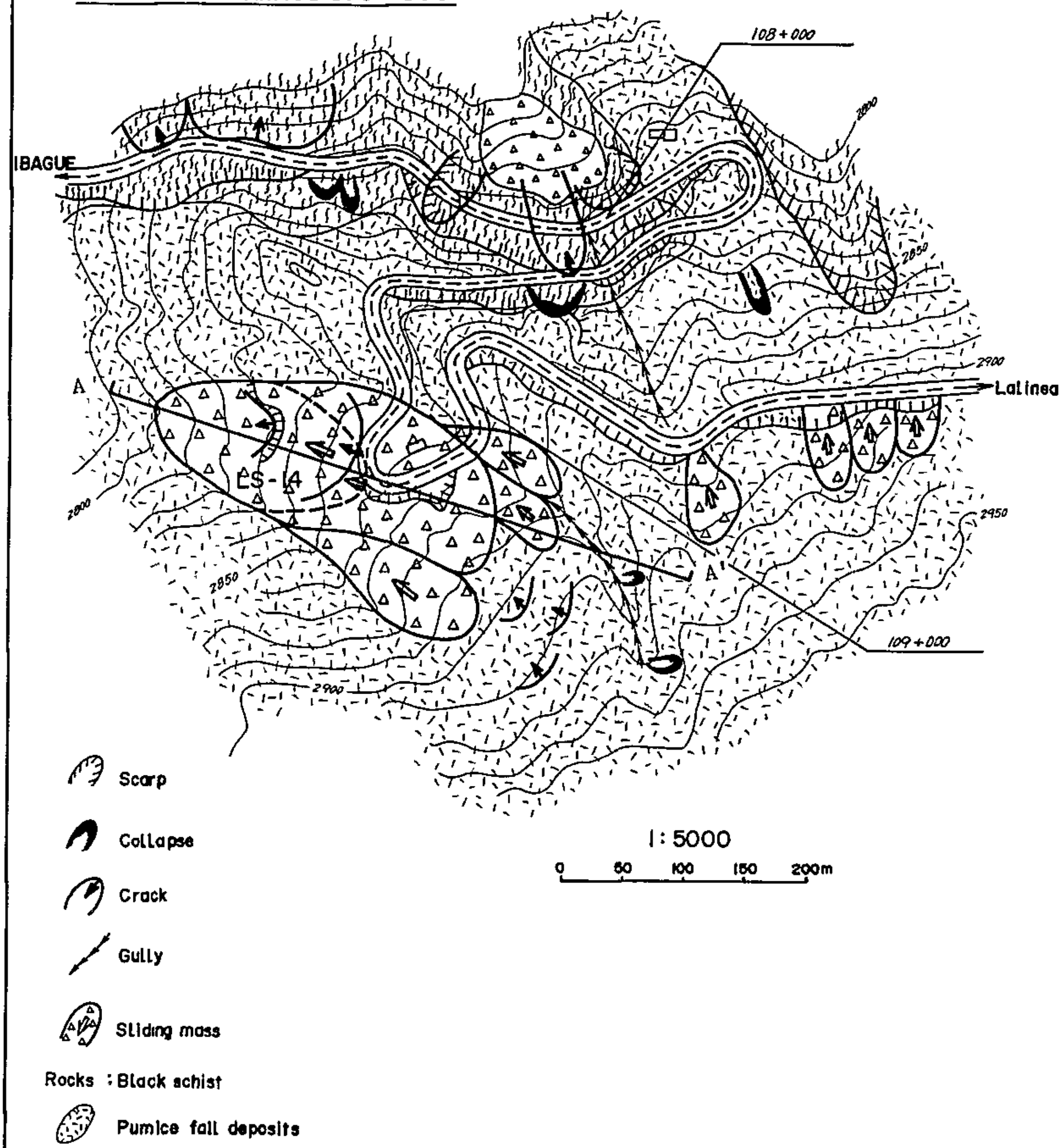
Annex Fig. 6 - 13 Plan & Cross Section of Critical Landslide Area

LS - 12, 13 Km 106.200 ~ 280
Km 106.470 ~ 540

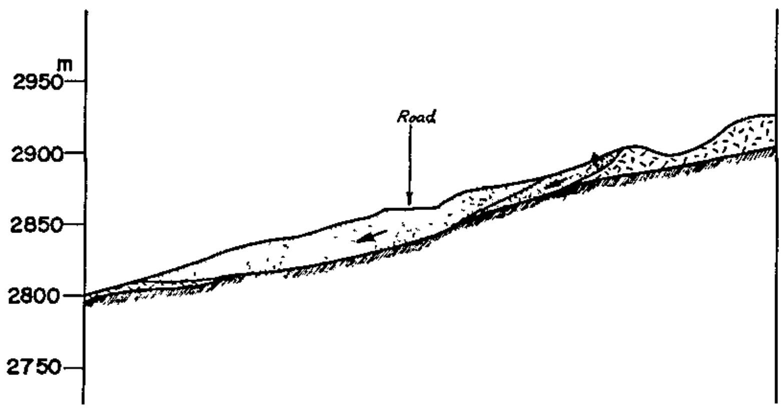


Annex Fig. 6 – 14 Plan & Cross Section of Critical Landslide Area

LS – 14 Km 108.570 ~ 800

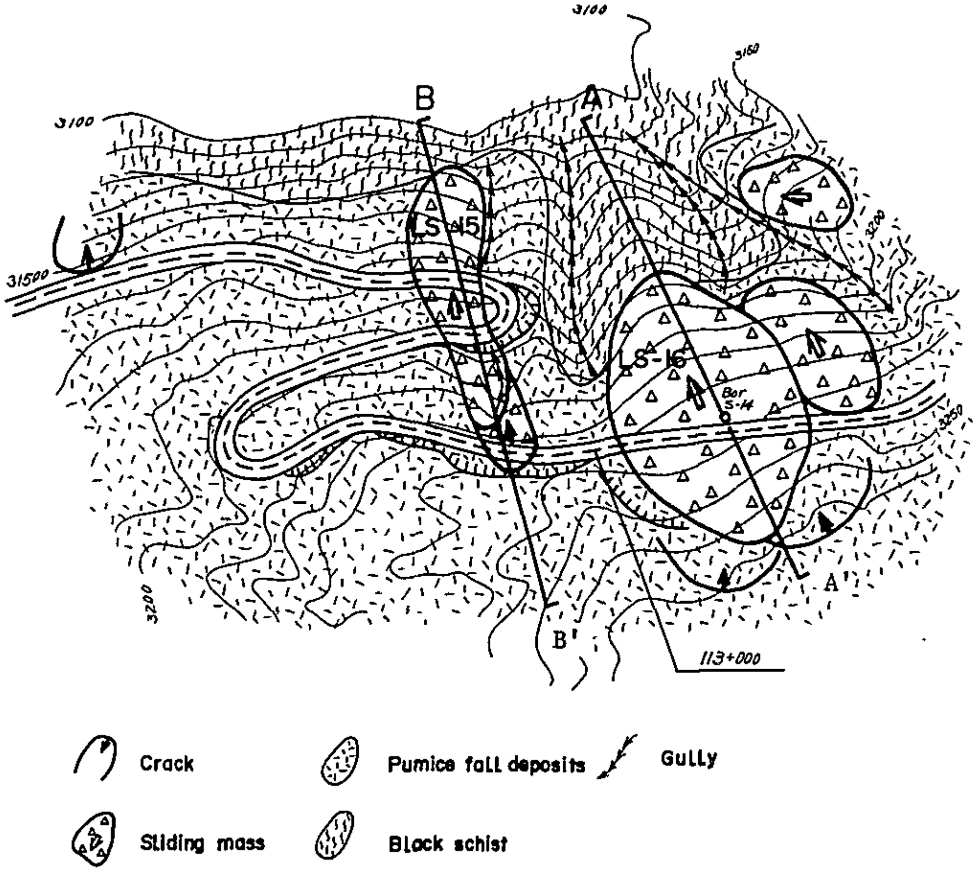


Section A – A'

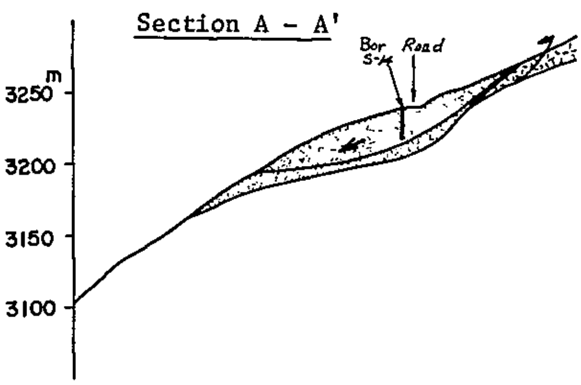


Annex Fig. 6 – 15 Plan & Cross Section of Critical Landslide Area

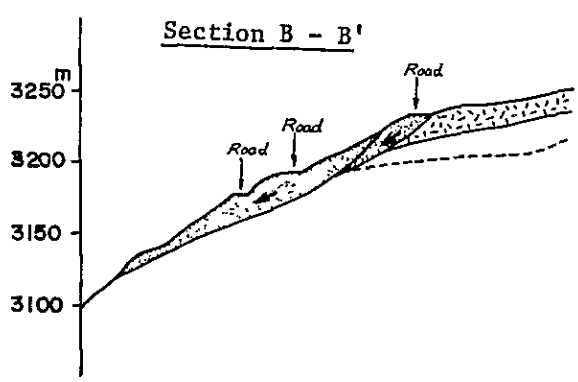
LS–15. 16 Km 112.340 ~ 520
Km 113.000 ~ 200



LS – 16

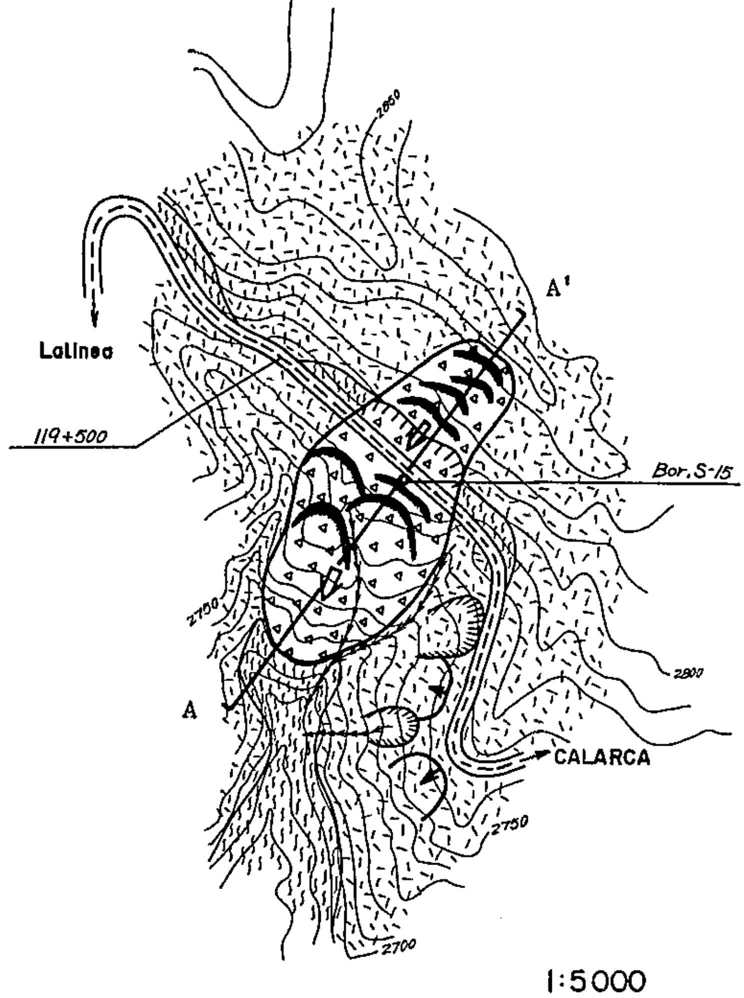


LS – 15

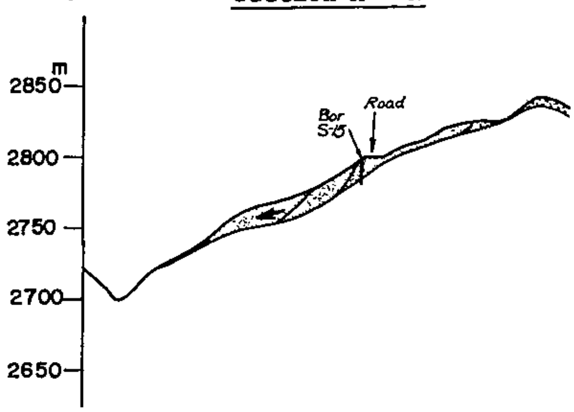


Annex Fig. 6 – 16 Plan & Cross Section of Critical Landslide Area

LS – 17 Km119.550 ~ 650



Section A – A'

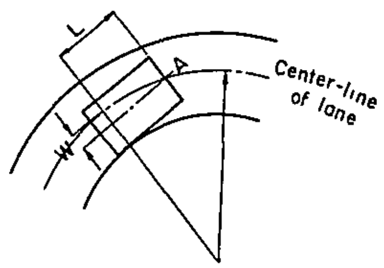


ANNEX 7

Annex 7-1. Widening of Road to Facilitate Passing of Large Vehicles at Curves

The width of the roadway is generally determined by adding an allowance to the maximum width of a vehicle (2.5 m). As illustrated in Annex Fig. 7-1, the front wheels and rear wheels of a vehicle travel different paths when going through a curve. Thus, the vehicle requires a wider roadway when turning a curve than when running straight.

When a vehicle passes along a curve, the widening is determined so as to provide the vehicle with the same margin on each side as when travelling straight based on assumption that the front center (point A) of the vehicle is always on the center line of the lane.



Annex Fig.7-1 Widening for Large-size Vehicles

7-1-1. Widening for Large-Size Truck

The widening for a large-size truck is calculated as follows.

R: Radius of curvature of the lane center line(turning radius of the front edge center of vehicle)

W: Widening

L: Distance from the front edge of vehicle to the rear wheel axle

From Annex Fig. 7-1, the following formula is established.

$$W = R - \sqrt{R^2 - L^2}$$

$$L^2 = 2RW - W^2$$

W^2 is negligibly small compared with 2RW.

Hence, the widening (W) is determined as follows.

$$W = L^2/2R$$

7-1-2. Widening for Semi-Trailers

From Annex Fig. 7-2 the widening necessary for the tractor is given by the following formula.

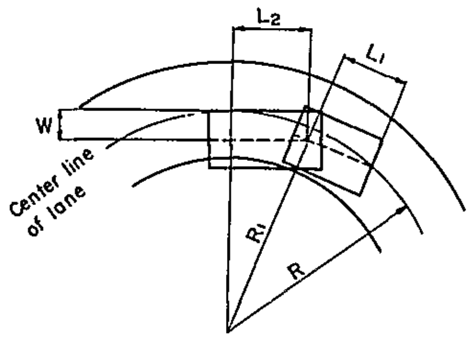
$$W_1 = L_1^2/2R$$

The widening required for the trailer alone is given by the following formula.

$$W_2 = L_2^2/2R_1, \quad R_1 = R - W_1$$

Thus, the widening required is given by the following formula.

$$W = W_1 + W_2 = L_1^2/2R + RL_2^2/(2(R^2 - L_1^2))$$



Annex Fig.7-2 Widening for Semi-trailer

Where, R: radius of curvature of the lane center line

W: widening

W_1: widening for tractor

W_2: widening for trailer

L_1: distance from the front of the tractor to the second axle

L_2: distance from the second axle of the tractor to the rear axle of trailer

7-1-3. Specification for Vehicle Used for Determination of Widening

1. Vehicle Specifications

Typical dimensions of vehicles are employed as follows.

Semi-trailer truck	:	$L_1 = 5.3$ m, $L_2 = 9.0$ m
Large truck	:	$L_1 = 8.0$ m

2. Widening

By arrangements with the MOPT, it was decided to use standards as shown in Annex Table 7-1.

7-1-4. Widening

The conditions of passage for large vehicles at a curve are classified into five cases for which the widenings required are determined as shown in Annex Fig. 7-3.

(1) The passing status of large vehicles along the curves in the existing Ibague-Calarca section was studied using the following assumptions.

1) Running conditions

a. The large vehicles pass each other while running on the paved shoulders.

b. At the time of passing, one vehicle is permitted to cross into the other's lane.

2) Road conditions

The width of the straight road section is 6 m, of which 5.0 (2 x 2.50 m) is accounted for by the vehicle width, 0.5 m by the passing allowance, and 0.5 m (2 x 0.25 m) by lateral clearance.

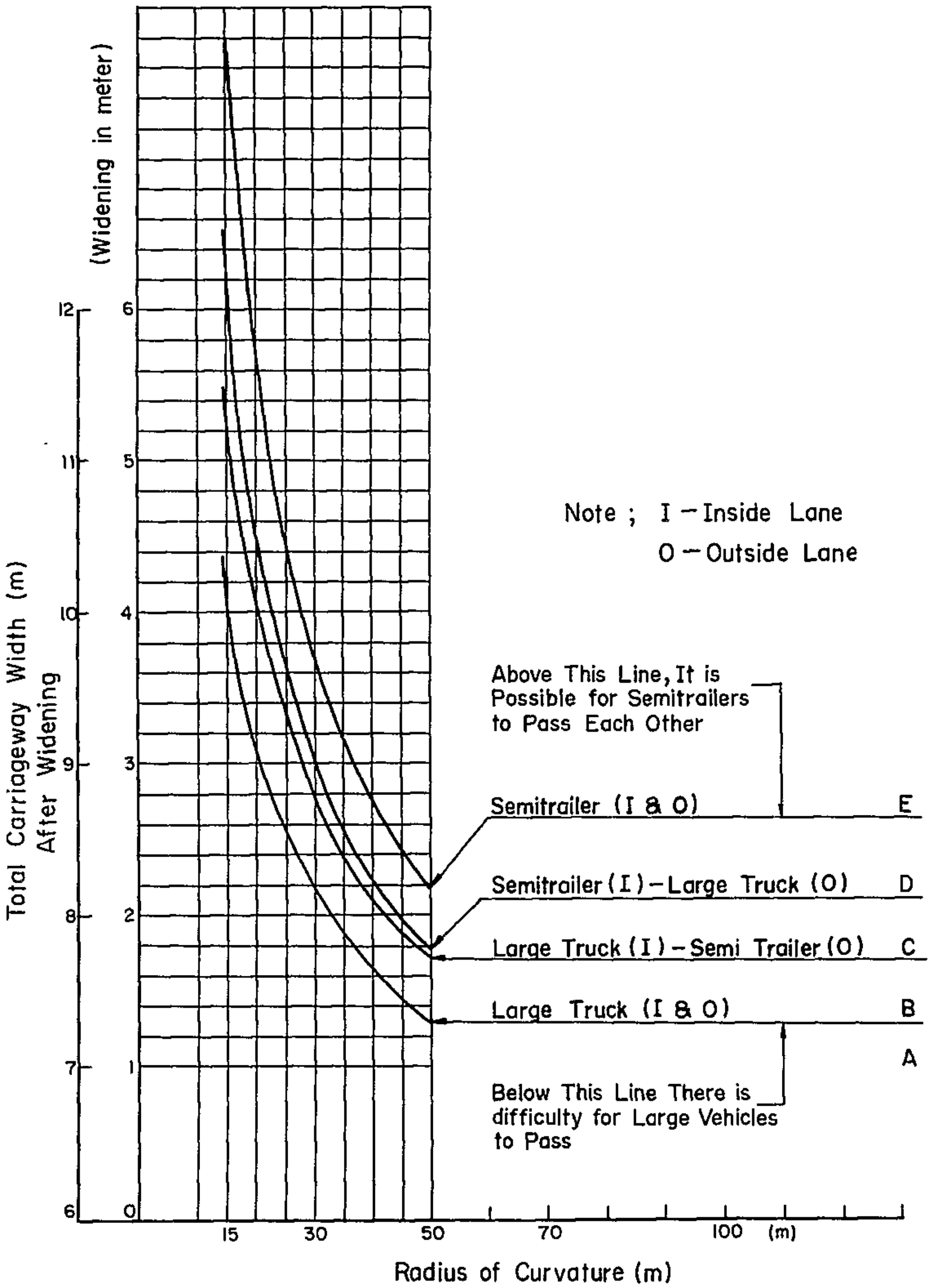
3) Passing status of large vehicles on the existing road

The passing status of the large vehicles running along the curves in the existing road is clarified according to Annex Fig. 7-3, and Annex Table 7-3.

(2) Widening Required for Critical Curve Improvement

By simplifying Annex Fig. 7-3, the widening for passing service level D is determined as described in Annex Table 7-2.

Annex Fig. 7-3 Widening and Carriageway width for Case Where 2 Large Vehicles Pass Each other



Annex Table - 7.1 Present Status of Passing Condition and Summary of Improvement Plan

Sub-Section	STATION 3)	Existing Status				Critical Curve Improvement Plan (P1)				Minimum Scale Improvement Plan (P2)			
	Km	Radius	Paved Width	Passing Condition 1)	Sight Distance 2)	Radius	Paved Width	Passing Condition	Sight Distance	Radius	Paved Width	Passing Condition	Sight Distance
01	61.29	22,27 m	9.4 m	B	Good	22,27 m	10.5 m	D	Good	25 m	11 50 m	E	Good
01	61.71	39,22	10.7	D	Good			D	Good	35	11 00	E	Good
02	63.04	17,20	10.9	C	Bad	17,20	12.5	D	3.0 m	25	11 50	E	Good
02	63.13	18,19	11.5	C	Good	18,19	12.5	D	Good	25	11 50	E	Good
03	65 79	25,15,19	9.4	A	Bad	25,15,19	12.5	D	2.8 m	25	11 50	E	Good
03	65 88	32	8.8	D	Bad			D	0.3 m	32	11 00	E	Good
03	66 01	24	9.8	C	Good	24	10.5	D	Good	25	11 50	E	Good
03	67 32	24	9.8	C	Good	24	10.5	D	Good	25	11 50	E	Good
03	67 41	29	8.9	B	Bad	29	9.75	D	1.1 m	29	11 50	E	Good
03	67 62	24	8.9	B	Good	24	10.5	D	Good	25	11 50	E	Good
03	67 80	22	10.5	D	Good			D	Good	25	11 50	E	Good
04	68 53	19,20	9 9	B	Good	19,20	12.5	D	Good	25	11 50	E	Good
04	68 67	19	9 2	A	Good	19	12.5	D	Good	25	11 50	E	Good
04	68 72	24	9 4	B	Bad	24	10.5	D	2.0 m	25	11 50	E	Good
04	68 80	18	10 2	B	Good	18	12 5	D	Good	25	11 50	E	Good
04	68 90	24	9 5	B	Bad	24	10 5	D	2.0 m	25	11 50	E	Good
05	69 36	19	10.0	B	Good	19	12.5	D	Good	25	11 50	E	Good
05	69 64	19	11.2	C	Good	19	12.5	D	Good	40	10.50	E	Good
06	70 28	19	10.0	B	Good	19	12.5	D	Good	25	11 50	E	Good
06	71.06	18	9.4	B	Good	18	12.5	E	Good	25	11 50	E	Good

Note: 1) Refer to Table 9-4 in Chapter 9. 2) Good - more than 30 meters. Bad - less than 30 meters. 3) STATION is relative to predetermined Km post for construction.

Annex Table - 7.1 (Cont'd.) Present Status of Passing Condition and Summary of Improvement Plan

Sub-Section	STATION	Existing Status				Critical Curve Improvement Plan (P1)				Minimum Scale Improvement Plan (P2)			
	Km	Radius	Paved Width	Passing Condition	Sight Distance	Radius	Paved Width	Passing Condition	Sight Distance	Radius	Paved Width	Passing Condition	Sight Distance
08	74 24	29,24 m	10.7 m	D	Good	m	m	D	Good	25 m	11 50 m	E	Good
08	74 89	34	9.0	D	Bad			D	1.0 m	34	11 00	E	Good
09	75 50	27,19	10.4	C	Good	27,19	12.50	D	Good	25	11 50	E	Good
10	75 97	36,24,37	10.5	D	Bad			D	1.6 m	35	11 00	E	Good
10	77 13	20,29	10.2	C	Bad	20,29	10.50	D	1.0 m	25	11 50	E	Good
10	78 21	24	8.7	B	Good	24	10.50	D	Good	35	11 00	E	Good
10	78 25	24	10.5	D	Good			D	Good	35	11.00	E	Good
10	78 97	26	9.1	B	Bad	26	9.75	D	0.7 m	26	11 50	E	Good
10	79.04	20	10.5	D	Good			D	Good	25	11 50	E	Good
10	79 61	20,25	10.5	D	Bad			D	0.8 m	25	11 50	E	Good
11	81 37	19,14	10.5	B	Good	19,14	14.00	D	Good	25	11 50	E	Good
12	83 11	29,19,26	10.3	B	Good	29,19,26	12.50	D	Good	25	11 50	E	Good
13	83 60	24,23,31	10.5	D	Good			D	Good	25	11 50	E	Good
13	83 83	20	10.5	D	Good			D	Good	25	11 50	E	Good
13	84 44	22	10.5	D	Bad			D	1.6 m	25	11 50	E	Good
13	84.56	24	10.5	D	Bad			D	1.2 m	25	11 50	E	Good
13	86 35	19	10.3	B	Good	19	12.50	D	Good	25	11 50	E	Good
13	86.43	21	11.2	D	Bad			D	1.8 m	25	11 50	E	Good
13	86 52	21	10.9	D	Good			D	Good	25	11 50	E	Good
14	94.30	22	9.7	B	Bad	22	10.50	D	1.6 m	25	11 50	E	Good
14	95.38	21	9.7	B	Good	21	10.50	D	Good	25	11 50	E	Good
14	96.19	29,20	10.5	D	Good			D	Good	25	11 50	E	Good
14	96.46	28	9.9	D	Bad			D	1.1 m	28	11 50	E	Good

Annex Table 7-1 (Cont'd.) Present Status of Passing Condition and Summary of Improvement Plan

Sub-Section	STATION	Existing Status				Critical Curve Improvement Plan (P1)				Minimum Scale Improvement Plan (P2)			
	Km	Radius	Paved Width	Passing Condition	Sight Distance	Radius	Paved Width	Passing Condition	Sight Distance	Radius	Paved Width	Passing Condition	Sight Distance
14	96 52	23 m	10.5 m	D	Bad	m	m	D	2.0 m	25 m	11 50 m	E	Good
15	97 88	26,24	10.8	D	Good			D	Good	25	11 50	E	Good
16	100 09	27	10.1	D	Bad			D	1.0 m	27	11 50	E	Good
17	101.23	15	9.8	A	Good	15	12.50	D	Good	Impossible			
17	102.01	25	8.9	B	Good	25	9.75	D	Good	25	11 50	E	Good
17	102.08	28	9.7	D	Bad			D	0.5 m	28	11 50	E	Good
18	103.55	34	8.8	D	Bad			D	0.5 m	34	11 00	E	Good
18	104.94	21	9.5	B	Bad	21	10.50	D	1.5 m	25	11 50	E	Good
18	105.27	21	11.0	D	Good			D	Good	25	11.50	E	Good
18	105.96	14	14.1	D	Bad			D	3.6 m	25	11 50	E	Good
18	106.57	20,16	11.5	C	Good	20,16	12.50	D	Good	25	11.50	E	Good
18	107.06	26	10.0	D	Bad			D	1.0 m	26	11.50	E	Good
18	108.10	22	9.2	B	Bad	22	10.50	D	2.6 m	25	11.50	E	Good
18	108.64	20	11.0	D	Bad			D	1.5 m	25	11.50	E	Good
18	110.20	29	8.5	B	Bad	29	9.75	D	0.6 m	29	11.50	E	Good
18	110.47	25	8.7	B	Good	25	9.75	D	Good	25	11.50	E	Good
18	110.77	16	9.2	A	Bad	16	12.50	D	0.5 m	25	11.50	E	Good
18	110.86	22,13,23	10.5	A	Good	22,13,23	14.00	D	Good	25	11.50	E	Good
18	111.47	24	10.5	D	Good			D	Good	25	11.50	E	Good
18	111.66	16	12.5	D	Good			D	Good	25	11.50	E	Good
18	112.40	20	10.5	D	Good			D	Good	25	11.50	E	Good
18	112.69	23	10.5	D	Good			D	Good	25	11.50	E	Good
18	115.63	20	8.6	A	Good	20	9.0	D	Good	25	11.50	E	Good
18	116.62	15	12.5	D	Bad			D	0.8	25	11.50	E	Good
18	116.98	13	9.6	A	Good	13	14.0	D	Good	25	11.50	E	Good

Annex Table 7-1 (Cont'd.) Present Status of Passing Condition and Summary of Improvement Plant

Sub-Section	STATION	Existing Status				Critical Curve Improvement Plan (P1)				Minimum Scale Improvement Plan (P2)			
	Km	Radius	Paved Width	Passing Condition	Sight Distance	Radius	Paved Width	Passing Condition	Sight Distance	Radius	Paved Width	Passing Condition	Sight Distance
18	117.15	20 m	10.5 m	D	Good	m	m	D	Good	25 m	11.50 m	E	Good
18	117.37	18	10.5	B	Good	18	12.5	D	Good	25	11.50	E	Good
18	117.60	23	10.5	D	Good			D	Good	25	11.50	E	Good
18	117.86	15	12.5	D	Bad			D	0.6 m	25	11.50	E	Good
18	118.71	15	12.5	D	Good			D	Good	25	11.50	E	Good
18	118.74	15	12.5	D	Bad			D	3.1 m	25	11.50	E	Good
18	118.80	20	10.5	D	Good			D	Good	25	11.50	E	Good
18	119.14	20	10.5	D	Good			D	Good	25	11.50	E	Good
18	119.33	20	11.8	D	Bad			D	0.5 m	25	11.50	E	Good
18	119.88	15	10.5	B	Bad			D	2.0 m	25	11.50	E	Good
18	120.13	20	10.5	D	Good			D	Good	25	11.50	E	Good
18	120.46	20	10.5	D	Bad			D	0.6 m	25	11.50	E	Good
18	120.75	15	12.5	D	Good			D	Good	25	11.50	E	Good
18	120.95	15	12.5	D	Bad			D	0.9 m	25	11.50	E	Good
18	122.70	15	12.5	D	Bad			D	5.0 m	25	11.50	E	Good
18	123.85	15	12.5	D	Bad			D	1.5 m	25	11.50	E	Good
18	124.06	13	12.0	B	Bad	13	14.0	D	3.4 m	25	11.50	E	Good
18	124.37	15	12.5	D	Good			D	Good	25	11.50	E	Good
18	125.85	25	8.8	B	Good	25	9.75	D	Good	25	11.50	E	Good
18	125.95	15	12.5	D	Good			D	Good	25	11.50	E	Good
18	129.10	15	12.0	C	Bad	15	12.50	D	2.1 m	25	11.50	E	Good
18	129.92	15	12.5	D	Good			D	Good	25	11.50	E	Good
18	130.06	20	9.7	B	Good	20	10.5	D	Good	25	11.50	E	Good
18	130.10	15	10.5	B	Bad	15	12.5	D	3.0 m	25	11.50	E	Good

Annex Table 7-1 (Cont'd.) Present Status of Passing Condition and Summary of Improvement Plant

Sub-Section	STATION Km	Existing Status				Critical Curve Improvement Plan (P1)				Minimum Scale Improvement Plan (2)			
		Radius	Paved Width	Passing Condition	Sight Distance	Radius	Paved Width	Passing Condition	Sight Distance	Radius	Paved Width	Passing Condition	Sight Distance
18	130.18	15 m	11.1 m	B	Good	15 m	12.5 m	D	Good	25 m	11.50 m	E	Good
18	130.58	20	10.5	D	Good			D	Good	25	11.50	E	Good
18	131.26	15	11.5	C	Bad	15	12.5	D	3.2 m	25	11.50	E	Good
18	131.50	15	10.8	B	Bad	15	12.5	D	4.0 m	25	11.50	E	Good
18	131.65	20	9.0	A	Good	20	10.5	D	Good	25	11.50	E	Good
18	132.09	15	11.2	B	Good	15	12.5	D	Good	25	11.50	E	Good
18	132.26	20	11.2	D	Bad			D	1.4 m	25	11.50	E	Good
18	133.19	20	9.5	B	Bad	20	10.5	D	1.4 m	25	11.50	E	Good
18	133.99	15	10.5	B	Bad	15	12.5	D	2.8 m	25	11.50	E	Good
18	134.51	25	9.7	D	Good			D	Good	25	11.50	E	Good
18	135.08	18	10.6	B	Bad	18	12.5	D	1.8 m	25	11.50	E	Good

Note 1 Passing Condition

		Outside Lane / Inside lane	Truck	Tmula	Description
Passing Condition	A	Truck	Slow down / Stop	Slow down / Stop	A truck, or a bus or a tractomula on the inside lane vs a truck or a bus or a tractomula on the outside lane. Traffic on the inside lane must stop and wait, then proceed one at a time. Traffic on the outside lane slows down to half speed.
		Tmula	Slow down / Stop	Slow down / Stop	
	B	Truck	/	Slow down / Stop	A truck or a bus on the inside lane vs a tractomula on the outside lane, or a tractomula on the inside lane vs a truck or a bus or a tractomula on the outside lane. Traffic on the inside lane must stop and wait, then proceed one at a time. Traffic on the outside lane slows down to half speed.
		Tmula	Slow down / Stop	Slow down / Stop	A truck or a bus on the inside lane vs a truck or a bus on the outside lane can proceed in both directions without stopping nor waiting.
	C	Truck	/	/	A tractomula on the inside lane vs a truck or a bus or a tractomula on the outside lane. Traffic on the inside lane must stop and wait, then proceed one at a time. Traffic on the outside lane slows down to half speed.
		Tmula	Slow down / Stop	Slow down / Stop	A truck or a bus on the inside lane vs a truck or a bus on the outside lane can proceed in both directions without stopping nor waiting.
	D	Truck	/	/	A tractomula vs a tractomula. Traffic on the inside lane must stop and wait, then proceed one at a time. Traffic on the outside lane slows down to half speed.
		Tmula	/	Slow down / Stop	
	E	Truck	/	/	A Traffic on the both sides can proceed with no stopping.
		Tmula	/	/	

2 Sight Distance

Good : 30 m or more
Bad : Less than 30 m

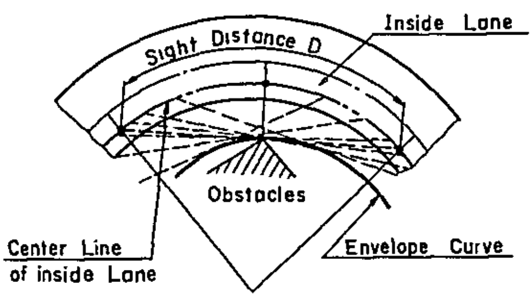
3 The value in the column of sight distance shows the length to be widened for keeping sight distance 30 m.

4 Station is relative to predetermined Km Post for Construction.

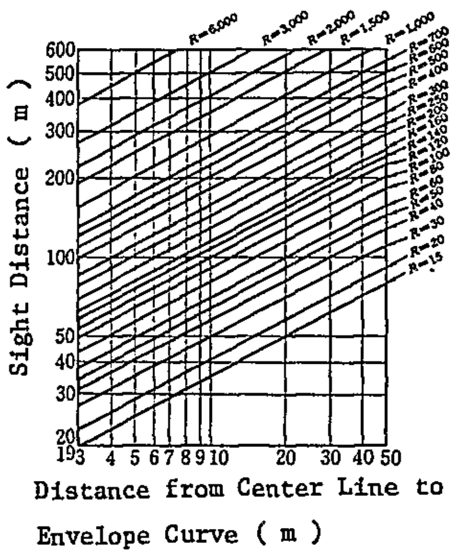
Annex 7-2. Maintenance of Stopping Sight Distances at Curves

In the Ibague-Calarca section where the mountain slopes lie close on the inside of sharp curves, the stopping sight distance is insufficient. At these points, driving is hazardous and drivers are forced to slow down. Because the level of road service has fallen in parts, improvement is imperative. In this case the distance from the center of the lane to the envelope locus described by obstacles hindering the line of sight (See Annex Fig. 7-4) is shown in Annex Fig. 7-5. The widenings required for maintaining sight distances are given in Annex Table 7-1. These values are slightly higher than those from Annex Figure 7-5. (See Annex Fig. 7-4)

Annex Fig. 7-4 Sight Distance at Sharp Curve



Annex Fig. 7-5 Sight Distances at Obstacles



ANNEX 7-3 Design Life of the Pavement Overlaid in 1980 ~ 1981 by the Rehabilitation Project

1. Ibague - Calarca Section

Design life of the pavement overlaid in 1980 - 1981 is esteimated by using "Thickness Design - Full Depth Asphalt Pavement Structures for Highways and Streets" of Asphalt Institute MS-1 as follows;

Given: (1) Initial Daily Traffic (IDT) = 2,282 vehicles per day in 1980

(2) Number of heavy trucks = $2,282 \times \frac{50}{100} \times \frac{56}{100} = 640$

(3) Average Gross weight = 30,000 Lbs.

(4) Annual growth rate of traffic = 5.0% and

(5) Single Axle equivalent = 18,000 Lbs.

(6) Old pavement consists of 4 inches asphaltic concrete in poor condition and 6 inches granular base.

(7) Overlay thickness surfaced in 1980 - 1981 = 3 inches

Calculation:-

(1) Design subgrade strength value CBR = 8%

(2) Effective Thickness Te = Full depth

Asphalt pavement thickness = T_A

Thickness of Pavement layers inches		Conversion Factor		Te
3	x	1.0	=	3.0
4	x	0.7	=	2.8
6	x	0.3	=	1.8
		Total		7.6

(3) Initial Traffic Number (ITN) = 310 (from Fig.III-1) 1)

(4) Design Traffic Number (DTN) = 200 (from Fig. IV-1) 2)

(5) Adjustment Factor $\frac{200}{310} = 0.64$

(6) Annual growth rate is 5.0% by interpolation from Table III-3[3)] design life of the pavement overlaid in 1980 - 1981 is estimated to be ten (10) years.

2. Melgar - Ibague Section

Design life of the pavement overlaid in 1980-81 is estimated by using Asphalt Institute MS-1 as follows;

Given: (1) IDT = 5,344 vehicles per day in 1980.

(2) Number of heavy trucks $= 5,344 \times \frac{50}{100} \times \frac{40}{100} = 1,070$

(3) Average gross weight = 26,000 Lbs.

(4) Single axle equivalent = 18,000 Lbs.

(5) Annual growth rate of traffic = 5.0%

(6) Old pavement consists of 3.5 inches asphaltic concrete in poor condition and 6 inches granular base.

(7) Overlay thickness = 3 inches (Surfaced in 1980 - 1981)

Calculation:-

(1) CBR Value = 8%

(2) $T_e = T_A$

3 inches x 1.0 =		3.0
4.0 inches x 0.7 =		2.8
6 inches x 0.3 =		1.8
	Total	7.6 inches

(3) ITN = 470 (from Fig. III-1)[1]

(4) DTN = 200 (from Fig. IV-1)[2]

(5) Adjustment factor $\frac{200}{470} = 0.42$

(6) Annual growth rate = 5.0%

By interpolation from Table III-3[3], design life of the pavement overlaid in 1980-81 is estimated to be seven(7) years.

Note: 1) Fig. III-1 of Asphalt Institute Manual Series MS-1.

2) Fig. IV-1 of Asphalt Institute Manual Series MS-1.

3) Table III-3 of Asphalt Institute Manual Series MS-1.

Annex 7-4 Pavement Design Procedures

7-4-1 Pavement Design for New Construction

The design criteria to be followed are those described in the Asphalt Institute Manual Series (MS-1).

(1) Medium Scale Improvement Plan (Ibague-Calarca Section)

1) Ibague-Coello. (Km 56 - Km 70) section

Given Initial Daily Traffic (IDT) is 2282 vehicles per day in 1980.
Assume annual growth rate = 5%

IDT = 1674 in 1987

Number of Heavy Trucks = $3210 \times \frac{50}{100} \times \frac{56}{100} = 900$

Average Gross Weight = 30,000 lbs

Single Axle Equivalent = 18,000 lbs

a) CBR = 20%
b) ITN = 460 (Initial Traffic Number)
c) DTN = 460 x 1.67 = 770 (Design Traffic Number)
(by Interpolation from Table III-3) 1)
d) TA = 6.5 inches Thickness of asphalt concrete (Fig. V-1) 2)
e) Minimum thickness of asphalt concrete is considered to be 3 inches

6.5 - 3.0 = 3.5 inches

f) 3.5 inches is substituted by granular base

3.5 inches x 2.0 = 7 inches Say 20cm,base

* Substitution Factor From Design Manual

2) Coello - Q. Perales (Km 70 - Km 101) section

Traffic condition is the same as that of Ibague-Coello section.

1) CBR = 8%
2) ITN = 460
3) DTN = 770
4) TA = 9.0 inches (from Fig. V-1)
5) Minimum thickness of asphalt concrete is considered to be 3 inches

9.0 - 3.0 = 6.0 inches

6) 6.0 inches is substituted by 3 inches granular base and 3 inches subbase.

3.0 inches x 2.0 = 6 inches say 15cm base
3.0 inches x 2.7 = 8 inches say 20cm subbase

Note : 1) Table III-3 of Asphalt Institute Manual Series (MS-1)
2) Fig. V-1 of Asphalt Institute Manual Series (MS-1)

(2) Large Scale Improvement Plan

1) Girardot Bypass

Given initial Daily Traffic (IDT) is 2250 vehicles per day in 1980.

Assume annual growth rate = 5%

IDT = 3,016 in 1986

Number of Heavy Trucks $= 3,016 \times \frac{60}{100} \times \frac{50}{100} = 905$

Average Gross Weight = 27,000 Lbs.

Single Axle Equivalent = 18,000 Lbs.

a) CBR = 4%

b) ITN = 390 (Initial Traffic Number)

c) DTN = 390 x 1.67 = 650 (Design Traffic Number)
(by Interporating from Table III-3)[1)]

d) TA = 11.5 inches Thickness of asphalt concrete (from Fig. V-1)[2)]

e) Minimum thickness of asphalt concrete is considered to be 3 inches.

11.5 - 3.0 = 8.5 inches

f) 8.5 inches is substituted by granular base.

3.0 inches x 2.0* = 6 inches say 15 cm Base

5.5 inches x 2.7* = 14.8 inches say 40 cm Subbase

* Substitution Factor from Design Manual.

Note : 1) Table III-3 of Asphalt Institute Manual Series(MS-1)

2) Fig. V-1 of Asphalt Institute Manual Series(MS-1)

2) Ibague Bypass

Given Initial Daily Traffic (IDT) is 1,241 vehicles per day in 1980.

Assume annual growth rate = 5%

IDT = 1,746 in 1987

Number of Heavy Trucks $= 1,746 \times \frac{50}{100} \times \frac{56}{100} = 490$

Average Gross Weight = 30,000 lbs

Single Axle Equivalent = 18,000 lbs.

a) CBR = 8%

b) ITN = 250 (Initial Traffic Number)

c) DTN = 250 x 1.67 = 420 (Design Traffic Number)
(by interporating from Table III-3)[1]

d) TA - 9.0 inches Thickness of asphalt concrete (from Fig. V-1)[2]

e) Minimum thickness of asphalt concrete is considered to be 3 inches.

9.0 - 3.0 = 6.0 inches

f) 6.0 inches is substituted by granular base

3.0 inches x 2.0* = 6 inches say 15 cm Base

3.0 inches x 2.7* = 8 inches say 20 cm Subbase

* Substitution Factor from Design Manual

3) Coello and La Linea Bypass

Traffic condition is the same as Ibague-Coello section in Medium scale improvement plan.

1) CBR = 8%

2) ITN = 360

3) DTN = 600

4) TA = 9.0 inches (From Fig. V-1)[2]

5) Minimum thickness of asphalt concrete is considered to be 3 inches. 9.0 - 3.0 = 6.0 inches.

6) 6.0 inches is substituted by granular base and subbase.

3.0 inches x 2.0 = 6 inches say 15cm base

3.0 inches x 2.7 = 8 inches say 20 cm subbase

Note : 1) Table III-3 of Asphalt Institute Manual Series(MS-1)

2) Fig. V-1 of Asphalt Institute Manual Series(MS-1)

7-4-2 Overlay Thickness Design for the Existing Road Section

The design criteria to be followed are those described in the Asphalt Institute Manual Series (MS-17)

(1) Calarca-Buga

1) Calarca-Barragan

Assume the first year of overlay is 1985.

Number of Heavy Trucks $= 2910 \times \frac{50}{100} \times \frac{45}{100} = 654$

Average Gross Weight = 40,000 lbs

Annual Growth Rate = 5%, and

Single Axle Equivelent = 26,000 lbs

Existing pavement consists of 3 inches of asphalt concrete in poor condition, and 6 inches of granular base, where CBR value is 8%. Overlay thickness for 20 years Design Period is calculated as follows.

a) ITN = 250 (from Fig. III-1) [1]
b) DTN = 250 x 1.67 = 420 (from Table III-4) [2]
c) Rebound Deflection = 0.040* inch
d) Overlay Thickness = 2.8 inches = 3 inch (from Fig. IV-3) [3]

* Rebound Deflection calculated from Benkelman Beam Test Results shown in Annex Fig. 6-1.

2) Barragan-Secilla

Number of Heavy Trucks $= 1416 \times \frac{50}{100} \times \frac{45}{100} = 320$

a) ITN = 250 (from Fig. III-1)
b) DTN = 420 (from Table III-4)
c) Rebound Deflection = 0.034 inch
d) Overlay Thickness = 2.0 inch (from Fig. IV-3)

3) Sevilla-Uribe

The traffic condition is the same as that of Calarca-Barragan section.

a) ITN = 250 (from Fig. III-1) [1]
b) DTN = 420 (from Table III-4) [2]
c) Rebound Deflection = 0.042 inch
d) Overlay Thickness = 3.0 inch (from Fig. IV-3) [3]

Note : 1) Fig. III-1 of Asphalt Institute Manual Series (MS-17)
2) Table III-4 of Asphalt Institute Manual Series (MS-17)
3) Fig. IV-3 of Asphalt Institute Manual Series (MS-17)

4) Andalucia - San Pedro

Number of Heavy Trucks $= \frac{8246}{2} \times \frac{50}{100} \times \frac{42}{100} = 865$

Average Gross Weight = 26,000 lbs.

1) ITN = 360 (from Fig. III-1) [1)]
2) DTN = 360 x 1.67 = 600 (from Table III-4) [2)]
3) Rebound Deflection = 0.045 inch
4) Overlay Thickness = 3.8 inch = 4.0 inch (from Fig. IV-3)

The Rebound Deflection is calculated from the Benkelman Beam Test Results shown in Annex Fig. 6-1 by a procedure which is

described as follows,

7-4-3 Procedure For Calculation of Rebound Deflection.

(1) Calarca - Barragan

$$\bar{x} = \frac{\Sigma x}{65} = \frac{39.5}{65} = 0.61^{mm}$$

$$s = \frac{n(\Sigma x^2) - (\Sigma x)^2}{n(n-1)} = \frac{65x28.26-(39.50)^2}{65x64} = \frac{1836.9 - 1560.25}{4160} = \underline{0.26}^{mm}$$

f = 0.92 (Av. temperature 35.64°C)

$(\bar{x}+2s)f = (0.61 + 2 \times 0.26) \times 0.90 = 1.02^{mm} = \underline{0.040}$ inch

(2) Barragan - Sevilla

$\bar{x} = 0.47$ $s = 0.24$ $f = 0.90$ (Av. temp. 34.6°C)

$(x+2s)f = (0.47 + 2 \times 0.24) \times 0.91 = 0.86^{mm} = \underline{0.034}$ inch

(3) Sevilla - Uribe

$x = 0.55$ $s = 0.31$ $f = 0.92$ (Av. Temp 34°C)

$(x+2s)f = (0.55 + 2 \times 0.31) \times 0.92 = 1.08^{mm} = \underline{0.042}$ inch

(4) Andalucia - San Pedro

$x = 0.59$ $s = 0.38$ $f = 0.84$ (Av. temp. 39.9°C)

$(x+2s)f = (0.59 + 2 \times 0.38) \times 0.84 = 1.13^{mm} = \underline{0.045}$ inch

---

Where $\bar{x}$: Sample mean value

s : Standard deviation

n : Number of individual test values

f : Temperature adjustment factor

Benkelman Beam Test Results

(From Annex Fig. 6-1)

1) Calarca - Barragan

		$\sum x^{1)}$	$\sum x^2$
135.0^{km} - 141.0^{km}	10^{Point}	7.9	7.14
141.0 - 146.0	10	5.8	3.58
146.0 - 151.0	10	4.8	2.47
451.0 - 156.0	10	5.8	4.35
156.0 - 161.0	10	7.5	6.41
161.0 - 166.0	10	5.6	3.08
166.5 - 168.5	5	2.1	1.23
	65	39.5^{mm}	28.26^{mm2}

2) Barragan - Sevilla

168.5 - 173.5	10	5.5	4.37
173.5 - 178.5	10	6.2	3.70
178.5 - 183.5	10	3.7	2.13
183.5 - 188.5	10	3.6	1.46
188.5 - 193.5	10	4.7	2.31
	50	23.7^{mm}	13.97^{mm2}

3) Sevilla - Uribe

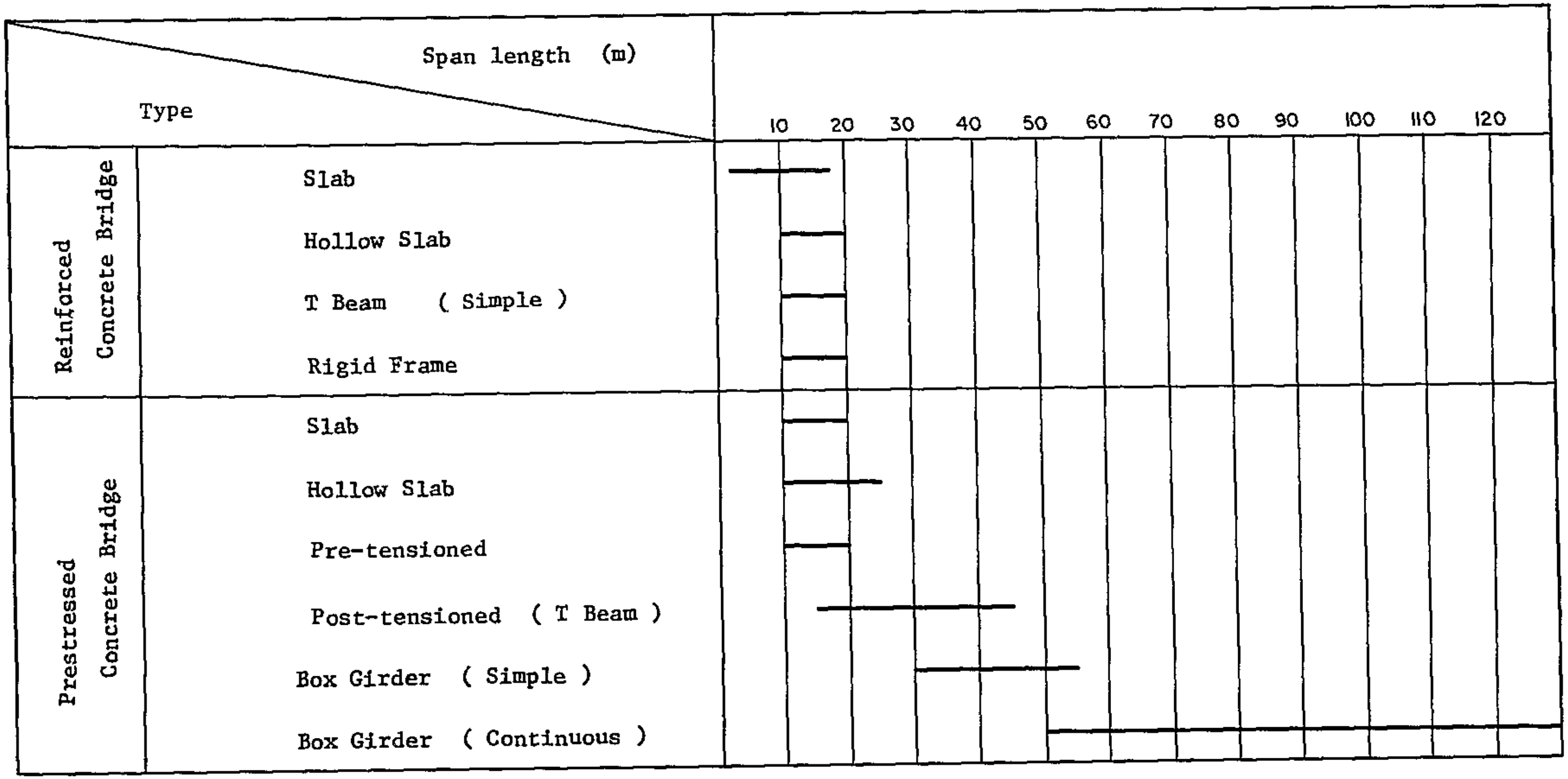
193.5 - 198.5	10	6.1	4.19
198.5 - 201.0	5	2.3	1.47
201.0 - 206.0	10	3.1	1.55
206.0 - 211.0	10	4.4	2.76
211.0 - 216.0	10	7.7	6.57
216.0 - 220.5	7	4.9	4.09
	52	28.5^{mm}	20.63^{mm2}

4) Andalucia - San Pedro

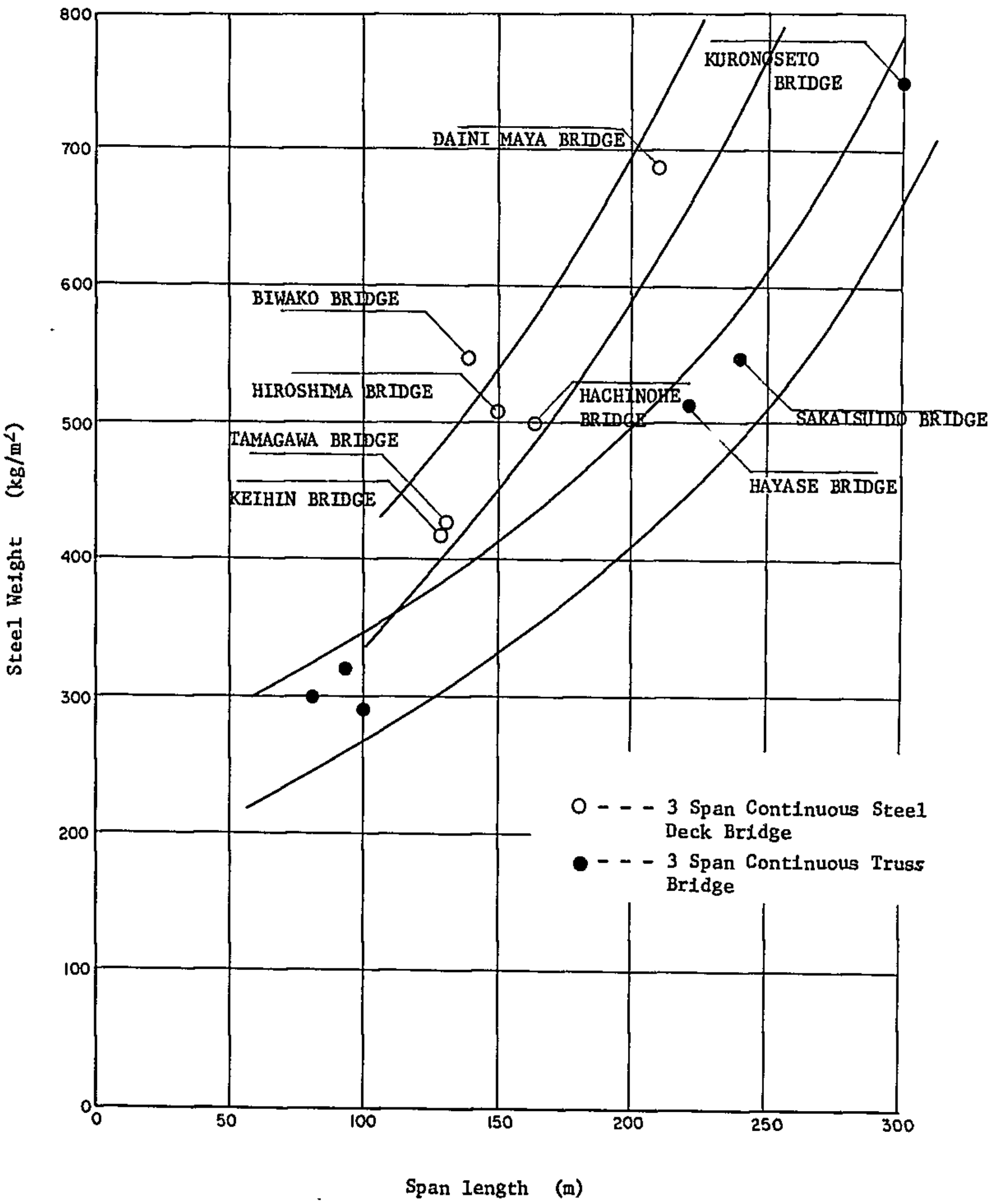
79.0 - 84.0	10	3.6	1.64
84.0 - 89.0	10	4.0	2.48
89.0 - 94.0	10	7.8	7.12
94.0 - 99.0	10	8.2	8.24
	40	23.6mm	$19.48mm^2$

Note : 1) x is individual test value.

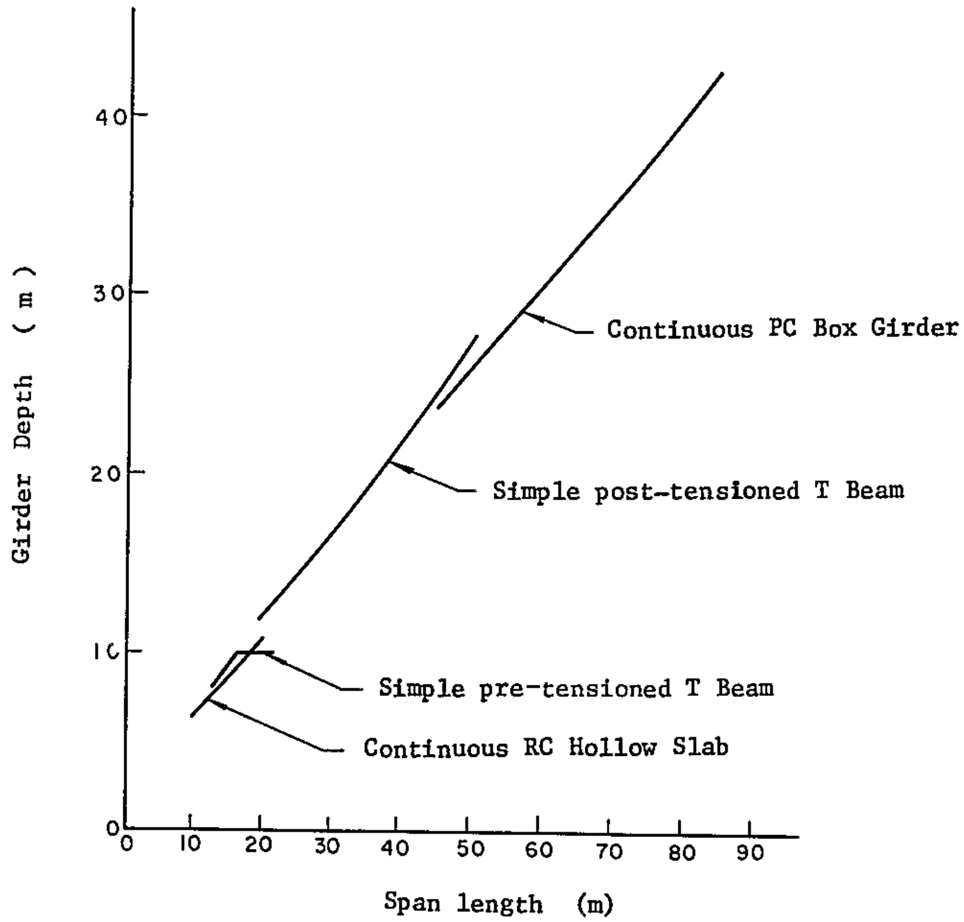
Annex Fig. 7-6 Recommended Span for Concrete Bridges



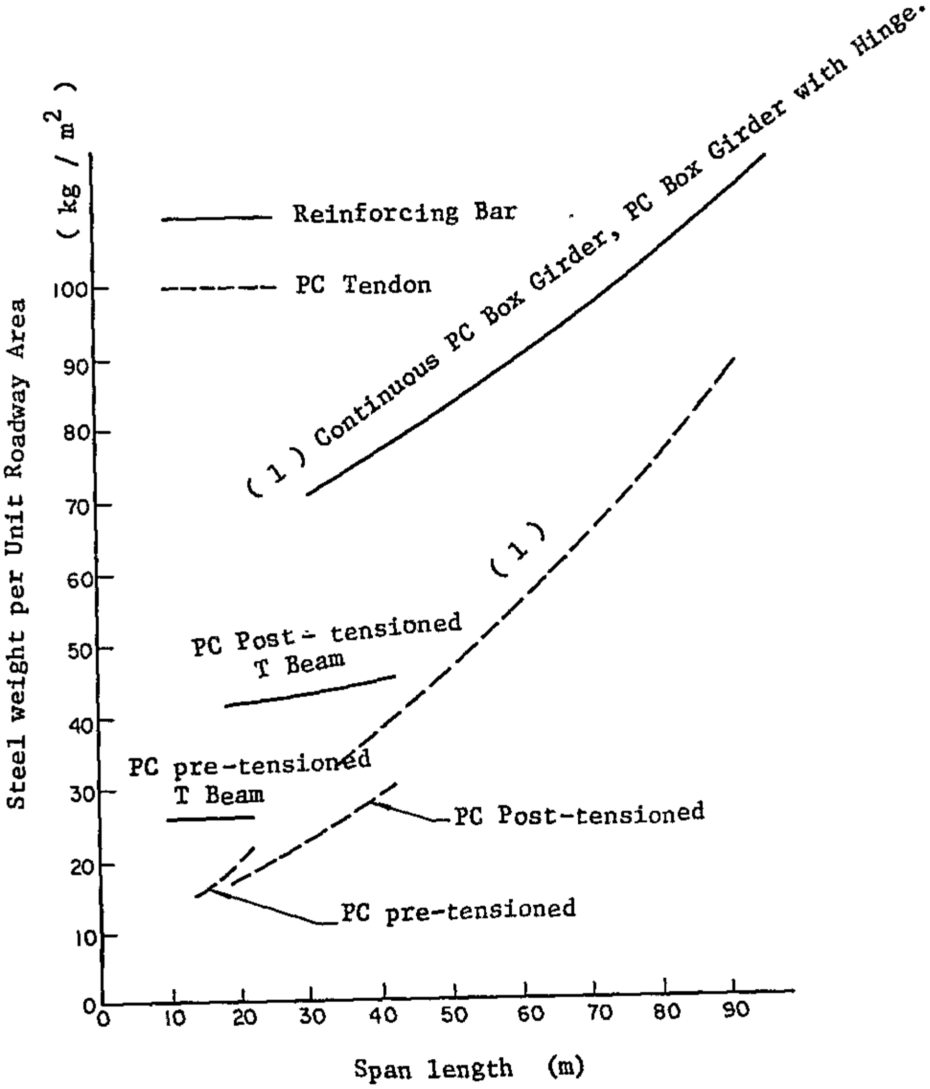
Annex Fig.7-7 Steel Weight of Steel Bridge



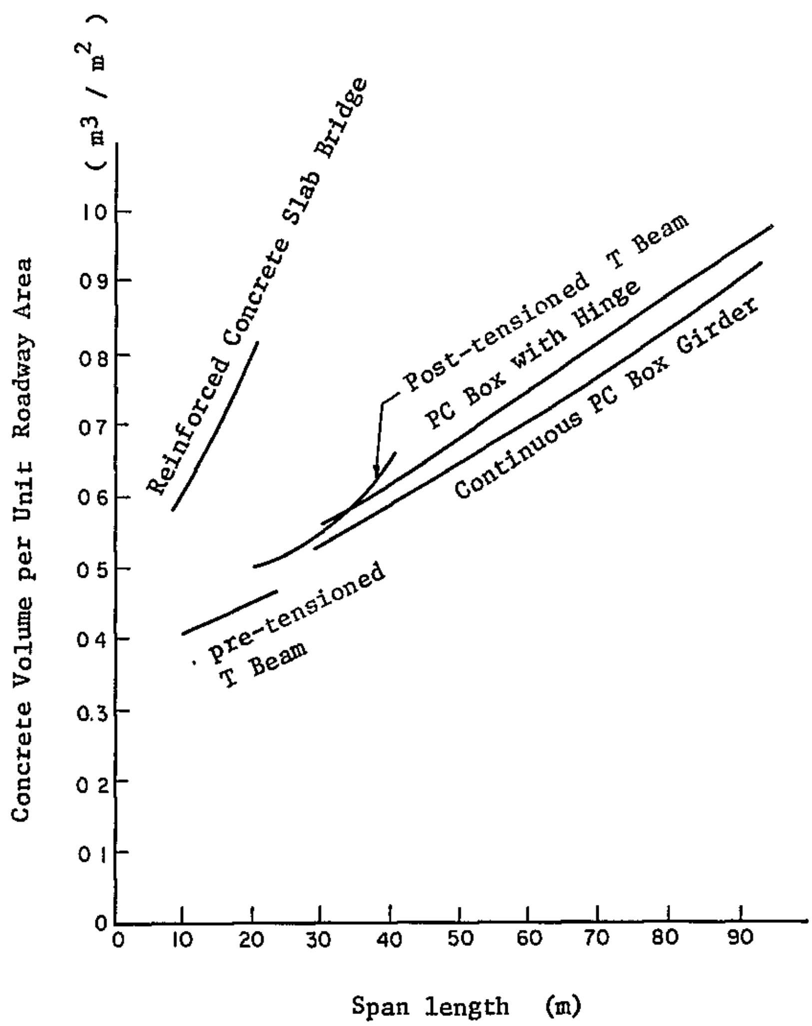
Annex Fig. 7-8 Span and Girder Depth of Concrete Bridge



Annex Fig. 7-9 Span Length and Steel Weight per Unit Roadway Area

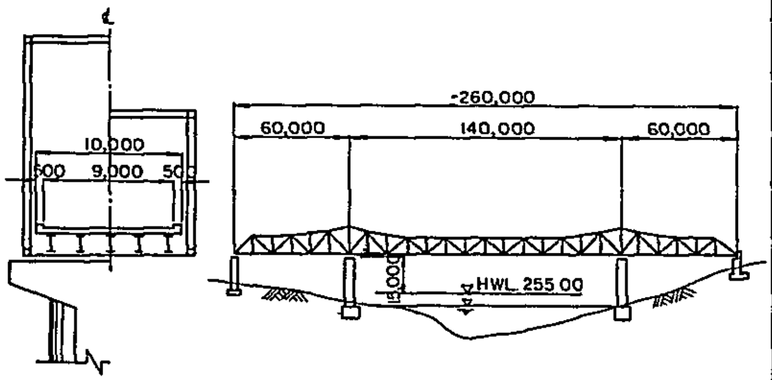
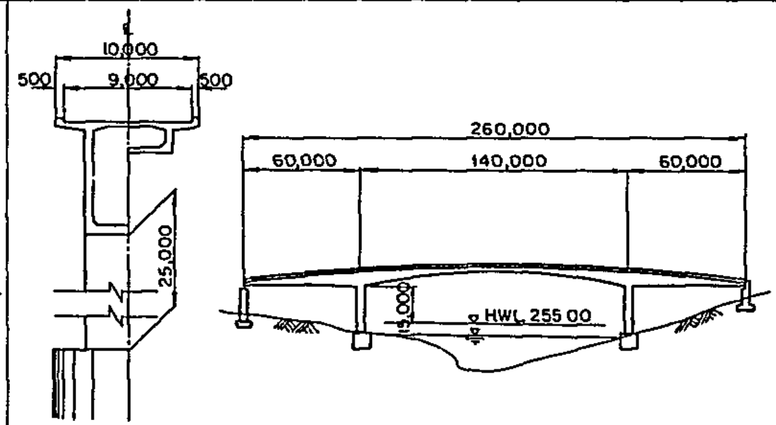


Annex Fig. 7-10 Concrete Volume per Unit Roadway Area



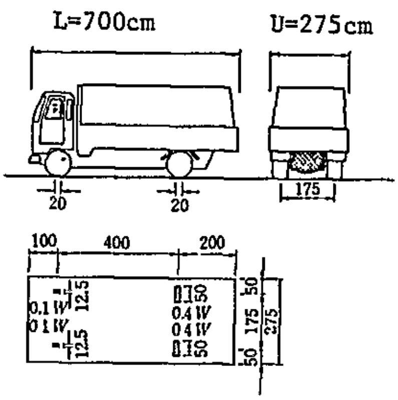
Annex Fig. 7-11

COMPARATIVE ANALYSIS OF BRIDGE OVER RIO MAGDALENA

Descriptions	3-Span Continuous Steel Truss	3-Span Continuous P.C. Box Girder
TYPICAL CROSS SECTION AND SIDE VIEW		
APPROXIMATE MATERIALS QUANTITIES	**Superstructure** Steel Weight 920^{t} Concrete 360^{m3} Reinforcement 29^{t} Form 3400^{m2} Pavement 2340^{m2} **Substructure** Concrete 1130^{m3} Reinforcement 90^{t} Form 1200^{m2}	**Superstructure** Concrete 2930^{m3} P.C. Cable 257^{t} Reinforcement 187^{t} Form 9830^{m2} Pavement 2340^{m2} **Substructure** Concrete 1850^{m3} Reinforcement 130^{t} Form 1360^{m2}
APPROXIMATE CONSTRUCTION COST	Superstructure $270,443,000 Substructure $ 15,157,000 Total $285,600,000	Superstructure $221,427,000 Substructure $ 22,567,000 Total $243,994,000
PRACTICABILITY OF ERECTION	Erection High Level Construction period Short	Erection (Cantilever method) High Level Construction period Long
MAINTENANCE	Painting cost is necessary	Maintenance cost is negligible
CONCLUSION	———	Recommended

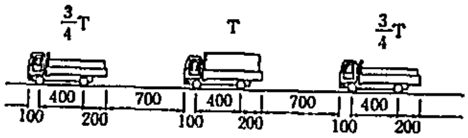
Annex Fig. 7-12 Bridge Live Loads

T-Load

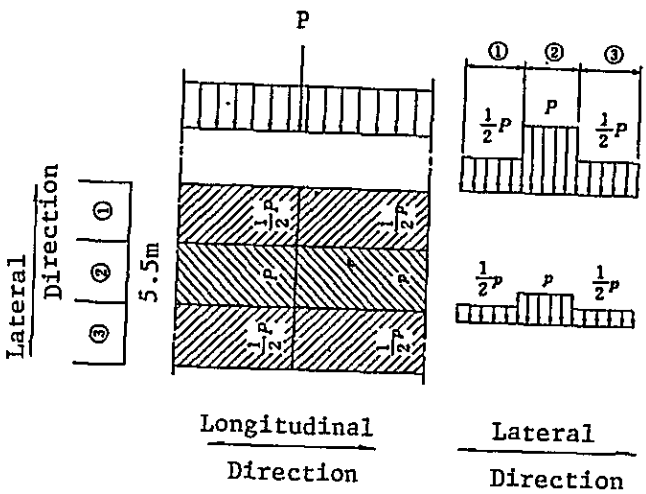


LOAD	W (t)	0.1W(kg)	0.4W(kg)
T-20	20	2000	8000
T-14	14	1400	5600

W ; Total Weight of Truck and Load.



L-Load



P ; Concentrated Load

p ; Uniform Load

LOAD	P (kg/m)	p (kg/m²)	
		ℓ≦80	ℓ>80
L-20	5000	350	430-L*
L-14	70% of above		

* 430-L≧300 kg/m²

..nnex Table 7 – 2 – (1) Preventive Works

Section No.	Station (Km)	Geology		TD & ED	PO	Type and extent of preventive works
		Surface	bedrock			
1	61,820~61,850	Soil	granodiorite	⑤ – M	B	②H = 4, L = 30 m
2	61,820~61,860	〃	〃	② – M	B	①224 m²
3	62,000~62,045	〃	〃	⑤ – L	B	②H = 6, L = 45 m
4	62,520~62,680	〃	〃	① – L	A	※ LS – 1
5	62,800~62,830	Pumice flow deposit	〃	② – L	A	②H = 6, L = 30 m
6	63,200~63,385	Soil	〃	② – M	A	①827 m²
7	63,385~63,575	〃	〃	② – S	B	①850 m²
8	63,625~63,660	〃	〃	⑤ – M	C	①196 m²
9	63,610~63,830	〃	〃	④ – S	C	⑨3300 m²
10	63,860~63,960	〃	〃	④ – M	A	⑨1000 m²
11	63,880~63,900	〃	〃	⑤ – C	C	⑥120 m²
12	63,900~63,960	〃	〃	⑤ – M	C	⑮H = 4, L = 60 m
13	64,015~64,020	〃	〃	⑤ – S	B	⑩20 m²
14	64,010~64,030	—	〃	④ – S	C	⑦400 m²
15	64,120~64,300	Soil	〃	⑤ – M	C	⑮H = 4, L = 90 m
16	64,180~64,220	〃	〃	② – M	C	①134 m²
17	64,340~64,375	〃	〃	② – M	B	⑱500 m²
18	64,420~64,580	Pumice flow, Soil	〃	② – M	C	①716 m²
19	64,495~64,525	〃	〃	⑤ – S	B	②H = 4, L = 30 m²
20	64,580~64,590	〃	〃	⑥ – M	B	②H = 3, L = 20 m²
21	64,590~64,640	Sand and gravel	—	② – M	C	⑱600 m²
22	64,915~65,000	〃	—	⑤ – M	A	⑥360 m², ⑫H = 1, L = 85 m
23	65,020~65,300	〃	—	② – S	B	⑦2,240 m²
24	65,300~65,480	—	granodiorite	② – S	A	⑨4,500 m²
25	65,320~65,330	〃	〃	⑥ – S	A	⑬H = 4, L = 7 m

※ Preventive works for landslide are shown in Table 7–15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probabily
C : Low probabilty

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted – T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
⑦ Rock net
⑧ Rock fence
⑨ Grout faced
⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱' Soil removal works

Annex Table 7 − 2 − (2) Preventive Works

Section No.	Station (Km)	Geology		TD & ED	PO	Type and extent of preventive works
		Surface	bedrock			
26	65,375~65,385	completely weathered gr.	granodiorite	⑥−M	A	⑬H=4, L=10 m, ⑭W=4, L=30 m
27	45,420~65,425	〃	〃	⑥−M	A	⑬H=4, L=10 m, ⑭W=4, L=30 m
28	65,503~65,510	〃	〃	⑥−S	A	⑬H=4, L=7 m
29	65,480~65,820	〃	〃	②−M	B	⑨5,100 m²
30	65,610~65,618	〃	〃	⑥−S	A	⑬H=4, L=8 m
31	65,820~65,830	〃	〃	⑥−M	C	⑬H=4, L=10 m
32	65,840~65,880	〃	〃	②−M	B	⑦1,000 m²
33	65,900~66,220	〃	〃	②−M	A	①1342 m², ⑧H=1.5, L=300 m
34	66,020~	〃	〃	⑥−M	A	⑬H=4, L=20 m
35	66,200~66,300	〃	〃	②−S	A	⑦700 m²
36	66,300~66,380	〃	〃	③−S	A	①447 m², ⑧H=1.5, L=80 m
37	66,220~	〃	〃	⑥−M	A	⑬H=4, L=15 m
38	66,260~	〃	〃	⑥−S	A	⑬H=4, L=10 m
39	66,290~	〃	〃	⑥−M	A	⑬H=4, L=15 m, ⑭W=4, L=25
40	66,380~	〃	〃	⑤−S	A	③H=3, L=10 m
41	66,385~66,450	〃	〃	③−S	C	⑨150 m²
42	66,685~66,840	soil	〃	②−M	C	①184 m²
43	66,865~66,880	completely weathered gr.	〃	②−M	A	②H=4, L=15 m
44	66,915~66,925	〃	〃	⑥−S	B	③H=3, L=10 m
45	66,925~67,030	〃	〃	②−S	C	①587 m²
46	66,985~67,015	〃	〃	⑥−M	B	⑩150 m²
47	67,030~67,075	〃	〃	②−S	A	②H=4, L=45 m
48	67,075~67,085	〃	〃	⑥−S	A	③H=3, L=10 m
49	67,085~67,095	〃	〃	④−S	B	⑦100 m²
50	67,095~67,120	〃	〃	⑥−S	A	③H=3, L=25 m, ⑧H=1.5, L=25 m

※ Preventive works for landslide are shown in Table 7−15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probably
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted −T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
⑦ Rock net
⑧ Rock fence
⑨ Grout faced
⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (3) Preventive Works

Section No.	Station (Km)	Geology: Surface	Geology: bedrock	TD & ED	PO	Type and extent of preventive works
51	67,120~67,200	completely weathered gr.	granodiorite	②-S	A	①358 m², ⑧H=1.5, L=80 m
52	67,215~67,260	〃	〃	⑤-M	B	④H=7, L=45 m
53	67,260~67,325	〃	〃	③-M	A	③H=3, L=65 m, ⑧H=1.5, L=65m
54	67,350~67,500	〃	〃	②-S	A	①671 m²
55	67,380~67,400	〃	〃	⑤-S	B	②H=4, L=20 m
56	67,450~67,480	〃	〃	⑤-M	C	②H=4, L=30 m
57	67,500~67,510	〃	〃	⑥-L	C	⑬H=4, L=15 m, ⑭W=4, L=10m, ⑯L=8m
58	67,510~67,650	〃	〃	②-S	C	⑦1120 m²
59	67,650~67,660	soil	〃	⑥-L	B	⑬H=4, L=40 m
60	67,660~67,710	pumice (flow gravel), sand and gravel	〃	②-S	A	①224 m², ⑧H=1.5, L=50 m
61	67,680~67,695	〃	〃	⑤-S	B	②H=6, L=15 m
62	67,780~67,850	〃	〃	②-M	C	⑰2,000 m², ⑱7,000 m²
63	67,840~67,880	soil	〃	⑤-M	C	⑩200 m²
64	67,990~68,000	〃	〃	⑥-L	B	⑬H=4, L=20 m, ⑭W=4, L=40 m
65	68,020~68,060	pumice (flow gravel), sand and gravel	〃	②-S	A	⑦1,000 m²
66	68,120~68,145	〃	—	②-M	A	③H=3, L=25 m
67	68,145~68,250	soil sand and gravel	—	②-S	B	①246 m²
68	68,250~68,340	〃	granodiorite	②-S	C	①402 m²
69	68,340~68,365	〃	〃	②-M	B	①112 m², ⑧H=1.5, L=25 m
70	68,365~68,400	completely weathered gr.	〃	②-M	A	③H=3, L=35 m, ⑧H=1.5, L=35 m
71	68,430~68,450	〃	〃	③-M	B	⑨200 m²
72	68,450~68,540	〃	〃	②-S	A	①402 m², ⑧H=1.5, L=90 m
73	68,540~68,550	〃	〃	⑥-M	B	⑯L=8 m
74	68,560~68,570	soil	〃	⑥-L	B	⑬H=4, L=30 m
75	68,570~68,620	〃	〃	②-M	B	⑰2,000 m², ⑱8,000 m²

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probablity
C : Low probablity

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted-T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
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⑧ Rock fence
⑨ Grout faced
⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (4) Preventive Works

Section No	Station (Km)	Geology: Surface	Geology: bedrock	TD & ED	PO	Type and extent of preventive works
76	68,720~68,800	soil	granodiorite	②-S	C	⑰2,000 m^2, ⑱8,000 m^2
77	68,900~68,950	completely weathered gr.	〃	③-S	C	①224 m^2
78	69,060~69,090	〃	〃	②-M	A	①390 m^2
79	69,130~69,150	〃	〃	②-S	A	①90 m^2
80	69,150~69,230	soil	〃	②-S	C	①358 m^2
81	69,230~69,300	〃	〃	②-S	B	①313 m^2
82	69,300~69,360	〃	〃	②-M	A	①268 m^2
83	69,380~69,360	〃	〃	②-S	A	①90 m^2
84	69,400~69,540	completely weathered gr.	〃	②-M	B	⑨1,400 m^2
85	69,540~69,665	〃	〃	③-M	A	①559 m^2
86	69,690~69,700	soil	〃	⑥-L	B	④H=4, L=20 m
87	69,700~69,900	completely weathered gr.	〃	③-M	C	⑨2,000 m^2
88	69,900~70,000	soil	black schist	②-M	C	①449 m^2
89	70,000~70,225	〃	black schist chert lime stone	③-S	A	⑦4,500 m^2
90	70,225~70,500	soil completely weathered gr.	black schist granodiorite	②-S	B	①1230 m^2
91	70,515~70,525	pumice (low deposit soil	black schist	①-M	A	③H=3, L=10 m
92	71,300~71,425	soil	amphibolite	②-S	C	⑨1,000 m^2
93	71,425~71,445	weathered rock	〃	③-S	B	⑨200 m^2
94	71,445~71,730	〃	〃	③-M ⑥-M	A	⑥H=1.5, L=285 m
95	71,735~71,760	soil	granodiorite black schist	⑥-L	A	⑥H=4, L=40 m, ⑩L=20 m
96	71,470~71,525	〃	amphibolite	⑤-M	B	④H=7, L=55 m
97	71,705~71,730	〃	〃	⑤-M	B	②H=4, L=25 m
98	71,770~72,240	〃	black schist amphibolite	①-L	A	※LS-2
99	72,400~72,600	〃	alter nation of gr and blsch	①-M ②-M	B	⑤H=10, L=200m
100	72,695~72,780	〃	〃	②-M	B	①380 m^2

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probability
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted - T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
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⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (5) Preventive Works

Section No.	Station (Km)	Geology: Surface	Geology: bedrock	TD & ED	PO	Type and extent of preventive works
101	72,785~72,795	pumice flow deposit. soil	alternation of grandbl.sch	⑥-M	A	⑬H=4, L=20 m
102	72,830~72,840	〃	〃	⑥-L	A	⑬H=4, L=25 m
103	72,995~73,060	〃	〃	③-S	A	②H=4, L=65 m
104	73,060~73,220	soil	〃	②-M	C	①537 m²
105	73,220~73,280	〃	〃	②-S	A	①268 m²
106	73,280~73,450	〃	〃	①-M	C	⑤H=10, L=170 m
107	73,400~73,560	〃	〃	⑤-M	C	①716 m²
108	73,670~73,920	〃	〃	①-L	A	※LS-3
109	73,930~74,060	〃	blak schist	③-M	C	①581 m²
110	74,100~74,200	〃	〃	②-S	B	②H=4, L=100 m
111	74,260~74,280	soil sand and gravel	blak schist chert	⑥-M	A	⑬H=4, L=30 m
112	74,400~74,800	pumice flow deposit. soil	blak schist	②-S	B	②1,789 m²
113	74,900~75,060	〃	〃	②-S	C	①716 m²
114	75,100~75,140	soil	〃	②-S	B	①179 m²
115	75,180~75,290	weathered rock	〃	②-M	C	②H=6, L=110 m
116	75,290~75,400	〃	blak schist graphite schist	③-L	A	①246 m², ⑥1,100 m²
117	75,400~75,505	soil	〃	①-L	A	※LS-4
118	75,505~75,515	〃	〃	⑥-L	A	⑬H=4, L=120 m
119	75,530~75,555	weathered rock.	blak schist	③-L	A	③H=3, L=25 m, ④H=15, L=25 m
120	75,555~75,720	〃	〃	④-S	C	⑦1,115 m²
121	75,790~75,820	〃	〃	②-S	C	①134 m²
122	75,900~75,910	〃	〃	②-S	C	①45 m²
123	76,380~76,520	soil weathered rock		②-M	C	①626 m²
124	76,520~76,840	soil	black schist green schist	①-L	B	※LS-5
125	76,860~76,930	〃	〃	②-S	A	③H=3, L=70 m

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probablly
C : Low probablity

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
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⑥ Flexible type wall with concrete frame
⑦ Rock net
⑧ Rock fence
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⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 − 2 − (6) Preventive Works

Section №	Station (Km)	Geology: Surface	Geology: bedrock	TD & ED	PO	Type and extent of preventive works
126	76,945~76,955	soil	black schist green schist	⑥−S	A	⑱L=8m
127	77,020~77,120	〃	black schist	②−M	C	①559 m²
128	77,125~77,135	〃	〃	⑥−M	A	⑬H=4 L=30m, ⑭W=4 L=20m ⑯L=8m
129	77,200~77,255	〃	〃	②−M	C	①184 m²
130	77,285~77,390	weathered rock	〃	③−M	A	①470 m², ⑧H=1.5, H=105 m
131	77,390~77,410	soil	〃	⑥−M	A	⑬H=4, L=15m, ⑭W=4, L=30m
132	77,320~77,400	〃	〃	⑤−M	B	②H=6, L=80 m
133	77,410~77,520	〃	〃	②−M	B	①615 m²
134	77,520~77,530	〃	〃	②−S	A	①56 m², ⑧H=15, L=10m
135	77,530~77,585	weathered rock	〃	②−S	B	①307 m²
136	77,585~77,595	soil	〃	⑥−S	A	③H=3, L=10m
137	77,595~77,650	pumice flow deposit soil	〃	②−S	C	①246 m²
138	77,650~77,670	〃	〃	②−S	B	①90 m²
139	77,710~77,720	〃	〃	⑥−M	B	⑬H=4, L=10 m
140	77,750~77,830	〃	〃	②−S	C	①358 m²
141	77,830~78,080	〃	alternation of grand bl.sch.	①−L	A	※LS−6
142	78,100~78,240	〃	〃	②−M	C	①626 m²
143	78,260	〃	〃	⑥−L	B	⑬H=4, L=20m, ⑭W=4, L=100m
144	78,260~78,300	〃	〃	②−M	A	①179 m²
145	78,300~78,400	〃	〃	②−S	C	①335 m²
146	78,360~78,400	〃	〃	⑤−M	B	⑩280 m²
147	78,460~78,485	〃	〃	⑤−M	C	⑩125 m²
148	78,540~78,600	〃	〃	⑤−S	B	④H=7, L=60m
149	78,600~78,665	〃	black schist	⑤−M	A	④H=7, L=65 m
150	78,605~78,640	〃	〃	⑥−S	A	③H=3, L=35m, ⑧H=15, L=35m

※ Preventive works for landslide are shown in Table 7−15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probabily
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
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⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (7) Preventive Works

Section No.	Station (Km)	Geology: Surface	Geology: bedrock	TD & ED	PO	Type and extent of preventive works
151	78,640~78,660	pumice flow deposit. soil	black schist	②-S	B	① 9 0 m²
152	78,740~78,790	weathered rock.	〃	③-S	C	⑨ 9 0 0 m²
153	79,000~79,040	pumice flow deposit. weathered rock.	〃	②-M	C	① 1 7 9 m²
154	79,040~79,100	soil weathered rock	green schist black schist	⑥-M	A	③ H=3 L=6 0 m ⑧ H=1.5 L=3 5 m ⑬ H=4 L=2 0 m
155	79,100~79,180	weathered rock	green schist	④-S	C	⑦ 4 8 0 m²
156	79,120~79,160	soil	〃	⑤-M	C	⑩ 2 8 0 m²
157	79,300~79,380	pumice flow deposit	black schist	②-S	C	① 3 5 8 m²
158	79,380~79,390	pumice flow deposit. soil	〃	⑥-M	A	⑬ H=4 L=8 m ⑭ W=4 L=2 0 m ⑯ 8 m
159	79,420~79,520	weathered rock	〃	④-M	C	⑦ 6 0 0 m²
160	79,520~79,620	〃	black schist green schist	④-S	C	⑦ 5 0 0 m²
161	79,625~79,635	soil	〃	⑤-M	A	⑬ H=4 L=1 5 m ⑭ W=4 L=2 0 m
162	79,640~79,650	pumice flow deposit	green schist	②-M	C	① 3 4 m²
163	79,710~79,760	〃	〃	③-S	C	⑦ 3 0 0 m²
164	79,720~79,745	soil	〃	⑤-M	B	① 1 1 2 m²
165	79,760~79,980	〃	black schist	②-S	C	① 1,2 3 0 m²
166	79,980~80,055	〃	〃	②-M	B	① 3 3 5 m² ⑧ H=1.5 L=7 5 m
167	80,030~80,060	〃	〃	⑤-M	A	④ H=7 , L=3 0 m
168	80,150~80,155	〃	〃	⑥-S	B	⑬ H=4 L=1 0 m ⑭ W=4 L=1 5 m
169	80,165~80,380	pumice flow deposit. soil	alternation of gr. and bl. sch.	③-S	B	⑥ 1,7 2 0 m²
170	80,400~80,420	〃	〃	⑤-M	B	④ H=5 , L=2 0 m
171	81,040~81,330	weathered rock	〃	③-L	A	① 2,2 7 0 m², ⑧ H=1.5, L=2 9 0 m
172	81,330~81,390	soil	〃	②-L	A	① 3 3 5 m²
173	81,400	〃	〃	⑥-M	A	⑬ H=4 L=6 0 m ⑭ W=4 L=2 0 0 m
174	81,430~81,500	〃	〃	①-L	A	※L S - 7
175	81,500~81,590	weathered rock	〃	③-M	A	① 6 0 4 m²

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probably
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
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⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (8) Preventive Works

Section No.	Station (Km)	Geology Surface	Geology bedrock	TD & ED	PO	Type and extent of preventive works
176	81,590~81,800	weathered rock	green schist	④-S	C	⑦2,100 m²
177	82,000~82,300	soil weathered rock	green schist black schist	①-L	A	※LS-8
178	82,600~82,660	soil pumice flow deposit	green schist	②-M	C	③H=3, L=60 m
179	82,600~82,800	〃	〃	⑤-M	C	④H=5, L=100 m
180	82,660~82,750	〃	〃	③-M	A	①604 m² ⑧H=1.5, L=90 m
181	82,750~82,880	〃	〃	②-M	B	①872 m² ⑧H=1.5, L=130 m
182	82,940~83,100	pumice flow deposit	pumice flow deposit (hard)	②-M	C	②H=6, L=60 m
183	83,100~83,150	〃	〃	②-M	C	②H=6, L=50 m ⑧H=1.5, L=50 m
184	83,160~83,225	〃	〃	②-M	A	①363 m² ⑧H=1.5, L=65 m
185	83,225~83,320	〃	〃	②-M	C	①531 m² ⑧H=1.5, L=95 m
186	83,320~83,430	〃	〃	②-M	C	②H=6, L=110 m, ④H=1.5, L=110 m
187	83,400~83,600	soil	black schist	⑤-S	C	④H=5, L=200 m
188	83,450~83,535	pumice flow deposit	〃	②-S	B	①475 m², ⑧H=1.5, L=85 m
189	83,535~83,660	〃	〃	②-S	C	⑦1,000 m²
190	83,660~83,820	〃	〃	②-S	C	①894 m²
191	83,820~83,830	〃	〃	⑥-M	B	⑬H=4 L=20 m ⑭W=4 L=30 m ⑯L=8 m
192	83,880~83,920	〃	〃	②-S	B	⑦1,000 m²
193	83,920~84,080	〃	〃	③-S	A	⑨1,280 m²
194	84,200~84,320	〃	〃	②-M	B	①670 m²
195	84,250~84,260	〃	〃	⑥-L	B	⑬H=4 L=30 m ⑭W=4 L=40 m ⑯L=8 m
196	84,940~84,950	〃	green schist	⑥-S	B	⑬H=4 L=15 m
197	85,140~85,190	〃	pumice flow deposit (hard)	②-S	B	①224 m² ⑯L=8 m
198	85,290~85,375	〃	〃	②-M	A	⑤H=10, L=85 m
199	85,380~85,390	〃	〃	⑥-M	A	⑬H=4, L=10 m, ⑭W=4, L=20 m
200	85,400~85,420	pumice flow deposit sand and gravel	〃	②-S	C	①90 m²

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probabily
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted－T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
⑦ Rock net
⑧ Rock fence
⑨ Grout faced
⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (9) Preventive Works

Section No.	Station (Km)	Geology: Surface	Geology: bedrock	TD & ED	PO	Type and extent of preventive works
201	85,430~85,440	pumice flow deposit, sand and gravel.	pumice flow deposit	⑥-L	A	⑬ H=4 L=20m ⑭ W=4 L=20m ⑯ L=8 m
202	85,450~85,480	〃	black schist	②-S	C	① 201 m²
203	85,570~85,680	weathered rock	〃	③-S	A	⑨ 1,650 m²
204	85,690~85,725	soil	〃	②-S	B	① 156 m²
205	85,690~85,725	〃	〃	⑤-M	B	④ H=7, L=35 m
206	85,780~85,830	weathered rock	〃	④-S	B	⑦ 400 m²
207	85,885~85,960	〃	〃	②-S	C	① 335 m², ⑧ H=1.5, L=75 m
208	85,965~85,975	soil	〃	②-S	C	⑯ L=8 m
209	86,040~86,260	〃	〃	②-S	C	① 984 m²
210	86,040~86,080	〃	〃	⑤-L	B	⑤ H=10, L=40 m
211	86,260~86,355	soil weathered rock	〃	②-L	B	⑤ H=10, L=95 m
212	86,360~86,370	〃	〃	⑥-M	B	⑬ H=4, L=15 m, ⑭ W=4, L=30 m
213	86,400~86,540	weathered rock	〃	③-M	A	⑦ 2,100 m²
214	86,540~86,555	〃	〃	⑥-S	C	③ H=3, L=15 m, ⑧ H=1.5, L=15 m
215	86,555~86,580	〃	〃	②-S	B	① 140 m²
216	86,885~86,720	〃	〃	④-S	B	⑦ 280 m²
217	86,750~86,815	soil	〃	⑤-M	B	⑤ H=10, L=65 m
218	86,218~87,000	soil weathered rock	〃	②-S	C	① 637 m
219	87,000~87,040	〃	〃	③-M	A	③ H=3, L=40 m
220	87,140~87,210	〃	〃	②-M	C	① 235 m²
221	87,240~87,250	soil	〃	⑥-M	C	⑬ H=4, L=20 m
222	87,250~87,300	〃	〃	②-M	A	① 112 m², ⑧ H=1.5, L=50 m
223	87,300~87,310	〃	〃	⑥-S	B	③ H=3, L=10 m, ⑧ H=1.5, L=10 m
224	87,420~87,475	weathered rock	green schist	④-S	C	⑦ 825 m²
225	87,475~87,530	〃	〃	③-M	A	① 246 m², ⑧ H=1.5, L=55 m

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probabilty
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted-T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
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⑧ Rock fence
⑨ Grout faced
⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (10) Preventive Works

Section No.	Station (Km)	Geology Surface	Geology bedrock	TD & ED	PO	Type and extent of preventive works
226	87,530~87,570	soil	green schist	⑤-M	A	②H=4, L=40 m
227	87,530~87,590	soil weathered rock	〃	③-S	C	①335 m³, ⑥H=1.5, L=60 m
228	87,630~87,660	weathered rock	black schist	③-M	B	⑨600 m²
229	87,700~87,850	soil weathered rock	〃	④-S	C	⑦2,250 m²
230	87,850~87,885	〃	〃	②-L	B	①196 m³, ⑥H=1.5, L=35 m
231	87,885~87,895	〃	〃	⑥-S	C	⑬H=4, L=10 m
232	87,900~87,915	weathered rock	〃	③-M	B	①69 m³, ⑧H=1.5, L=15 m
233	88,010~87,055	〃	〃	③-M	B	①201 m³, ⑧H=1.5, L=15 m
234	88,310~88,350	〃	〃	③-S	B	②H=6, L=40 m
235	88,350~88,380	soil	〃	②-S	A	②H=6, L=30 m
236	88,380~88,440	〃	〃	②-S	B	②H=6, L=60 m
237	88,490~88,550	〃	〃	②-M	C	③H=3, L=60 m
238	88,580~88,610	〃	〃	⑤-M	B	⑤H=10, L=30 m
239	88,650~88,660	soil sand and gravel	〃	⑥-M	A	⑭W=4, L=30 m, ⑯L=8 m
240	88,690~88,735	weathered rock	〃	③-S	A	⑨450 m²
241	88,790~88,800	soil	〃	⑥-S	C	⑭W=4, L=30 m, ⑯L=8 m
242	88,890~88,940	weathered rock	〃	③-S	C	⑨750 m
243	88,950~89,000	soil	〃	⑤-M	A	⑤H=10, L=50 m
244	89,120~89,150	weathered rock	green schist	③-M	C	①168 m³
245	89,220~89,360	soil weathered rock	〃	②-S	C	①626 m³
246	89,360~89,400	weathered rock	〃	④-S	B	⑦400 m²
247	89,400~89,850	soil weathered rock	〃	③-S	C	①2,516 m³
248	93,000~93,080	〃	black schist	②-S	C	⑦1,600 m²
249	93,080~93,160	〃	〃	③-S	A	⑨960 m²
250	93,160~93,170	soil	〃	⑥-M	B	⑬H=4, L=15 m, ⑭W=4, L=20 m

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probabily
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted-T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
⑦ Rock net
⑧ Rock fence
⑨ Grout faced
⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (11) Preventive Works

Section No.	Station (Km)	Geology		TD & ED	PO	Type and extent of preventive works
		Surface	bedrock			
251	93,205~93,340	weathered rock	green schist	④-S	B	② 2,025 m²
252	93,260~93,300	〃	〃	⑤-M	B	④ H=7, L=40 m
253	93,345~93,360	soil	〃	⑥-L	A	⑬ H=4, L=16 m ⑭ W=4, L=50 m
254	93,420~93,490	weathered rock	black schist	④-S	C	⑦ 1,400 m²
255	93,520~93,590	soil	〃	②-M	B	③ H=3, L=70 m
256	93,590~93,640	weathered rock	〃	②-M	B	① 224 m, ⑧ H=1.5, L=50 m
257	93,640~93,680	〃	〃	②-S	B	① 179 m²
258	93,680~93,710	soil	〃	②-S	B	③ H=3, L=30 m
259	93,710~93,760	weathered rock	alternation of gr.& bl.sch	③-M	B	⑨ 750 m²
260	93,760~93,820	soil	〃	②-M	B	② H=6, L=40 m, ⑧ H=1.5, L=40 m
261	93,820~93,880	weathered rock	〃	②-M	C	① 402 m²
262	93,840~93,910	soil	〃	⑤-M	B	④ H=5, L=70 m
263	93,880~93,890	〃	〃	⑥-M	A	⑬ H=4, L=20 m ⑭ W=4, L=30 m, ⑮ L=8 m
264	93,890~93,950	weathered rock	〃	②-M	C	① 268 m², ⑧ H=1.5, L=60 m
265	93,950~94,050	〃	〃	⑤-L	A	⑤ H=10, L=100 m, ⑩ 500 m²
266	93,980~94,080	soil	〃	②-M	C	① 671 m²
267	94,100~94,320	pumice flow deposit weathered rock	〃	②-S	A	⑨ 3,000 m²
268	94,180~94,230	weathered rock	black schist	⑤-M	A	⑤ H=10, L=100 m
269	94,330~94,350	soil	alternation of gr.& bl.sch	⑥-M	C	⑬ H=4, L=20 m
270	94,540~94,620	weathered rock	green schist	③-S	C	⑨ 800 m²
271	94,540~94,600	soil	〃	⑤-M	B	④ H=5, L=60 m
272	94,620~94,630	〃	alternation of gr.& bl.sch	⑥-L	B	⑬ H=4, L=30 m
273	94,675~94,800	soil weathered rock	〃	③-M	A	⑦ 3,750 m²
274	94,670~94,760	〃	〃	⑤-L	A	⑮ H=6, L=90 m, ④ H=7, L=90 m
275	94,840~95,000	weathered roc	green schist	③-S	C	① 894 m²

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probabilty
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted-T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
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⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (12) Preventive Works

Section No.	Station (Km)	Geology: Surface	Geology: bedrock	TD & ED	PO	Type and extent of preventive works
276	94,880~94,900	weathered rock	green schist	⑤-M	B	④H=5, L=20 m
277	94,970~95,050	〃	alternation of gr. & bl. sch	⑤-M	C	⑤H=10, L=80 m
278	95,000~95,045	pumice flow deposit weathered rock	〃	②-M	B	①201 m^2, ⑥315 m^2
279	95,045~95,110	weathered rock	green schist	④-M	B	⑦550 m^2
280	95,240~94,370	〃	〃	③-S	C	⑦910 m^2
281	95,370~95,380	〃	〃	⑥-M	A	②H=4, L=10 m, ⑧H=1.5, L=10 m
282	95,390~95,400	〃	〃	⑥-L	B	⑬H=4, L=20 m, ⑭W=4, L=50 m
283	95,400~95,560	〃	〃	③-S	A	⑨1,600 m^2
284	95,560~95,640	〃	〃	③-S	C	⑦640 m^2
285	95,780~95,860	〃	〃	③-L	A	③H=3, L=80 m, ⑧H=1.5, L=80 m
286	95,860~96,200	〃	〃	③-M	A	⑨8,500 m^2
287	96,010~96,040	soil	〃	⑤-M	B	④H=7, L=30m
288	96,100~96,180	〃	〃	⑤-M	C	②H=6, L=80m
289	96,245~96,285	weathered rock	black schist	②-S	A	①179 m^2, ⑥280 m^2
290	96,285~96,320	〃	〃	②-S	C	⑨525 m^2
291	96,320~96,365	soil	〃	②-M	A	①201 m^2, ⑥315 m^2
292	96,320~96,360	〃	〃	⑤-M	A	④H=5, L=40 m
293	96,365~96,430	〃	〃	②-M	C	①291 m^2, ⑥455 m^2
294	96,430~96,470	weathered rock	〃	③-S	B	⑨800 m^2
295	96,520~96,690	〃	〃	③-S	B	①760 m^2, ⑧H=1.5, L=170 m
296	96,630~96,645	〃	〃	⑤-M	B	④H=7, L=15 m
297	96,645~96,800	〃	〃	③-M	A	①693 m^2, ⑧H=1.5, L=155 m
298	96,710~96,755	soil	〃	⑤-L	B	⑤H=10, L=90 m
299	96,800~96,920	weathered rock	green schist	④-M	B	⑨1,800 m^2
300	96,820~96,920	〃	〃	⑥-L	B	④H=7, L=100 m, ⑮H=6, L=100 m

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probability
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted - T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
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⑧ Rock fence
⑨ Grout faced
⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (13) Preventive Works

Section No	Station (Km)	Geology: Surface	Geology: bedrock	TD & ED	PO	Type and extent of preventive works
301	96,920~96,980	weathered rock	green schist	③-S	C	⑨600 m²
302	96,985~97,040	soil	black schist	⑤-M	B	④H=5, L=55m
303	96,980~97,130	〃	〃	②-S	C	①671 m²
304	97,140~97,190	〃	〃	⑤-M	C	④H=7, L=50 m
305	97,320~97,440	〃	〃	②-S	A	③H=3, L=120m
306	97,385~97,440	〃	〃	⑤-M	C	④H=5, L=55 m
307	97,450~97,530	weathered rock	〃	③-S	B	①358m², ⑧H=1.5, L=80m²
308	98,560~97,580	soil	〃	⑤-M	A	④H=7, L=20m
309	97,590~97,720	weathered rock	〃	③-S	C	①581 m²
310	97,730~97,820	soil	porphyrite black schist	①-L	A	※LS-9
311	97,820~97,900	weathered rock	black schist	③-M	A	①447 m², ⑧H=1.5, L=80 m
312	97,900~97,920	soil	〃	⑥-L	A	⑬H=4, L=20m, ⑭W=4, L=50 m
313	97,935~98,000	soil weathered rock	〃	③-S	A	①363 m², ⑧H=1.5, L=65 m
314	98,000~98,090	〃	〃	②-S	B	①503 m², ⑧H=1.5, L=90m
315	98,200~98,370	weathered rock	〃	④-S	C	⑦1,700 m²
316	98,200~98,290	〃	〃	⑤-M	B	④H=7, L=90m
317	98,310~98,325	soil	black schist	⑤-M	A	④H=5, L=15m
318	98,370~98,480	pumice flow deposit soil	〃	②-S	C	①492 m²
319	98,480~98,650	weathered rock	〃	②-S	C	①760 m²
320	98,480~98,550	soil	〃	⑤-S	B	④H=5, L=70 m
321	98,570~98,635	〃	〃	⑤-M	B	④H=5, L=65 m
322	98,770~98,885	weathered rock	〃	③-M	A	⑦920 m²
323	98,765~98,855	〃	〃	⑤-S	B	④H=5, L=90 m
324	98,920~98,960	〃	〃	③-S	B	①224 m²
325	98,950~99,060	soil	〃	⑤-M	A	④H=5, L=110 m

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probablity
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
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⑧ Rock fence
⑨ Grout faced
⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (14) Preventive Works

Section №	Station (Km)	Geology Surface	Geology bedrock	TD & ED	PO	Type and extent of preventive works
326	98,960~99,060	soil	black schist	②-S	C	①559㎡
327	99,065~99,085	〃	〃	⑤-M	A	④H=5, L=20m
328	99,090~99,170	weathered rock	〃	④-S	B	⑦800㎡
329	99,200~99,300	soil weathered rock	〃	②-S	C	①447㎡
330	99,390~99,410	〃	〃	⑤-M	A	④H=5, L=20m
331	99,440~99,580	pumice flow deposit soil	〃	②-S	C	①626㎡
332	99,800~99,865	〃	〃	⑤-S	B	⑤H=10, L=65m
333	99,890~99,940	〃	〃	②-M	C	②H=4, L=50m
334	100,000~100,100	weathered rock	〃	④-S	C	⑦800㎡
335	100,110~100,140	〃	〃	③-S	B	⑦450㎡
336	100,185~100,225	〃	〃	③-S	A	①179㎡, ⑧H=1.5, L=40m
337	100,225~100,365	〃	alt.of gr & bl.sch	④-S	C	⑦810㎡
338	100,400~100,700	〃	black schist	④-S	C	⑦1,500㎡
339	100,750~100,900	volcanic ash	alt.of gr & bl.sch	③-M	C	①335㎡, ⑧H=1.5, L=50m
340	100,900~101,170	〃	〃	②-M	A	⑤H=10, L=270m, ⑧H=1.5, L=50m
341	101,230~100,240	sand and gravel	〃	⑥-L	A	⑬H=4, L=60m, ⑭W=4, L=200m
342	101,250~101,350	volcanic ash weathered rock	green schist	③-M	A	①559㎡, ⑧H=1.5, L=50m
343	101,350~101,550	〃	alt.of gr & bl.sch	①-L	A	※LS-10
344	101,900~101,910	〃	black schist	⑥-M	B	⑭W=4, L=40m, ⑯L=8m
345	101,950~102,000	〃	green schist	③-S	B	⑦750㎡
346	102,070~102,120	〃	〃	③-S	A	⑦750㎡
347	102,120~102,220	volcanic ash	〃	②-S	C	①447㎡
348	102,220~102,230	〃	〃	⑥-S	A	⑭W=4, L=10m, ⑯L=8m
349	102,330~102,400	〃	〃	⑤-M	C	④H=5, L=70m
350	102,650~102,750	weathered rock	black schist	②-M	A	①559㎡, ⑧H=15, L=100m

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probability
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted-T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
⑦ Rock net
⑧ Rock fence
⑨ Grout faced
⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 − 2 − (15) Preventive Works

Section No	Station (Km)	Geology: Surface	Geology: bedrock	TD & ED	PO	Type and extent of preventive works
351	102,830~102,840	weathered rock	black schist	⑥−M	B	⑬H=4, L=20 m
352	102,860~102,980	volcanic ash soil	〃	①−L	A	※LS−11
353	103,140~103,230	volcanic ash weathered rock	〃	③−S	C	⑦900 m²
354	103,320~103,450	〃	black schist porphyrite	④−S	C	①581 m²
355	103,460~103,540	〃	black schist	④−S	B	⑨800 m²
356	103,470~103,530	〃	〃	⑤−M	B	④H=5, L=60m
357	103,650~103,850	〃	〃	③−S	B	①894 m², ⑧H=1.5, L=200 m
358	103,850~103,870	〃	porphyrite	⑤−L	A	④H=5, L=20 m
359	103,870~104,000	〃	〃	③−L	A	①581 m², ⑧H=1.5, L=130 m
360	104,000~104,130	〃	〃	②−M	B	⑥910 m²
361	104,045~104,070			⑤−M	B	④H=5, L=35 m
362	104,130~104,300	weathered rock	porphyrite	③−M	A	⑨3,400 m²
363	104,340~104,430	〃	〃	③−S	B	⑨900 m²
364	104,400~104,500	〃	〃	⑤−S	B	④H=5, L=100 m, ⑮H=4, L=100 m
365	104,430~104,520	〃	〃	③−M	A	①402 m², ⑧H=1.5, L=90 m
366	104,630~104,710	〃	〃	③−M	A	③H=3, L=80 m
367	104,640~104,700	soil	〃	⑤−S	A	⑬H=4, L=60 m
368	104,700~104,825	weathered rock	〃	③−S	C	⑦1,250 m²
369	104,825~104,880	〃	〃	③−M	A	③H=3, L=55 m, ⑧H=15, L=55 m
370	105,180~105,300	〃	〃	③−S	B	①537 m², ⑧H=1.5, L=120 m
371	105,360~105,400	volcanic ash	black schist	⑤−M	B	②H=4, L=40 m
372	105,430~105,560	〃	〃	②−S	B	⑥H=10, L=130 m
373	105,530~105,750	〃	〃	①−L	A	⑤H=10, L=220 m
374	105,820~106,010	〃	〃	⑤−M	C	④H=5, L=190 m
375	106,200~106,280	〃	〃	②−M	B	⑥1,120 m²

※ Preventive works for landslide are shown in Table 7−15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probabilty
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted −T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
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⑨ Grout faced
⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (16) Preventive Works

Section No.	Station (Km)	Geology: Surface	Geology: bedrock	TD & ED	PO	Type and extent of preventive works
376	106,200~106,280	volcanic ash	black schist	①-L	A	※LS-12
377	106,350~106,400	〃	〃	⑤-L	C	⑤H=10, L=50m
378	106,470~106,540	〃	〃	①-L	A	※LS-13
379	106,875~106,910	〃	〃	⑤-M	B	④H=5, L=35m
380	107,040~107,150	〃	〃	②-S	C	①492m
381	107,310~107,400	〃	〃	①-M	A	⑤H=10, L=90m
382	107,500~107,660	〃	〃	④-S	C	⑦1,600m²
383	107,570~107,640	〃	〃	⑤-M	A	④H=7, L=70m
384	107,640~107,800	〃	〃	⑤-M	B	④H=7, L=160m
385	107,850~107,880	〃	〃	⑤-S	B	④H=5, L=30m
386	107,950~108,000	〃	〃	⑤-M	A	④H=7, L=30m
387	108,010~108,040	〃	〃	⑤-S	B	④H=7, L=30m
388	108,330~108,380	〃	〃	②-S	A	①335m
389	108,570~108,800	〃	〃	①-L	B	※LS-14
390	108,901~109,150	〃	〃	②-S	C	①559m²
391	109,151~109,300	〃	〃	②-S	A	③H=3, L=150m
392	109,500~109,800	〃	〃	② S	L	①1,342m
393	109,810~109,910	〃	〃	⑤-M	A	④H=5, L=60m
394	109,910~110,000	〃	〃	②-S	B	③H=3, L=100m
395	110,100~110,200	soil volcanic ash	〃	⑤-M	A	⑤H=10, L=200m
396	110,240~110,290	〃	〃	②-S	A	①224m²
397	110,290~110,360	〃	〃	⑤-M	B	⑤H=10, L=140m
398	110,390~110,450	〃	〃	②-S	A	①268m²
399	110,450~110,540	〃	〃	②-S	C	①201m²
400	110,540~110,590	〃	〃	②-M	B	①224m²

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probablly
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted-T type retaining wall
⑤ Crib wall
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⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (17) Preventive Works

Section No.	Station (Km)	Geology: Surface	Geology: bedrock	TD & ED	PO	Type and extent of preventive works
401	110,700~111,100	soil volcanic ash	black schist	②-S	C	①894 m³
402	111,330~111,400	volcanic ash	〃	②-S	B	①391 m³
403	111,730~111,840	〃	〃	②-S	B	①492 m³
404	111,840~112,000	〃	〃	②-S	C	①358 m³
405	112,000~112,050	〃	〃	⑤-M	A	④H=5, L=50 m
406	112,200~112,340	〃	〃	②-S	C	①783 m³
407	112,340~112,520	〃	〃	①-L	A	※LS-15
408	113,000~113,200	〃	〃	①-L	A	※LS-16
409	114,340~114,450	weathered rock	diabase	③-S	C	⑦2,200 m³
410	114,550~114,600	〃	〃	③-S	C	①224 m³
411	114,650~114,700	soil	〃	②-M	B	①391 m³
412	114,860~114,940	〃	〃	②-M	C	①358 m³, ⑧H=1.5, L=80 m
413	115,070~115,100	volcanic ash	black schist	⑤-M	B	④H=5, L=30 m
414	115,125~115,150	〃	〃	②-S	A	①168 m³
415	115,200~115,400	〃	〃	②-S	C	①671 m³, ⑧H=1.5, L=200 m
416	115,400~115,500	〃	〃	⑤-M	A	④H=5, L=100 m
417	115,540~115,600	〃	〃	⑤-M	B	④H=7, L=60 m
418	115,700~115,770	〃	〃	⑤-L	A	④H=7, L=140 m
419	116,360~116,430	〃	〃	②-S	C	①313 m³
420	116,600~116,650	〃	〃	⑤-M	C	④H=7, L=50 m
421	116,900~116,980	〃	〃	②-S	B	①358 m³
422	117,120~117,160	〃	〃	⑤-M	B	④H=5, L=40 m
423	117,170~117,300	〃	〃	②-S	C	①581 m³
424	117,470~117,520	〃	〃	②-S	B	①335 m³
425	117,700~117,790	〃	〃	②-M	B	①402 m³, ⑧H=1.5, L=90 m

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probability
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted -T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
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⑧ Rock fence
⑨ Grout faced
⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 − 2 − (18) Preventive Works

Section No.	Station (Km)	Geology		TD & ED	PO	Type and extent of preventive works
		Surface	bedrock			
426	117,130~118,120	volcanic ash	black schist	①−L	B	※LS−17
427	118,150~118,220	〃	〃	⑥−M	A	③ H=3 L=70m ⑧ H=1.5 L=70m ⑭ W=4 L=40m
428	118,350~118,400	〃	〃	⑤−M	A	④H=5, L=50m
429	118,420~118,475	〃	〃	⑤−S	B	①246㎡
430	118,520~118,600	〃	〃	⑤−S	C	④H=5, L=80m
431	118,600~118,660	〃	〃	②−S	C	①268㎡
432	118,660~118,700	〃	〃	②−S	A	①179㎡
433	118,710~118,740	〃	〃	⑤−M	A	④H=5, L=30m
434	118,740~118,810	〃	〃	②−S	C	①313m
435	118,810~118,850	〃	〃	⑤−M	A	④H=5, L=40m
436	119,220~119,260	〃	〃	②−M	A	③H=3, L=40m
437	119,310~119,450	〃	〃	②−M	A	①626㎡, ⑧H=1.5, L=140m
438	119,550~119,650	〃	〃	①−L	A	※LS−18
439	119,650~119,780	〃	〃	⑤−M	A	⑪900m
440	119,950~120,000	〃	〃	⑤−M	C	④H=7, L=50m
441	120,150~120,330	〃	〃	②−S	C	①604㎡
442	120,250~120,340	〃	〃	⑤−M	A	④H=7, L=90m
443	120,410~120,550	〃	〃	②−S	B	③H=3, L=140m
444	120,430~120,450	〃	〃	⑤−S	C	①90㎡
445	120,520~120,550	〃	〃	⑤−S	C	①90㎡
446	120,720~120,750	〃	〃	⑤−S	C	④H=5, L=30m
447	120,780~120,820	〃	〃	⑤−M	B	④H=7, L=40m
448	120,820~120,870	〃	〃	②−M	B	①335㎡
449	120,850~120,970	〃	〃	⑤−L	A	⑪3,600m
450	121,030~121,060	〃	〃	⑤−M	C	④H=7, L=30m

※ Preventive works for landslide are shown in Table 7−15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probablity
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted − T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
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⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (19) Preventive Works

Section No	Station (Km)	Geology Surface	Geology bedrock	TD & ED	PO	Type and extent of preventive works
451	121,270~121,350	volcanic ash	black schist	⑤-M	C	④H=7, L=80m
452	121,400~121,880	〃	〃	②-S	C	①1,610m²
453	121,850~122,050	〃	〃	⑤-M	B	④H=7, L=100m
454	122,700~122,750	〃	〃	⑤-S	C	④H=5, L=50m
455	123,050~123,300	〃	〃	⑤-M	B	④H=5, L=250m
456	123,500~123,650	〃	〃	⑤-S	C	④H=5, L=150m
457	123,650~123,720	〃	〃	⑤-S	B	④H=5, L=70m
458	123,800~123,820	〃	〃	⑤-M	B	④H=7, L=20m
459	123,840~123,860	〃	〃	⑤-M	A	④H=7, L=20m
460	123,870~123,930	〃	〃	⑤-M	B	④H=7, L=60m
461	124,030~124,060	〃	〃	②-S	C	①134m²
462	124,150~124,180	〃	〃	①-M	B	③H=3, L=30m
463	124,190~124,270	〃	〃	⑤-S	C	④H=5, L=20m
464	124,300, 124,320	〃	〃	⑤-S	C	④H=5, L=20m
465	124,370~124,400	〃	〃	⑤-S	C	④H=5, L=30m
466	124,620~124,680	〃	〃	⑤-M	B	④H=7, L=60m
467	124,850~125,000	〃	〃	⑤-M	B	④H=7, L=150m
468	125,025~125,100	〃	〃	⑤-L	B	④H=7, L=150m
469	125,250~125,400	〃	〃	②-S	C	①671m²
470	125,480~125,530	〃	〃	⑤-M	C	④H=5, L=50m
471	125,740~125,780	〃	〃	⑤-M	C	④H=5, L=40m
472	125,860~126,220	〃	〃	②-S	C	①1,610m²
473	126,050~126,110	〃	〃	⑤-L	A	③H=10, L=60m
474	126,220~126,380	〃	〃	②-S	C	①716m²
475	126,450~126,520	〃	〃	①-M	C	⑤H=10, L=70m

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probablty
C : Low probablty

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted -T type retaining wall
⑤ Crib wall
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⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (20) Preventive Works

Section No	Station (Km)	Geology Surface	Geology bedrock	TD & ED	PO	Type and extent of preventive works
476	126,610~126,660	volcanic ash	black schist	②-M	C	③H=3, L=50m
477	126,900~127,075	〃	〃	②-S	C	①783 m²
478	127,075~127,200	〃	〃	①-M	B	③H=3, L=125m
479	127,310~127,375	〃	〃	⑤-M	B	④H=5, L=65m
480	127,580~127,680	〃	〃	②-S	B	③H=3, L=100m
481	127,680~127,780	〃	〃	①-M	B	⑤H=10, L=100m
482	127,970~128,050	〃	〃	②-S	C	①179m²
483	128,050~128,080	〃	〃	⑤-S	C	①134 m²
484	128,150~128,450	〃	〃	②-S	B	①1,342 m²
485	128,450~128,700	〃	〃	②-S	C	①839 m²
486	128,760~128,820	〃	〃	⑤-M	B	④H=5, L=60m
487	128,800~128,870	〃	〃	②-S	C	①235 m²
488	128,870~128,900	〃	〃	②-M	B	①134 m²
489	128,930~129,000	〃	〃	①-M	B	⑤H=10, L=70m
490	129,000~129,500	〃	〃	②-S	C	①1,677 m²
491	129,520~129,620	〃	〃	①-M	B	③H=3, L=100m
492	129,620~129,900	〃	〃	②-M	C	①1,565 m²
493	129,950~130,000	〃	〃	⑤-M	B	④H=7, L=50m
494	130,000~130,120	〃	〃	②-S	C	①537 m²
495	130,180~130,230	〃	〃	②-M	B	③H=3, L=50m
496	130,230~130,330	〃	〃	②-M	C	①335 m²
497	130,330~130,350	〃	〃	②-S	B	①90 m²
498	130,350~130,450	〃	〃	②-M	C	①335 m²
499	130,450~130,600	〃	〃	③-S	B	⑦1,500 m²
500	130,600~130,800	〃	〃	②-S	B	①1,118 m²

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probability
C : Low probability

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted-T type retaining wall
⑤ Crib wall
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⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7 - 2 - (21) Preventive Works

Section No.	Station (Km)	Geology		TD & ED	PO	Type and extent of preventive works
		Surface	bedrock			
501	130,960~131,000	volcanic ash	black schist	④-S	B	⑦400 m^2
502	131,070~131,100	〃	〃	②-S	B	①134 m^2
503	131,400~131,420	volcanic ash weathered rock	green schist	②-M	B	③H=3, L=20m
504	131,420~131,625	〃	〃	③-S	C	①470 m^2
505	131,625~131,675	〃	〃	②-M	A	①224 m^2, ⑧H=1.5, L=50m
506	131,725~131,810	〃	black schist	②-M	B	①380 m^2, ⑧H=1.5, L=85m
507	131,810~132,000	〃	green schist	③-M	A	⑨1,900 m^2
508	132,000~132,040	〃	diabase	③-M	A	⑨800 m^2
509	132,150~132,340	〃	〃	③-M	A	③H=3, L=190m, ⑧H=1.5, L=190m
510	132,340~132,520	〃	〃	②-S	C	①805 m^2
511	132,520~132,750	〃	green schist	③-M	B	⑨2,300 m^2
512	132,900~133,000	〃	diabase	②-S	B	③H=3, L=100m
513	133,000~133,200	〃	〃	②-S	C	①894 m^2
514	133,380~133,420	〃	〃	②-S	B	①179 m^2
515	133,680~133,710	〃	〃	②-S	C	①134 m^2
516	133,830~134,120	〃	〃	②-S	B	①1,621 m^2
517	134,400~134,800	〃	〃	②-S	C	①1,789 m^2

※ Preventive works for landslide are shown in Table 7-15

Legend

Type of expected damage (TD)

1. Landslide
2. Surface layer fall
3. Rock avalanches
4. Rock fall
5. Failure of shoulder and road
6. Debris flow

Extent of damages (ED)

L : Large scale
M : Medium scale
S : Small scale

Probability of Occurrence (PO)

A : High probability
B : Medium probabily
C : Low probabilty

Type of preventive works

① Concrete block retaining wall
② Leaning wall
③ Gravity type retaining wall
④ Inverted-T type retaining wall
⑤ Crib wall
⑥ Flexible type wall with concrete frame
⑦ Rock net
⑧ Rock fence
⑨ Grout faced
⑩ Wire cylinder (Gabion)
⑪ Piling works
⑫ Foot protection
⑬ Sediment control dam
⑭ Watercourse works
⑮ Bank protection works
⑯ Culverts
⑰ Spray application of seed
⑱ Soil removal works

Annex Table 7- 3 (1) Comparison of Direct Cost between Preventive Work and Corrective Work

Extent of Damage: Large, Probability: High (UNIT: $'000)

No.	Station	Classification	Preventive Work (A)	Corrective Work (B)	(A - B)
4	K62.520-K62.800	Landslide	9,881	8,229	(+)1,652
5	K62.800-K62.830	Fall	505	3,147	(-)2,642
95	K71.735-K71.760	Debris flow	1,101	7,617	(-)6,516
98	K71.770-K72.240	Landslide	25,438	23,021	(+)2,417
102	K72.830-K72.840	Debris flow	510	2,318	(-)1,808
108	K73.670-K73.920	Landslide	4,328	12,857	(-)8,529
116	K75.290-K75.400	Fall	1,575	3,957	(-)2,382
117	K75.400-K75.505	Landslide	5,636	5,262	(+) 374
118	K75.505-K75.515	Debris flow	2,446	2,318	(+) 128
119	K75.530-K75.555	Fall	253	2,623	(-)2,370
141	K77.830-K78.080	Landslide	7,766	12,639	(-)4,873
177	K82.000-K82.300	Landslide	19,283	15,167	(+)4,116
201	K85.430-K85.440	Debris flow	1,424	2,318	(-) 894
253	K93.345-K93.360	Debris flow	1,041	7,617	(-)6,576
265	K93.950-K94.050	Failure of Valleyside	7,206	7,477	(-) 271
274	K94.670-K94.760	Failure of Valleyside	6,332	7,085	(-) 753
285	K95.780-K95.860	Fall	1,168	2,523	(-)1,355
310	K97.730-K97.820	Landslide	9,384	4,421	(+)4,963
312	K97.900-K97.920	Debris flow	408	7,617	(-)7,209
352	K102.860-K102.980	Landslide	3,975	5,974	(-)1,999
358	K103.850-K103.870	Failure of Valleyside	581	7,617	(-)7,036
373	K105.530-K105.750	Landslide	15,011	11,035	(+)3,976
376	K106.200-K106.280	Landslide	5,547	3,976	(+)1,571
378	K106.470-K106.540	Landslide	3,179	3,497	(-) 318
407	K112.340-K112.520	Landslide	5,638	9,187	(-)3,549
408	K113.000-K113.200	Landslide	3,037	10,099	(-)7,062
418	K115.700-K115.770	Failure of Valleyside	7,494	6,302	(+)1,192
438	K119.550-K119.650	Landslide	9,497	4,865	(+)4,632
449	K120.850-K120.970	Failure of Valleyside	23,890	8,260	(+)15,630
473	K126.050-K126.110	Failure of Valleyside	4,094	5,519	(-)1,425
Total			187,628	214,544	(-)26,916

Note: This is a list of locations at which there is high probability for slope failure.

Annex Table 7-3 (2) Comparison of Direct Cost between Preventive Work and Corrective Work

Extent of Damage: Medium, Probability: High (Unit: $'000)

No.	Station	Classification	Preventive Work (A)	Corrective Work (B)	(A) - (B)
6	K63,200-K63,385	Fall	2,273	1,021	(+) 1,252
10	K63,860-K63,960	Fall	123	478	(-) 355
22	K64,915-K65,000	Failure of valley side	511	3,917	(-) 3,406
26	K65,375-K65,385	Debris flow	633	4,817	(-) 4,184
27	K65,420-K65,425	Debris flow	633	4,817	(-) 4,184
33	K65,900-K66,220	Fall	3,687	1,532	(+) 2,155
34	K66,020	Debris flow	408	4,817	(-) 4,409
37	K66,220	Debris flow	306	4,817	(-) 4,511
39	K66,290	Debris flow	663	4,817	(-) 4,154
43	K66,865-K66,880	Fall	137	376	(-) 239
51	K67,120-K67,200	Fall	983	478	(+) 505
53	K67,260-K67,325	Fall	658	478	(+) 180
66	K68,120-K68,145	Fall	253	478	(-) 225
70	K68,365-K68,400	Fall	511	478	(+) 33
78	K69,060-K69,090	Fall	682	478	(+) 204
82	K69,300-K69,360	Fall	468	478	(-) 10
85	K69,540-K69,665	Fall	977	1,021	(-) 44
91	K70,515-K70,525	Land slide	101	239	(-) 138
94	K71,445-K71,730	Debris flow	1,274	6,371	(-) 5,097
101	K72,785-K72,795	Debris flow	408	4,817	(-) 4,409
111	K74,260-K74,280	Debris flow	611	4,817	(-) 4,206
128	K77,125-K77,135	Debris flow	1,628	4,817	(-) 3,189
130	K77,285-K77,390	Fall	1,291	1,021	(+) 270
131	K77,390-K77,410	Debris flow	735	4,817	(-) 4,082
144	K78,260-K78,300	Fall	313	478	(-) 165
149	K78,600-K78,665	Failure of valley side	3,479	3,917	(-) 438
154	K79,040-K79,100	Debris flow	1,172	4,817	(-) 3,645
158	K79,380-K79,390	Debris flow	1,180	4,817	(-) 3,637
161	K79,625-K79,635	Failure of valley side	592	783	(-) 191
167	K80,030-K80,060	Failure of valley side	1,606	2,350	(-) 744

Note; This is a list of locations at which there is a high probability of slope failure.

Annex Table 7-3 (3) Comparison of Direct Cost between Preventive Work and Corrective Work

Extent of Damage: Medium, Probability: High (Unit: $'000)

No.	Station	Classification	Preventive Work (A)	Corrective Work (B)	(A) - (B)
175	K81,500-K81,590	Fall	1,056	478	(+) 578
180	K82,660-K82,750	Fall	1,458	478	(+) 980
184	K83,160-K83,225	Fall	925	478	(+) 447
198	K85,290-K85,375	Fall	5,800	478	(+)5,322
199	K85,380-K85,390	Debris flow	490	4,817	(-)4,327
213	K86,400-K86,540	Fall	853	1,021	(-) 168
219	K87,000-K87,040	Fall	405	478	(-) 73
222	K87,250-K87,300	Fall	3,609	478	(+) 3,131
225	K87,475-K87,530	Fall	676	478	(+) 198
226	K87,530-K87,570	Failure of valley side	366	3,133	(-) 2,767
239	K88,650-K88,660	Debris flow	1,160	4,817	(-) 3,657
243	K88,950-K89,000	Failure of valley side	3,412	3,917	(-) 505
263	K93,880-K93,890	Debris flow	1,567	4,817	(-) 3,250
268	K94,180-K94,230	Failure of valley side	6,823	3,917	(+) 2,906
273	K94,675-K94,800	Fall	1,524	478	(+) 1,046
281	K95,370-K95,380	Debris flow	136	4,817	(-) 4,681
286	K95,860-K96,200	Fall	1,041	2,043	(-) 1,002
291	K96,320-K96,365	Fall	679	3,612	(-)2,933
297	K96,645-K96,800	Fall	1,904	1,021	(+) 883
308	K97,560-K97,580	Failure of valley side	1,071	1,567	(+) 496
311	K97,820-K97,900	Fall	1,139	478	(+) 661
317	K98,310-K98,325	Failure of valley side	436	1,175	(-) 739
322	K98,770-K98,885	Fall	374	1,021	(-) 647
325	K98,950-99,060	Failure of valley side	3,194	7,833	(-) 4,639
327	K99,065-K99,085	Failure of valley side	581	1,567	(-) 986
330	K99,390-K99,410	Failure of valley side	681	1,567	(-) 986

Note; This is a list of locations at which there is a high probability of slope failure.

Annex Table 7-3 (4) Comparison of Direct Cost between Preventive Work and Corrective Work

Extent of Damage: Medium, Probability: High (Unit: $'000)

No.	Station	Classification	Preventive Work (A)	Corrective Work (B)	(A) - (B)
350	K102,650-K102,750	Fall	1,424	478	(+) 946
362	K104,130-K104,300	Fall	416	1,021	(-) 605
365	K104,430-K104,520	Fall	1,105	478	(+) 627
366	K104,630-K104,710	Fall	810	478	(+) 332
369	K104,825-K104,880	Fall	803	478	(+) 325
381	K107,310-K107,400	Land slide	6,141	2,298	(+) 3,843
383	K107,570-K107,640	Failure of valley side	3,747	3,917	(-) 170
386	K107,950-K108,000	Failure of valley side	1,606	3,917	(-) 2,311
393	K109,850-K109,910	Failure of valley side	1,742	3,917	(-) 2,175
395	K110,100-K110,200	Failure of valley side	13,646	3,917	(+) 9,729
405	K112,000-K112,050	Failure of valley side	1,452	3,917	(-) 2,465
416	K115,400-K115,500	Failure of valley side	2,904	3,917	(-) 1,013
427	K118,150-K118,220	Debris flow	1,594	4,817	(-) 3,223
428	K118,350-K118,400	Failure of valley side	1,452	3,917	(-) 2,465
433	K118,710-K118,740	Failure of valley side	1,162	3,133	(-) 1,971
436	K119,220-K119,260	Fall	405	478	(-) 73
437	K119,310-K119,450	Fall	1,720	1,021	(+) 699
439	K119,650-K119,780	Failure of valley side	5,973	7,833	(-) 1,860
442	K120,250-K120,340	Failure of valley side	4,818	3,917	(+) 901
459	K123,840-K123,860	Failure of valley side	1,071	1,567	(-) 496
505	K131,625-K131,675	Fall	615	478	(+) 137
507	K131,810-K132,000	Fall	233	1,532	(-) 1,299
509	K132,150-132,340	Fall	2,774	1,021	(+) 1,753
	Total		128,040	197,120	(-) 69,080

Note; This is a list of locations at which there is a high probability of slope failure.

Annext Table 7-3 (5) Comparison of Direct Cost between Preventive Work and Corrective Work

Extent of Damage: Large, Probability: Medium (UNIT: $'000)

No.	Station	Classification	Preventive Work (A)	Corrective Work (B)	A - B
3	K62,000-K62,045	Failure of Valleyside	757	3,525	(-) 2,768
64	K67,990-K68,000	Debris flow	980	1,602	(-) 622
74	K68,560-K68,570	Debris flow	611	1,602	(-) 991
86	K69,690-K69,700	Debris flow	408	1,602	(-) 1,194
124	K76,520-K76,840	Land slide	6,337	14,817	(-) 8,480
143	K78,260	Debris flow	1,838	1,602	(+) 236
195	K84,250-K84,260	Debris flow	1,914	1,602	(+) 312
210	K86,040-K86,080	Failure of Valleyside	2,729	12,227	(-) 9,498
211	K86,260-K86,355	Fall	6,482	3,235	(+) 3,247
230	K87,850-K87,885	Fall	499	2,460	(-) 1,961
272	K94,620-K94,630	Debris flow	611	1,602	(-) 991
282	K95,390-K95,400	Debris flow	1,123	1,602	(-) 479
298	K96,710-K96,755	Failure of Valleyside	6,141	3,525	(+) 2,616
300	K96,800-K96,920	Failure of Valleyside	7,035	7,479	(-) 442
389	K108,570-K108,800	Land slide	2,272	10,731	(-) 8,459
468	K125,025-K125,100	Failure of Valleyside	8,029	6,302	(+) 1,727
Total Direct Cost			47,766	75,513	(-) 27,747

Note; This is a list of locations at which there is a medium probability of slope failure.

Annex Table 7-3 (6) Comparison of Direct Cost between Preventive Work and Corrective Work

Extent of Damage: Medium, Probability: Medium (Unit: $'000)

No.	Station	Classification	Preventive Work (A)	Corrective Work (B)	(A) - (B)
1	K61,820-K61,850	Failure of valley side	275	2,828	(-)2,553
17	K64,340-K64,375	Fall	35	478	(-) 443
20	K64,580-K64,590	Debris flow	203	251	(-) 48
29	K65,480-K65,820	Fall	624	2,043	(-)1,419
32	K65,840-K65,880	Fall	406	12	(+) 394
46	K66,985-K67,015	Debris flow	115	4,817	(-)4,702
52	K67,215-K67,260	Failure of valley side	2,409	3,525	(-)1,116
69	K68,340-K68,365	Fall	307	478	(-) 171
71	K68,430-K68,450	Fall	24	478	(-) 454
73	K68,540-K68,550	Debris flow	731	4,817	(-)4,086
75	K68,570-K68,620	Fall	1,348	478	(+) 870
84	K69,400-K69,540	Fall	172	1,021	(-) 849
96	K71,470-K71,525	Failure of valley side	2,944	4,308	(-)1,364
97	K71,705-K71,730	Failure of valley side	229	1,958	(-)1,729
99	K72,400-K72,600	Land slide	13,646	5,107	(+)8,539
100	K72,695-K72,780	Fall	664	478	(+) 186
132	K77,320-K77,400	Failure of valley side	1,346	3,917	(-)2,571
133	K77,410-K77,520	Fall	1,075	1,021	(+) 54
139	K77,710-K77,720	Debris flow	204	4,817	(-)4,613
146	K78,360-K78,400	Failure of valley side	214	3,133	(-)2,919
164	K79,720-K79,745	Failure of valley side	196	1,958	(-)1,762
166	K79,980-K80,055	Fall	921	478	(+) 443
170	K80,400-K80,420	Failure of valley side	581	1,567	(-) 986
181	K82,750-K82,880	Fall	2,105	1,021	(+)1,084
191	K83,820-K83,830	Debris flow	1,442	4,817	(-)3,375
194	K84,200-K84,320	Fall	1,171	1,021	(+) 150
205	K85,690-K85,725	Failure of valley side	1,873	2,742	(-) 869

Note; This is a list of locations at which there is a medium probability of slope failure.

Annex Table 7-3 (7) Comparison of Direct Cost between Preventive Work and Corrective Work

Extent of Damage: Medium, Probability: Medium (Unit: $'000)

No.	Station	Classification	Preventive Work (A)	Corrective Work (B)	(A) - (B)
212	K86,360-K86,370	Debris flow	735	4,817	(-) 4,082
217	K86,750-K86,815	Failure of valley side	4,435	3,917	(+) 518
228	K87,630-K87,660	Fall	74	478	(-) 404
233	K88,010-K87,055	Fall	418	478	(-) 60
238	K88,580-K88,610	Failure of valley side	2,047	2,350	(-) 303
250	K93,160-K93,170	Debris flow	592	4,817	(-) 4,225
252	K93,260-K93,300	Failure of valley side	2,141	3,133	(-) 992
255	K93,520-K93,590	Fall	709	478	(+) 231
256	K93,590-K93,640	Fall	615	478	(+) 137
259	K93,710-K93,760	Fall	92	478	(-) 386
260	K93,760-K93,820	Fall	852	478	(+) 374
262	K93,840-K93,910	Failure of valley side	2,033	3,917	(-) 1,884
271	K94,540-K94,600	Failure of valley side	1,742	3,917	(-) 2,175
276	K94,880-K94,900	Failure of valley side	581	1,567	(-) 986
278	K95,000-K95,045	Fall	679	478	(+) 201
279	K95,045-K95,110	Fall	223	478	(-) 255
287	K96,010-K96,040	Failure of valley side	1,606	2,350	(-) 744
296	K96,630-K96,645	Failure of valley side	803	1,175	(-) 372
299	K96,800-K96,920	Fall	221	1,021	(-) 800
302	K96,985-K97,040	Failure of valley side	1,597	3,917	(-) 2,320
316	K98,200-K98,290	Failure of valley side	4,817	3,917	(+) 900
321	K98,570-K98,635	Failure of valley side	1,888	3,917	(-) 2,029
351	K102,830-K102,840	Debris flow	408	4,817	(-) 4,409
356	K103,470-K103,530	Failure of valley side	1,742	3,917	(-) 2,175

Note; This is a list of locations at which there is a medium probability of slope failure.

Annex Table 7-3(8) Comparison of Direct Cost between Preventive Work and Corrective Work

Extent of Damage: Medium, Probability: Medium (Unit: $'000)

No.	Station	Classification	Preventive Work (A)	Corrective Work (B)	(A) - (B)
360	K104,000-K104,130	Fall	947	2,980	(-)2,033
371	K105,360-K105,400	Failure of valley side	366	3,133	(-)2,767
375	K106,200-K106,280	Fall	1,166	1,021	(+) 145
379	K106,875-K106,910	Failure of valley side	1,016	2,742	(-)1,726
384	K107,640-K107,800	Failure of valley side	8,564	7,833	(+) 731
397	K110,290-K110,360	Failure of valley side	9,552	3,917	(+)5,635
400	K110,540-K110,590	Fall	391	478	(-) 87
411	K114,650-K114,700	Fall	683	478	(-)1,479
417	K115,540-K115,600	Failure of valley side	3,212	3,917	(-) 705
422	K117,120-K117,160	Failure of valley side	1,162	3,133	(-)1,971
425	K117,700-K117,790	Fall	1,105	478	(+) 627
447	K120,780-K120,820	Failure of valley side	2,141	3,133	(-) 992
448	K120,820-K120,870	Fall	585	478	(+) 107
453	K121,850-K122,050	Failure of valley side	5,353	7,833	(-)2,480
455	K123,050-K123,300	Failure of valley side	7,260	11,750	(-)4,490
458	K123,800-K123,820	Failure of valley side	1,071	1,567	(-) 496
460	K120,870-K123,930	Failure of valley side	3,212	3,917	(-) 705
462	K124,150-K124,180	Land slide	304	717	(-) 413
466	K124,620-K124,680	Failure of valley side	3,212	3,917	(-) 705
467	K124,850-K125,000	Failure of valley side	8,029	7,833	(+) 196
478	K127,075-K127,200	Land slide	1,266	3,192	(-)1,926
479	K127,310-K127,375	Failure of valley side	1,887	3,917	(-)2,030
481	K127,680-K127,780	Land slide	6,823	2,554	(+)4,269

Note; This is a list of locations at which there is a medium probability of slope failure.

Annex Table 7-3 (9) Comparison of Direct Cost between Preventive Work and Corrective Work

Extent of Damage: Medium, Probability: Medium (Unit: $'000)

No.	Station	Classification	Preventive Work (A)	Corrective Work (B)	(A) - (B)
486	K128,760-K128,820	Failure of valley side	1,742	3,917	(-)2,175
488	K128,870-K128,900	Fall	234	478	(-) 244
489	K128,930-K129,000	Land slide	4,776	1,788	(+)2,988
491	K129,520-K129,620	Land slide	1,013	2,554	(-)1,541
493	K129,950-K130,000	Failure of valley side	2,676	3,917	(-)1,241
495	K130,180-K130,230	Fall	506	478	(+) 28
503	K131,400-K131,420	Fall	203	478	(-) 275
506	K131,725-K131,810	Fall	1,044	478	(+) 566
511	K132,520-K132,750	Fall	282	1,532	(-)1,250
	Total		148,964	215,747	(-)66,783

Note; This is a list of locations at which there is a medium probability of slope failure.

Annex

Table 7-4 PREVENTIVE AND CORRECTIVE WORKS: QUANTITIES (Page 1)

Station	Preventive Works	Corrective Works	Remarks
No.5 K62.800- K62.830	Slope protection 30m (Concrete leaning wall)	Removal of fall mass 900m3 Gravity wall H=4m 30m	Need at least 2 days for reopening one lane
No.95 K71.735- K71.760	Concrete gravity dam 40m H=4m Concrete Lining Channel 20m W=4m	Retaining Wall H=10m 20m (Crib type) P.C.T.Bridge L=20m 1 Span	3 days for reopening one lane
No.102 K72.830- K72.840	Concrete gravity dam 25m H=4m	Retaining Wall H=10m 10m (Crib type) R.C.Bridge L=10m 1 Span	2 days for reopening one lane
No.108 K73.670- K73.920	Horizontal drilling 360m Collecting drain 190m Pipe drainage 600 dia. 300m Gravity wall H=3m 240m Miscellaneous work	Removal of sliding mass 11,200m3 Gravity wall H=4m 280m Half bridge 56m Paving and Miscellaneous	3 days for reopening one lane
No.116 K75.290- K75.400	Slope protection 246m2 (Concrete block) Slope protection I,100m2 (Concrete frame work)	Removal of fall mass 1650m3 Gravity wall H=4m 55m Paving and Miscellaneous	2 days for reopening one lane
No.119 K75.530- K75.505	Gravity wall H=3m 25m Rock fence 25m	Removal of fall mass 750m3 Retaining wall H=4m 25m Half bridge 25m	2 days for reopening one lane
No.141 K77.830- K78.080	Collecting drain 120m Pipe drainage 600 dia. 200m Retaining wall H=10m 100m Miscellaneous work	Removal of sliding mass 11,000 m3 Gravity wall H=4m 275m Half bridge 55m Paving and Miscellaneous	3 days for reopening one lane
No.201 K85.430- K85.440	Concrete gravity dam 20m H=4m Concrete lining channel W=4m 20m Box Culvert 4.5mx4m 8m	Retaining wall H=10m 10m (CRIB TYPE) R.C. Bridge L=10m 1 Span	2 days for reopening one lane
No.253 K93.345- K93.360	Concrete gravity dam 16m H=4m Concrete lining channel 50m W=4m	Removal of fall mass (Crib type) P.C.T.Bridge L=20m 1 Span	2 days for reopening one lane

PREVENTIVE AND CORRECTIVE WORKS: QUANTITIES (Page 2)

Table 7- 4 (Cont'd)

Station	Preventive Works	Corrective Works	Remarks
No.265 K93.950- K94.050	Retaining wall H=10m 100m (Crib type) Gabion 600 dia. l=6m 500m2	Half bridge 75m R.C.Bridge L=10m 1 Span	5 days for reopening one lane
No.274 K94.670- K94.760	Retaining wall H=7m 90m Slope protection 90m (Concrete Leaning wall)	Half bridge 70m R.C.Bridge L=10m	5 days for reopening one land
No.285 K95.780- K95.860	Gravity wall H=3m 80m Rock fence 80m	Removal of fall mass 1,200m3 Gravity wall H=4m 40m Half bridge 20m	7 days for reopening one lane
No.312 K97.900- K97.920	Concrete gravity dam 20m H=4m Concrete Lining Channel 50m	Retaining wall H=10m 20m P.C.T.Bridge L=20m 1 Span	3 days for reopening one lane
No.352 K102.860- K102.980	Horizontal drilling 180m Collection drain 100m Pipe drainage 600 dia. 300m Gravity wall H=3m 40m Miscellaneous work	Removal of sliding mass 5,200m3 Gravity wall H=4m 130m Half bridge 26m Paving and Miscellaneous	2 days for reopening one lane
No.358 K103.850- K103.870	Retaining wall H=5m 20m	Retaining wall H=10m (Crib type) 20m P.C.T.Bridge L=20m 1 Span	3 days for reopening one lane
No.378 K106.470- K106.540	Steel Pile H-200x200 582m Collecting drain 170m Pipe drainage 600 dia.250m Miscellaneous work	Removal of sliding mass 3,200m3 Gravity wall H=4m 80m Half bridge 16m Paving and Miscellaneous	2 days for reopening one lane
No.407 K112.340- K112.520	Pile fundation 3.0m dia. 108m	Removal of sliding mass 8,000m3 Gravity wall H=4m 200m Half bridge 40m Paving and Miscellaneous	2 days for reopening one lane
No.408 K113.000- K113.200	Horizontal drilling 230m Collecting wall 3.5m dia. 26m Collecting drain 140m Pipe drainage 600 dia. 250m Miscellaneous work	Removal of sliding mass 8,800m3 Gravity wall H=4m 220m Half bridge 44m Paving and Miscellaneous	3 days for reopening one lane
No.473 K126.050- K126.110	Retaining wall H=10m 60m (Crib type)	Half bridge 50m R.C.Bridge L=10m 1 Span	5 days for reopening one lane

Annex 7-5 Comparative Cost Study for Disasters Occasioned by Slope Failure

(1) Detouring and Waiting Traffic

If the road is closed by slope failure or some other reason, some traffic will detour to the northern route via Manizales - Honda - Bogota. Annex Table 7-5 presents some of the daily traffic, which will divert to the northern route in 1980. Annex Table 7-6 indicates the distances between Uribe and Bogota: one through the project road and the other through the northern route. Assuming that the traffic growth rate is 5% per annum, the traffic cost in 1986 is calculated as follows:

Type of Veh.	Number of Veh.	The Existing Route Traffic Cost/day	The Northern Route Traffic Cost/day	Difference in Traffic Cost/day pesos
Autos	303	1,352,621	1,653,030	300,409
Bus	200	1,826,843	2,278,265	451,422
Truck	643	6,365,746	7,935,038	1,569,292
TMula	342	6,388,351	7,959,974	1,571,623
	1,488	15,933,561	19,826,307	3,892,746

Annex Table 7-7 represents the traffic which would wait for the reopening of the road. It is assumed that they will wait rather than detour, since the distances between origin and destination of this traffic are quite less than those in the case of detouring. The time related costs in VOC in 1986 are estimated for the traffic as:

Auto :	171 veh	x 401.9	=	68,725/day
Bus :	5 "	x 1,944.4	=	9,722/d y
Truck:	438 "	x 1.451.9	=	635,932/day
TMula:	110 "	x 3,260.5	=	358,655/day
Total	724			1,073,034/day

Annex Table 7-5 Detouring Traffic in Case of Road Closure

OD pairs in the aggregated zones	Traffic of AADT in 1980 Auto	Bus	Truck	Tmula	Total
1(Bogota) - 8 (Risaralda)	25	48	59	1	133
- 5 (Quindio)	47	7	83	8	145
- 6.7(Valle)	57	97	292	206	652
- 13 (Popayan)	16	11	20	12	59
11 (Santander, etc)					
- 8	11	-	4	-	15
- 5	2	-	-	6	8
- 6.7	56	-	27	9	92
- 13	8	-	7	-	15
Total	222	163	492	242	1,119

Source: From the OD Tables, February 1980.

Annex Table 7-6 Road Distance Between Uribe - Bogota

	Gradient in Percent 1%	3%	5%	7%	9%	Total
Uribe - Calarca - Ibague - - Espinal - Bogota	148.0 (0.407)	64.6 (0.177)	59.3 (0.163)	50.1 (0.138)	42.0 (0.115)	364.0 (Km) (1.000)
Uribe - Cartago - Manizales - Honda - Bogota	130.0 (0.293)	91.0 (0.205)	85.0 (0.192)	79.0 (0.178)	58.0 (0.132)	443.0 (Km) (1.000)

Source: Inventory data, MOPT.

Annex Table 7-7 Waiting Traffic in Case of Road Closure.

OD pairs in the aggregated zones	Traffic of AADT in 1980 Auto	Bus	Truck	TMula	Total
2 - 5. 6. 7. 8. 13	29	2	91	36	158
3 - 5. 6. 7. 8. 13	12	-	19	6	37
4 - 5. 6. 7. 8. 13	77	2	177	36	292
12- 5. 6. 7. 8. 13	6	-	48	-	54
Total	124	4	335	78	541

Source: From OD tables, February 1980.

Remarks: The time related cost are obtained from Annex Tables 9-1 and 9-8. They are shown below as the cost per year.

	Fixed cost	Dep & Int	Total/Year pesos
Auto	69792	76895	146687
Bus	554642	155066	709708
Truck	421496	108432	529928
TMula	730273	459794	1190067

If they are divided by 365, the daily-time-related cost are estimated:

Auto	401.9/day	x	124	=	49836
Bus	1,944.4 "	x	4	=	7778
Truck	1,451.9 "	x	335	=	486387
TMula	3,260.5 "	x	78	=	254319
			Total		798320 1)

Note: 1) The total traffic cost in 1986 is estimated by multiplying the growth rate (refer to Annex Table 4-4) to the above cost of each vehicle type. The cost in 1986 is:

3,892,746 + 1,073,034 = 4,965,780 pesos/day

(2) Evaluation of Preventive Work Against Slope Failure

The road is often closed by landslides or by failure of the subgrade. Deterioration of the slope ranges from minor failure of the shoulders and ditches, which would not interfere with the traffic but would only augument the cost of road maintenance, to the extensive scale of slope failure which would interrupt the traffic for many days. As mentioned above, the slope failures and collapses of Type L and M are considered to be of an extent which would interrupt the traffic for many days. The costs of preventive work and corrective work for the slope failures and collapses are summarized as follows.

Frequency Type A ($'000 in 1980)

	No of locations	Preventive work cost	Corrective work cost
LA	30	270,450	252,835
MA	80	187,844	233,238
Total	110	458,294	486,073
Average Cost		4,166	4,419

Frequency Type B

	No of locations	Preventive work cost	Corrective work cost
LB	16	67,450	89,561
MB	84	212,995	256,551
Total	100	280,445	346,112
Average Cost		2,804	3,461

Economic evaluation of the preventive work against failures requires probabilistic inference of their magnitudes and frequencies. At present no such statistical data is available and the study proposes a hypothetical condition for undertaking failure preventive works.

The following assumptions were made.

(1) At the locations denoted by type A, the failures will occur at least within 20 years, and at type B, within 40 years.

(2) Once the failure occurs, the road will be closed for 2 days which is required for reopening work.

Thus, failures will occur at 5 or 6 locations per year out of 110 locations of type A, causing road closure for 11 days per year. Likewise, at 2 or 3 places per year for type B, the road will be closed for 5 days per year. The above failures generate the corrective and traffic costs as shown in Annex Table 7-8 and 7-9.

Assuming that the costs required for corrective work, and, detouring and waiting, due to the failures are considered as benefit derived from the preventive work against slope failures, the following results are obtained.

The economic cost includes the cost of detailed engineering study, supervising and contingencies.

($'000 in 1980 prices)

	Type A	Type B	Total
Economic Cost in 1980 prices ('000 pesos)	458,294	280,445	738,739
Net P.W. (i=12%)	189,299	18,377	207,676
B/C (i=12%)	1.54	1.09	1.37
IRR	18%	13%	15%

Consequently, preventive work should be undertaken for both type A and B under the above assumptions.

Annex Table 7-8 <u>Cost Stream for Type A</u>

($'000 in 1980 prices)

Year	Preventive work cost	Savings		
		Corrective work	Traffic Cost	Total
'83	14582			
'84	6250			
'85	218731			
'86	218731			
'87		24305	57355	81660
'88		"	60223	84528
'89		"	63234	87539
'90		"	66396	90701
'91		"	69716	94021
'92		"	73201	97506
'93		"	76861	101166
'94		"	80705	105010
'95		"	84740	109045
'96		"	88977	113282
'97		"	93426	117731
'98		"	98097	122402
'99		"	103002	127307
'00		"	108152	132457
'01		"	113559	137864
'02		"	119237	143542
'03		"	125199	149504
'04		"	131459	155764
'05		"	138032	162337
Total	458294	461795	1751571	2213366
Tot.disc. i=12%	350222	-	-	539521
P.W. i=12%				189299
B/C, i=12%				1.54
I R R				18%

Annex Table 7-9 Cost Stream for Type B ($'000 in 1980 prices)

Year	Preventive work cost	Savings Corrective W.	Savings Traffic Cost	Sub-total
'83	8,924			
'84	3,824			
'85	133,849			
'86	133,848			
'87		8,653	26,072	34,725
'88		"	27,475	36,028
'89		"	28,244	37,397
'90		"	30,181	38,834
'91		"	31,690	40,343
'92		"	33,275	41,928
'93		"	34,938	43,591
'94		"	36,685	45,338
'95		"	38,519	47,172
'96		"	40,445	49,498
'97		"	42,468	51,121
'98		"	44,591	53,244
'99		"	46,821	55,474
2000		"	49,162	57,815
'01		"	51,620	60,273
'02		"	54,201	62,854
'03		"	56,911	65,564
'04		"	59,756	68,429
'05		"	62,744	71,397
Total	280,445	164,407	796,198	970,605
Tot. disc. i = 12%	214,312	-	-	232,689
PW,i=12%				18,377
B/C, i=12%				1.09
IRR				13%

ANNEX 8

Annex 8-1 Road Maintenance Cost

8-1-1 Effective Operating Man-Days per year [1)]

Effective operating man-days are shown as follows:

Holidays	15 days
Sundays	52
National Holidays	18
Absent	3
Total	88 days

365 days - 88 days = 277 days

Real operating days are shown as follows by subtracting rainy days and other days such as administration business.

(1) Operator and assistant

Rainy days and resupplying (estimate)	50 days
Transportation	6
Repairs	26
Administration	6
Total	88 days

277 days - 88 days = 189 days

(2) Laborers

Rainy days	50 days
Administration	6
Total	56 days

277 days - 56 days = 221 days

8-1-2 Unit Cost for Equipment, Labor and Materials

The basic cost estimate for equipment, labor and materials is shown in Table 8-1 to 8-4.

SOURCE: 1) MOPT : Costos de Conservacion en la Vial MELGAR - IBAGUE - BUGA.

8-1-3 Routine Maintenance Team

(1) General Maintenance Team (covering 60 km)

Foreman	1
Laborers	12
Driver	1
Truck	1

(2) Construction Team (covering 400 km)

Foreman	1
Masons	2
Laborers	6
Driver	1
Truck	1
Concrete mixer	1

(3) Construction Machinery (covering 1,000 km)

Bulldozer (D7G)	2
Motor Grader (3.7^m)	2
Loader	1
Truck	6
Water Tanker	1
Road Roller, Macadam	1
Air Compressor (5 m3/min)	1

8-1-4 Annual Requirement for Routine Maintenance

(Unit: $)

(1) General Maintenance Team

	Number	Basic Cost	Total
Foreman	1	104.55x8	836.40
Common Laborers	12	52.28x8	5,018.88
Driver	1	72.94x8	583.52
Truck	1	398.19x8	3,185.52
Tools	1	-	250.68
		Total	9,875.00

Annual operation 221 days $2,182,375.00

(2) Construction Team

	Number	Basic Cost	Total
Foreman	1	104.55x8	836,40
Mason	2	65.34x8	1,045.44
Common Laborers	6	52.28x8	2,509.44
Driver	1	72.94x8	583.52
Truck	1	398.19x8	3,185.52
Mixer	1	468.54x8	3,748.32
Tools		-	125.36
Materials		-	1,736.00 (35% of Labor Cost)
		Total	13,770.00

Annual operation 221 days $3,043,170.00

(3) Clearing of Landslide

	Number	Basic Cost	Total
Foreman	1	104.55x8	836.40
Common Laborers	3	52.28x8	1,254.72
Drivers	2	72.94x8	1,167.04
Operator, bull.	1	116.70x8	933.60
Operator, Loader	1	116.70x8	933.60
Trucks	2	398.19x8	6,371.04
Bulldozer	1	3,078.84x8	24,630.72
Loader	1	1,728.55x8	13,838.40
		Total	49,955.52

Annual operation 189 days $9,441,593.00

(4) Asphaltic Concrete Patching Team

1) Removal of Old Pavement

	Number	Basic Cost	Total
Foreman	1	104.55x8	836.40
Operator, compr.	1	87.53x8	700.24
Mechanic	1	104.55x8	836.40
Common Laborers	2	52.28x8	836.48
Air Compressor	1	339.10x8	2,712.80
Hand Hammer	1	28.25x8	226.00
		Total	6,148.32

Assuming construction at 20 m^3 per day

the cost per m^3	307.42
Loading per m^3	31.44
Hauling distance 1 Km-m^3	22.61
Total	$361.47/m3

2) Patching

Asphalt mixture $1620.63x2.35=3,808.48/$m^3$
(Transport from Plant included)

Therefore construction cost per m^3 is as follows:

361.47
3,808.48

Total $4,169.95

Assuming an annual rate of 1.5 percent of total construction

Carriageway $1,000^m x 7^m x 0.015 = 105^{m2}$

Shoulder $1,000^m x 1^m x 2 x 0.015 = 15^{m2}$

Total 120^{m2}

Annual Requirement per Km is

$120^{m2} x 0.10^m x 4,169.95$ = $50,039.40

(5) Total Annual Required Cost per 1 Km

Taking an ADT 2000 or more

1) General Maintenance

Annual Cost $2,182,375 \div 60^{Km} = 36,372.92$

2) Construction

Annual Cost $3,043,170 \div 400^{Km} = 7,607.93$

3) Removal of Debris

Annual Cost $9,441,593 \div 1000^{Km} = 9,441.59$

4) Asphalt Patching

Annual Cost per 1 Km	=50,039.40
Direct construction cost Total	103,461.84
Contingencies 10 percent	10,346.16
Total	$113,808.00

8-1-5 Periodic Maintenance

This periodic maintenance covers areas where local damage to the road base cannot be fixed by patching and also where the entire surface is overlaid every 7-10 years.

(1) Local Repair

Removal of existing pavement and construction of new pavement.

Assuming 5 percent of total construction

Carriageway $1,000^{m} x 7^{m} x 0.05 = 350^{m2}$

Necessary reconstruction estimates (Basic price shown in Table 8-1)

Removal of existing pavement	350^{m2} x144.80	= 50,428.00
Subbase course	350^{m2} x0.20^{m} x689.60	= 48,272.00
Base course	350^{m2} x0.15^{m} x957.40	= 50,263.50
Paving	350^{m2} x0.05^{m} x3,808.48	=66,648.40
Prime coat	350^{m2} x21.67	= 7,584.50
	Total	$223,196.40

(2) Overlay

Construction area per Km

Carrigeway	$1,000^{m} x 7^{m} = 7,000^{m2}$	
Paving	$7,000^{m2}$ x0.05x3,808.48	= 1,332,968.00
Prime coat	$7,000^{m2}$ x21.67	= 151,690.00
	Total	$1,484,658.00

(3) Periodic Maintenance Required Total per Km

Required local repair	223,196.40
Required overlay	1,484,658.00
Direct construction cost Total	1,707,854.40
Contingencies 10 percent	170,785.60
Total	$ 1,878,640.00

Annex Table 8-1-1 Construction Cost Estimate

CONSTRUCTION COST ESTIMATE		DATE PREPARED		SHEET OF	
FEASIBILITY STUDY OF THE BOGOTA - BUENAVENTURA ROAD PROJECT					
ESTIMATER		CHECKED BY			
DESCRIPTION	QUANTITY	UNIT MEAS.	UNIT PRICE	TOTAL	REMARKS
Item No. G-5 Excavation Common		(Hauling distance		500^{m} - 1000 m^3)	
Equipment					
Bulldozer D7G	8	HR	3,078.84	24,630.72	
Motor Scraper 621B	16	HR	4,530.08	72,481.28	
sub-total				97,112.00	
Labor					
Operator, bulldozer	8	MH	116.70	933.60	
Operator, scraper	16	MH	145.88	2,334.08	
Asst. operator	24	MH	72.94	1,750.56	
Foreman	8	MH	104.55	836.40	
Common Labor	24	MH	52.28	1,254.72	
sub-total				7,109.36	
Material					
Diesel	202.75	Gal	47.80	9,691.45	
Gasoline	3.96	Gal	47.80	189.29	
Motor Oil	4.58	Gal	283.63	1,299.02	
Transmission Oil	1.14	Gal	260.00	296.40	
Hydraulic Oil	0.88	Gal	236.35	208.00	
Grease	3.96	Lb	32.50	128.70	
Lubricants, Filters				1,814.50	15% of F.O.
sub-total				13,627.36	
Total Direct Cost For 1000 m^3				117,848.72	
Unit Direct Cost Per m^3				117.84	

Annex Table 8-1-2

COST ESTIMATE WORKSHEET	DATE PREPARED	SHEET	OF
FEASIBILITY STUDY OF THE BOGOTA-BUENAVENTURA ROAD PROJECT			
ESTIMATER	CHECKED BY		

Item No. G-5 Excavation Common (Hauling distance 500^{m} - 1000^{m^3})

Equipment

Bulldozer D7G

$1000\ m^3 \div (200 m^3/HR \times 0.8 \times 0.8) = 8$ HR

Motor Scraper 621B

$1000\ m^3$ $(16\ m^3 \times 0.8 \times 0.8 \times 6$ $^{times}) = 16$ HR

Labor

Operator, bulldozer		8 MH
Operator, scraper		16 MH
Asst. operator	8 HR + 16 HR	= 24 MH
Foreman		8 MH
Common Labor	3^{men} x 8 HR	= 24 MH

Annex Table 8-1-3

DATE PREPARED					
CONSTRUCTION COST ESTIMATE				SHEET	OF
FEASIBILITY STUDY OF THE BOGOTA - BUENAVENTURA ROAD PROJECT					
ESTIMATER		CHECKED BY			

DESCRIPTION	QUANTITY	UNIT MEAS.	UNIT PRICE	TOTAL	REMARKS
Item No.G-7 Excavation Hard Rock - 1000 m^3					
Equipment					
Air Compressor 17 m^3/min.	80	HR	927.60	74,208.00	
Crawler Drill PCR200	160	HR	723.51	115,761.60	
Bulldozer D8K w/Ripper	27	HR	4,816.00	130,032.00	
Motor Generator 200 KVA	80	HR	703.85	56,308.00	
sub-total				376,309.60	
Labor					
Operator, compressor	80	MH	87.53	7,002.40	
Operator, drill	160	MH	116.70	18,672.00	
Operator, bulldozer	27	MH	116.70	3,150.90	
Operator, generator	80	MH	87.53	7,002.40	
Asst. operator	27	MH	72.94	1,969.38	
Foreman	80	MH	104.55	8,364.00	
Common Labor	108	MH	52.28	5,646.24	
sub-total				51,807.32	
Material					
Diesel	1,218.23	Gal	47.80	58,231.94	
Gasoline	4.45	Gal	47.80	212.71	
Motor Oil	19.43	Gal	283.63	5,510.93	
Transmission Oil	1.12	Gal	260.00	291.20	
Hydraulic Oil	2.65	Gal	236.35	626.27	
Grease	19.38	Lb	32.50	629.85	
Lubricants, Filters				10,060.38	15% of F.O.
Explosive	300	Kg	110.00	33,000.00	
Cap electric	600	U	33.00	19,800.00	
Electric Cord	400	m	30.00	12,000.00	
Wire, Lead	400	m	50.00	20,000.00	
sub-total				160,363.28	
Total Direct Cost For 1000 m^3				588,480.20	
Unit Direct Cost Per m^3				588.48	

Annex Table 8-1-4

DATE PREPARED		
CONSTRUCTION COST ESTIMATE		SHEET OF
FEASIBILITY STUDY OF THE BOGOTA - BUENAVENTURA ROAD PROJECT		
ESTIMATER	CHECKED BY	

DESCRIPTION		QUANTITY	UNIT MEAS.	UNIT PRICE	TOTAL	REMARKS
Item No. G-7	Excavation Hard Rock - 1000 m^3					
Material	Explosive $1000^{m^3} \times 30^{kg}/100^{m^3}$	= 300 kg				
	Cap electric $1000 \times 60^{U}/100^{m^3}$	= 600 U				
	Cord $1000 \times 40^{m}/100^{m^3}$	= 400 m				
	Wire, Lead $1000 \times 40^{m}/100^{m^3}$	= 400 m				
Equipment	Air Compressor $1000^{m^3} \times 8^{HR}/100^{m^3}$	= 80 HR				
	Crawler Drill $80^{HR} \times 2^{unit}$	= 160 HR				
	D8K w/Ripper $1000^{m^3} \div (200^{m^3/HR} \times 0.6 \times 0.4)^{HR}$					
	add. 30%	= 27 HR				
	Motor Generator	80 HR				
Labor	Operator, compressor	80 MH				
	Operator, drill	160 MH				
	Operator, bulldozer	27 MH				
	Operator, generator	80 MH				
	Common Labor $4^{men} \times 27^{HR}$	= 108 MH				
	Foreman	80 MH				

Annex Table 8-1-5

CONSTRUCTION COST ESTIMATE	DATE PREPARED			SHEET OF	
FEASIBILITY STUDY OF THE BOGOTA - BUENAVENTURA ROAD PROJECT					
ESTIMATER		CHECKED BY			

DESCRIPTION	QUANTITY	UNIT MEAS.	UNIT PRICE	TOTAL	REMARKS
Item No. G-13 Concrete 3000 PSI (210 kg/cm^2) - 100 m^3					
Equipment					
Concrete Mixer	8	HR	468.54	3,748.32	
Tools	1	Lump		2,160.00	1% of Material
sub-total				5,908.32	
Labor					
Operator, mixer	16	MH	81.69	1,307.04	
Foreman	8	MH	104.55	836.40	
Common labor	96	MH	52.28	5,018.88	
sub-total				7,162.32	
Material					
Portland Cement	36.75	t	4,000.00	147,000.00	
Aggregate	97.9	m^3	600.00	58,740.00	
Sand	49.5	m^3	500.00	24,750.00	
Gasoline	5.28	Gal	47.80	252.38	
Motor Oil	0.09	Gal	283.63	25.53	
Grease	1.32	Lb	32.50	42.90	
Lubricants, Filters				49.28	15% of F.O.
sub-total				230,860.09	
Total Direct Cost For 100 m^3				243,930.73	
Unit Direct Cost Per m^3				2,439.31	

Annex Table 8-1-6

COST ESTIMATE WORKSHEET	DATE PREPARED	SHEET	OF
FEASIBILITY STUDY OF THE BOGOTA-BUENAVENTURA ROAD PROJECT			
ESTIMATER	CHECKED BY		

Item No. G-13 Concrete 3000 PSI (210 kg/cm2) - 100 m3

Equipment

Concrete Mixer 0.7 m^3

$0.7\ m^3 \times \frac{60}{3} \times 0.9 \times 8\ HR = 100\ m^3$

Material

Portland cement

$100\ m^3 \times 350\ kg/m^3 \times 1.05 = 36.75\ t$

Aggregate

$100\ m^3 \times 0.89\ m^3 \times 1.10 = 97.9\ m^3$

Sand

$100\ m^3 \times 0.45\ m^3 \times 1.10 = 49.5\ m^3$

Labor

Operator, mixer	16 MH
Foreman	8 MH
Common Labor $12^{men} \times 8^{HR}$	= 96 MH

Annex Table 8-1-7

CONSTRUCTION COST ESTIMATE	DATE PREPARED		SHEET	OF	
FEASIBILITY STUDY OF THE BOGOTA - BUENAVENTURA ROAD PROJECT					
ESTIMATER	CHECKED BY				

DESCRIPTION	QUANTITY	UNIT MEAS.	UNIT PRICE	TOTAL	REMARKS
Item No.G-23 Fabricated Reinforcing Steel - 1000 kg					
Equipment					
Flatbed Truck	5	HR	442.44	2,212.20	
Tools	1	Lump		500.00	
sub-total				2,712.20	
Labor					
Operator, driver	5	MH	72.94	364.70	
Foreman	5	MH	104.55	522.75	
Iron worker	40	MH	78.41	3,136.40	
Common Labor	40	MH	52.28	2,091.20	
sub-total				6,115.05	
Material					
Reinforcing Steel (deformed)	1,050	kg	45.00	47,250.00	
Binding wire	5	kg	50.00	250.00	
sub-total				47,500.00	
Total Direct Cost For 1000 kg				56,327.25	
Unit Direct Cost Per kg				56.33	

Annex Table 8-1-8

	DATE PREPARED				
CONSTRUCTION COST ESTIMATE				SHEET	OF
FEASIBILITY STUDY OF THE BOGOTA - BUENAVENTURA ROAD PROJECT					
ESTIMATER		CHECKED BY			

DESCRIPTION	QUANTITY	UNIT MEAS.	UNIT PRICE	TOTAL	REMARKS
Item No. P-4 Base Course - 1000 m^3					
Equipment					
Motor Grader 600R-1	16	HR	1,261.98	20,191.68	
Road Roller, Tire 20 t	25	HR	746.00	18,650.00	
Vibration Roller 10 t	25	HR	1,123.46	28,086.50	
Water Tanker	10	HR	434.52	4,345.20	
Pump	10	HR	387.58	3,875.80	
sub-total				75,149.18	
Labor					
Operator, grader	16	MH	116.70	1,867.20	
Operator, roller	50	MH	87.53	4,376.50	
Operator, driver	10	MH	72.94	729.40	
Operator, pump	10	MH	72.94	729.40	
Asst. Operator	16	MH	72.94	1,167.04	
Foreman	75	MH	104.55	7,841.25	
Common Labor	200	MH	52.28	10,456.00	
sub-total				27,166.79	
Material					
Coase Aggregate 3/4"-1/2"	585	m^3	640.96	374,961.60	
Fine Aggregate #4 - #200	715	m^3	640.96	458,286.40	
Diesel	236.50	Gal	47.80	11,304.70	
Gasoline	99.32	Gal	47.80	4,747.50	
Motor Oil	6.18	Gal	283.63	1,752.83	
Transmission Oil	2.24	Gal	260.00	582.40	
Hydraulic Oil	1.18	Gal	236.35	278.89	
Grease	8.40	Lb	32.50	273.00	
Lubricants, Filters				2,909.10	15% of F.O.
sub-total				855,096.42	
Total Direct Cost For 1000 m^3				957,412.39	
Unit Direct Cost Per m^3				957.41	

Annex Table 8-1-9

COST ESTIMATE WORKSHEET	DATE PREPARED	SHEET OF
FEASIBILITY STUDY OF THE BOGOTA-BUENAVENTURA ROAD PROJECT		
ESTIMATER	CHECKED BY	

Item No. P-4 Base Course - 1000 m^3

Material

Coarse Aggregate 1000 m^3 x 0.45 x 1.30 = 585 m^3

Fine Aggregate 1000 m^3 x 0.55 x 1.30 = 715 m^3

Equipment

Motor Grador

(585 m^3 + 715 m^3) ÷ (100 m^3/HR x 0.8) = 16 HR

R. Roller, Tyre and Vibration

1,300 m3 ÷ 60 m^3/HR x 1.15 = 25 HR

Water Tanker and Pump

25 HR x 40% = 10 HR

Labor

Operator, Grader		= 16 MH
Operator, Roller	2^{men} x 25^{HR}	= 50 MH
Operator, Driver		= 16 MH
Operator, Pump		= 10 MH
Foreman	3^{men} x 25^{HR}	= 75 MH
Common Labor	8^{men} x 25^{HR}	= 200 MH

Annex Table 8-1-10

DATE PREPARED

CONSTRUCTION COST ESTIMATE SHEET OF

FEASIBILITY STUDY OF THE BOGOTA - BUENAVENTURA ROAD PROJECT

ESTIMATER CHECKED BY

DESCRIPTION	QUANTITY	UNIT MEAS.	UNIT PRICE	TOTAL	REMARKS
Item No.P-9 Asphalt Concrete Pavement - 1000 Ton					
Equipment					
Asphalt Plant Ba 1000	19	HR	4,394.62	83,497.78	
Wheel Loader 950	38	HR	2,478.72	94,191.36	
Bulldozer D7G	38	HR	3,078.84	116,995.92	
Asphalt Finisher SA35	28	HR	822.56	23,031.68	
Road Roller, Macadam 10^t	28	HR	513.85	14,387.80	
Road Roller, Tire 20^t	28	HR	746.00	20,888.00	
Dump Truck 7 ton	237	HR	467.06	110,693.22	
Generator EG300	19	HR	1,147.00	21,793.00	
Tools	1	Lump		2,915.00	
sub-total				488,393.76	
Labor					
Operator, plant	57	MH	145.88	8,315.16	
Operator, finisher	56	MH	145.88	8,169.28	
Operator, Loader	38	MH	116.70	4,434.60	
Operator, bulldozer	38	MH	116.70	4,434.60	
Operator, roller	56	MH	87.53	4,901.68	
Operator, generator	19	MH	87.53	1,663.07	
Operator, driver	237	MH	72.94	17,286.78	
Operator, raker	56	MH	91.48	5,122.88	
Asst. operator	76	MH	72.94	5,543.44	
Foreman	42	MH	104.55	4,391.10	
Mechanic	19	MH	104.55	1,986.45	
Common labor	228	MH	52.28	11,919.84	
sub-total				78,168.88	
Material					
Asphalt cement 80-100	61.8	t	8,400.00	519,120.00	
Aggregate Coarse					
1/2" - #8	272	m^3	640.96	174,341.12	
3/8" - #16	77	m^3	640.96	49,352.92	
Aggregate Fine					
#4 - #200 crushed	310.8	m^3	500.00	155,400.00	
#4 - #200 natural	77.7	m^3	500.00	38,850.00	

(Cont'd)

Annex Table 8-1-11

CONSTRUCTION COST ESTIMATE	DATE PREPARED			SHEET OF	
FEASIBILITY STUDY OF THE BOGOTA - BUENAVENTURA ROAD PROJECT					
ESTIMATER		CHECKED BY			
DESCRIPTION	QUANTITY	UNIT MEAS.	UNIT PRICE	TOTAL	REMARKS
Material					
Filler	52.5	t	800.00	42,000.00	
Diesel	1,355.0	Gal	47.80	64,769.00	
Kerosene	176.0	Gal	49.40	8,694.00	
Grease	5.3	Lb	32.50	172.25	
Lubricants, Filters				1,364.00	15% of F.O.
sub-total				1,054,064.29	
Total Direct Cost For 1000 Ton				1,620,626.93	
Unit Direct Cost Per Ton				1,620.63	

Annex Table 8-1-12

COST ESTIMATE WORKSHEET	DATE PREPARED	SHEET	OF

FEASIBILITY STUDY OF THE BOGOTA-BUENAVENTURA ROAD PROJECT

ESTIMATER CHECKED BY

Item No.P-9 Asphalt Concrete Pavement - 1000 Ton

Material

Coarse Aggregate

1/2" - #8 1000^t x 35% x 0.74 m^3/t x 1.05 = 272 m^3

3/8" - #16 1000 x 10% x 0.74 x 1.05 = 77.7 m^3

Fine Aggregate

#4 - #200 crushed 1000 x 40% x 0.74 x 1.05 = 310.8 m^3

#4 - #200 natural 1000 x 10% x 0.74 x 1.05 = 77.7 m^3

Filler 1000^t x 5% x 1.05 = 52.5^t

Asphalt 1000 x 6% x 1.03 = 61.8^t

Equipment

Plant 70^t/Hr

1000^t x 1.03 + (70^t/Hr x 0.8) = 19 HR

Generator EG300 = 19 HR

Wheel Loader 950

19 HR x 2 unit = 38 HR

D7G = 38 HR

Dump Truck

1000^t x 1.03 + 7.0^t x 1.61^{HR} = 237^{HR}

Required time

Loading		= 0.06
Waiting		= 0.05
Hauling	15 km + 20 km/HR	= 0.75
Dump		= 0.10
Waiting		= 0.05
Return	15 km + 25 kg/HR	= 0.60
	Total	1.61

Finisher 1000^t + 36^t/HR = 28 HR

Rollers = 28 HR

Labor

Operator, plant	19^{HR} x 3^{men}	= 57 MH
Operator, Finisher	28^{HR} x 2^{men}	= 56 MH
Operator, raker		56 MH
Operator, loader		38 MH
Operator, bulldozer		38 MH
Operator, roller		56 MH
Operator, generator		19 MH

(Cont'd)

Annex Table 8-1-13

COST ESTIMATE WORKSHEET	DATE PREPARED	SHEET OF
FEASIBILITY STUDY OF THE BOGOTA-BUENAVENTURA ROAD PROJECT		
ESTIMATER	CHECKED BY	

Operator, driven	237 MH
Asst. operator	
$2^{men} \times 38^{HR}$	76 MH
Foreman 28 HR x 1.50 =	42 MH
Mechanic	19 MH
Common labor 38 HR x 6^{men} =	228 MH

Table 8-1-14

CONSTRUCTION COST ESTIMATE	DATE PREPARED			SHEET	OF
FEASIBILITY STUDY OF THE BOGOTA - BUENAVENTURA ROAD PROJECT					
ESTIMATER	CHECKED BY				

DESCRIPTION	QUANTITY	UNIT MEAS.	UNIT PRICE	TOTAL	REMARKS
Item No. P-3 Setting of Concrete Pipe 900^{mm} dia. - 100^{m}					
Equipment					
Excavator 215	11	HR	2,451.80	26,969.80	
Bulldozer D7G	6	HR	3,420.93	20,525.58	
Flatbed Truck 6 Ton	36	HR	398.19	14,334.84	
Tools		Lump		1,800.00	
sub-total				63,630.22	
Material					
Reinforced Concrete Pipe	102	m	1,300.00	132,600.00	
Sand	33	m^3	500.00	16,500.00	
Plank	3	m^3	5,860.00	17,580.00	
Cement Mortar	0.6	m^3	3,779.58	2,267.75	
Diesel	62.84	Gal	47.80	3,003.75	
Gasoline	289.51	Gal	47.80	13,838.58	
Motor Oil	5.75	Gal	283.63	1,630.87	
Transmission Oil	1.63	Gal	260.00	423.80	
Hydraulic Oil	0.25	Gal	236.35	59.09	
Grease	5.92	Lb	32.50	192.40	
Lubricants, Filters				2,941.05	
sub-total				191,037.29	
Labor					
Operator, Excavator	11	MH	116.70	1,283.70	
Operator, Bulldozer	6	MH	116.70	700.20	
Operator, Driver	36	MH	72.94	2,625.84	
Asst. Operator	11	MH	72.94	802.34	
Foreman	134	MH	104.55	14,009.70	
Common Labor	1720	MH	52.28	89,921.60	
sub-total				109,343.38	
Total Direct Cost For 100^{m}				364,010.89	
Unit Direct Cost Per m				3,640.10	

Annex Table 8-1-15

COST ESTIMATE WORKSHEET	DATE PREPARED	SHEET	OF
FEASIBILITY STUDY OF THE BOGOTA-BUENAVENTURA ROAD PROJECT			
ESTIMATER	CHECKED BY		

Excavation

Lower W. Upper W. Height

$1/2 \times (1.50 + 4.26) \times 2.30 \times 100^{m} = 662\ m^3$

(back-fill) $662 - 94 = 568\ m^3$

Equipment

Excavator 215

$662\ m^3 \div 61\ m^3/HR = 11\ HR$

Bulldozer D7G 6 HR

Labor

Operator, Excavator 11 MH

Operator, Bulldozer 6 MH

Operator, driver 36 MH

Common Labor $8^{HR} \times 15^{men} = 120$ MH

Setting:-

Foreman $100^{m}/6^{m} \times 8 = 134^{MH}$

Common Labor

$100^{m} \times 12^{men}/6^{m} \times 8 = 1600^{MH}$

Material

Reinforced Concrete Pipe

ϕ900 $100^{m} \times 1.02 = 102^{m}$

Sand $0.20^{m} \times 1.50^{m} \times 100^{m} \times 1.10 = 33\ m^3$

Plank $3.0\ m^3$

Cement Mortar $0.6\ m^3$

Transportation of Pipe

Flatbed Truck

$1.5^{t}/2.43^{m} \times 102^{m} \div (6^{t} \times 0.9) \times 2.5^{HR}$

add. 25% (Loading and Unloading) = 36^{HR}

Annex Table 8-2 -1 **Acquisition Cost of Equipment**

UNIT: $

Bulldozer	Caterpillar D6D	140 HP	7,586,930
Bulldozer	Caterpillar D7G	200 HP	10,339,870
Bulldozer	Caterpiller D8K	300 HP	14,416,180
Bulldozer	Caterpiller D8K w/Ripper	300 HP	16,173,880
Tractor Shovel	Caterpillar 955 L 1.8^{m3}	130 HP	6,990,730
Tractor Shovel	Caterpillar 977 L 2.1^{m3}	190 HP	11,229,990
Wheel Loader	Caterpillar 950 L 1.8^{m3}	130 HP	7,132,130
Excavator	Caterpillar 215 0.6^{m3}	85 HP	6,962,950
Motor Grader	Caterpillar 12 G 3.7^{m}	135 HP	7,656,470
Motor Grader	Komatsu GD 600R-1 3.7^{m}	145 PS	4,259,190
Motor Scraper	Caterpillar 621B 16^{m3}	330 HP	15,294,110
Road Roller, Macadam	Sakai KD7610 10 ton	87 PS	1,964,880
Road Roller, Tyre	Sakai TS7409 20 ton	95 PS	2,167,340
Vibration Roller	Sakai SV90 10 ton	133 PS	3,190,590
Asphalt Plant	Barber Green BA1000 70 T/H	190 HP	21,850,440
Asphalt Finisher	Barber Green SA35, 2.4^{m}-4.3^{m}	68 HP	2,835,120
Asphalt Finisher	Sakai PT280 1.8^{m}-2.8^{m}	22 PS	2,470,780
Asphalt Distributor	Hanta Kikai DS-50EA	26 PS	1,418,260
Concrete Batching Plan	Nikko BPU-150A 90 m^3/H	110 KW	16,342,470
Concrete Mixer, portable	Nikko NCSTM28 0.7^{m3}	15 PS	1,058,320
Air Compressor, portable	Komatsu EC105V $10.5^{m3/min}$	103 PS	1,982,450
Air Compressor, portable	Komatsu EC170V $17^{m3/min}$	170 PS	3,115,260
Motor Generator	Komatsu EG200 200 KVA	246 PS	2,363,830
Motor Generator	Komatsu EG300 300 KVA	363 PS	3,852,090
Truck Crane	Kato NK110 10 ton	110 PS	4,377,440
Truck Crane	Hitachi Kenki FH70 20 ton	140 PS	7,634,260
Crauler Crane	Hitachi Kenki KH70 23 ton	127 PS	8,019,470
Pile Driver	Isikawajima IDH25 2.5 ton	80 PS	2,626,390
Pile Driver	Isikawajima IDH35 3.5 ton	120 PS	3,326,810
Underwater Pump	Tsurumi TO-370 $10^{m3/min}$	37 KW	875,480
Crushing Plant	Daito Sangyo 60 T/H	130 KW	24,861,740
Blower	Mitsui MAF40 150^{m3}/min	11 KW	953,250
Crauler Drill	Furukawa PCR200 38^{mm} dia.		2,766,530
Concrete Pump car	Isikawajima IPF65T 60^{m3}/H	130 PS	6,828,770
Truck Mixer	Niigata Tekko NTO 350 3.5^{m3}	240 PS	2,529,080
Dump Truck	Dodge D600 7 ton	202 HP	1,478,800
Flatbed Truck	Dodge D600 6 ton	180 HP	1,247,500
Water Tanker	Dodge D600 2000 Gal.	200 HP	1,369,500
Drilling Machine	Yamato CH-1 66^{mm} dia.	5.5 KW	741,930
Leg Hammer	Furukawa 322D 22Hx108^{mm}		68,030
Grout Pump	Koken MG5A 65 l/min	3.7 KW	347,070

Annex

Table 8- 2-2 Hourly Costs Analysis

1980 Prices

Factor of Conversion US$1.00 = $75.73

BRAND: Caterpillar Bulldozer FOB US$100184
D6D Motor Diesel 140 HP Weight 15 ton

ITEM	CALCULATION	NUMBER	UNIT
1. GENERAL DATA			
A. Economic Life in Hours		10,000	Hours
B. Economic Life in Years		5	Years
2. ACQUISITION COSTS			
C. Total Cost		7,586,930	$
D. Cost of Tyres		-	
E. Total Cost less Tyres	C - D	7,586,930	$
3. HOURLY OWNERSHIP COSTS			
F. Depreciation	E/A	758.69	$/Hr
G. Hourly Ownership Costs	$\frac{E}{1,000}$x0.20710	1,571.25	$/Hr
4. HOURLY OPERATING COSTS			
H. Repairs	F x 1.2375	938.87	$/Hr
I. Cost of Fuels and Lubricants			
Diesel	47.80x3.75x1.1	197.18	
Gasoline	47.80x0.15x1.1	7.89	
Motor Oil	283.63x0.08x1.1	24.96	
Transmission Oil	260.00x0.03x1.1	8.58	
Hydraulic Oil	236.35x0.02x1.1	5.20	
Grease (Lb)	32.50x0.04x1.1	1.43	
Sub total		245.24	$/Hr
Lubricants and Filters	20%	49.05	$/Hr
J. Cost of Tyres		-	$/Hr
K. Operator and Asst.	(116.70+72.94)	189.64	$/Hr
L. Hourly Operating Costs	H + I + K	1,422.80	$/Hr
5. TOTAL DIRECT COST	G + L	2,994.05	$/Hr

HOURLY COST G+H = 2,510.12

Annex Table 8-3-1

QUANTITIES AND COST: THE IMPROVEMENT PLANS SELECTED (1)

Section (01) P-2
KM 61.3 - KM62.8

(UNIT: $'000)

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	603	m^2	2	1	1	4
Excavation Common M	610	m^3	11	48	2	61
Excavation Soft Rock	737	m^3	89	55	21	165
Embankment	170	m^3	10	6	2	18
Removal of Old Pavement	2,874	m^3	214	145	55	414
Carriageway Pavement	3,895	m^2	1,017	704	202	1,923
Shoulder Pavement	728	m^2	111	73	19	203
Gravity Wall $H=3^m$	21	m	84	117	12	213
Concrete Spraying	335	m^2	18	18	5	41
Guard Rail	364	m	361	533	46	943
Total			1,917	1,700	365	3,982
w/Overhead and Profit			2,626	1,936	415	4,977
Supervision			189	47	12	248
Contingency			282	199	42	523
Detailed Eng. w/Cont.			208	52	13	273
Total			3,305	2,234	482	6,021
Economic Cost			3,305	2,234	-	5,539

Section (02) P-3
KM62.800 - KM63.855

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	16,212	m^2	61	25	11	97
Excavation Common A	5,720	m^3	108	52	20	180
Excavation Common B	5,722	m^3	431	164	79	674
Excavation Soft Rock	14,598	m^3	1,777	1,101	425	3,303
Excavation Hard Rock	9,938	m^3	3,027	2,018	803	5,848
Embankment	5,340	m^3	308	183	67	558
Removal of Old Pavement	4,911	m^2	366	248	94	708
Carriageway Pavement	7,000	m^2	1,563	1,028	275	2,866
Shoulder Pavement	2,000	m^2	395	261	71	727
Concrete Spraying	2,402	m^2	130	129	35	294
Seed Spraying	9,274	m^2	149	216	40	405
Setting Pipe 900 dia.	140	m	219	264	26	509
Side Ditch	2,000	m	935	1,468	175	2,578
Catch Basin	15	U	30	94	4	128
Guard Rail	1,055	m	1,047	1,544	133	2,724
Total			10,546	8,795	2,258	21,599
w/Overhead and Profit			14,393	10,078	2,528	26,999
Supervision			1,026	257	67	1,350
Contingency			1,542	1,034	259	2,835
Detailed Eng. w/Cont.			1,129	283	73	1,485
Total			18,090	11,652	2,927	32,669
Economic Cost			18,090	11,652	-	29,742

Annex Table 8-3-1

QUANTITIES AND COST: THE IMPROVEMENT PLANS SELECTED (2)

Section (03) P-2
KM65.6 - KM68.1

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	10,103	m^2	38	15	7	60
Excavation Common M	6,904	m^3	122	544	20	686
Excavation Common B	6,414	m^3	483	184	89	756
Excavation Soft Rock	17,140	m^3	2,086	1,293	499	3,878
Excavation Hard Rock	49,115	m^3	14,958	9,976	3,969	28,903
Embankment	217	m^3	13	7	3	23
Removal of Old Pavement	4,282	m^2	319	216	82	617
Carriageway Pavement	6,633	m^2	1,732	1,198	343	3,273
Shoulder Pavement	1,628	m^2	247	164	44	455
Gravity Wall $H=3^m$	60	m	240	333	35	608
Slope Protection A	1,434	m^2	885	1,544	78	2,507
Concrete Spraying	4,236	m^2	229	228	62	519
Seed Spraying	2,613	m^2	42	61	11	114
Guard Rail	762	m	756	1,115	96	1,967
Total			22,150	16,878	5,338	44,366
w/Overhead and Profit			30,053	19,512	5,893	55,458
Supervision			2,107	527	139	2,773
Contingency			3,216	2,004	603	5,823
Detailed Eng. w/Cont.			2,318	580	152	3,050
Total			37,694	22,623	6,787	67,104
Economic Cost			37,694	22,623	-	60,317

Section (04) P-3
KM68,384 - KM69,228

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	17,833	m^2	67	27	12	106
Excavation Common A	19,500	m^3	369	176	67	612
Excavation Common B	19,558	m^3	1,472	562	271	2,305
Excavation Soft Rock	3,550	m^3	432	268	103	803
Excavation Hard Rock	29,768	m^3	9,066	6,046	2,405	17,517
Embankment	6,467	m^3	372	221	81	674
Removal of Old Pavement	2,592	m^2	193	131	49	373
Carriageway Pavement	4,403	m^2	983	647	173	1,803
Shoulder Pavement	1,258	m^2	249	164	44	457
P.C.T. Bridge $L=20^m$	1	Span	2,394	2,940	573	5,907
Gravity Wall $h=4^m$	64	m	527	702	75	1,304
Retaining Wall $h=7^m$	30	m	575	941	89	1,605
Concrete Spraying	3,240	m^2	176	174	47	397
Seed Paraying	13,633	m^2	219	318	58	595
Setting Pipe 900 dia.	80	m	125	151	15	291
Side Ditch	1,290	m	603	947	113	1,663
Catch Basin	8	U	16	50	2	68
Guard Rail	629	m	624	920	80	1,624
Total			18,462	15,385	4,257	38,104
w/Overhead and Profit			25,249	17,648	4,733	47,630
Supervision			1,810	453	119	2,382
Contingency			2,706	1,810	485	5,001
Detailed Eng. w/Cont.			1,991	498	131	2,620
Total			31,756	20,409	5,468	57,633
Economic Cost			31,756	20,409	-	52,165

Annex Table 8-3-1

QUANTITIES AND COST: THE IMPROVEMENT PLANS SELECTED (3)

Section (05) P-2
KM69.2 - KM70.1

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	1,329	m^2	5	2	1	8
Excavation Common M	760	m^3	13	60	2	75
Excavation Common B	777	m^3	59	22	11	92
Excavation Soft Rock	1,059	m^3	129	80	31	240
Excavation Hard Rock	4,007	m^3	1,220	814	324	2,358
Removal of Old Pavement	1,480	m^2	110	75	28	213
Carriageway Pavement	2,464	m^2	643	445	128	1,216
Shoulder Pavement	644	m^2	98	65	17	180
Gravity Wall h=3^m	20	m	80	111	12	203
Slope Protection A	616	m^2	380	663	34	1,077
Concrete Spraying	378	m^2	21	20	5	46
Embankment	78	m^3	4	3	1	8
Guard Rail	382	m	379	559	48	986
Total			3,141	2,919	642	6,702
w/Overhead and Profit			4,335	3,317	726	8,378
Supervision			318	80	21	419
Contingency			465	340	75	880
Detailed Eng. w/Cont.			349	88	23	460
Total			5,467	3,825	845	10,137
Economic Cost			5,467	3,825	-	9,292

Section (06) P-2
KM70.1 - KM72.9

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Excavation Common M	58	m^3	1	5	0	6
Embankment	800	m^3	46	27	10	83
Removal of Old Pavement	1,654	m	123	84	31	238
Carriageway Pavement	1,764	m^2	461	319	91	871
Shoulder Pavement	430	m^2	65	43	12	120
Gravity Wall H=3^m	64	m	256	355	37	648
Guard Rail	215	m	213	315	27	555
Total			1,165	1,148	208	2,521
w/Overhead and Profit			1,614	1,297	240	3,151
Supervision			120	30	8	158
Contingency			173	133	25	331
Detailed Eng. w/Cont.			132	33	9	174
Total			2,039	1,493	282	3,814
Economic Cost			2,039	1,493	-	3,532

Annex Table 8-3-1

QUANTITIES AND COST: THE IMPROVEMENT PLANS SELECTED (4)

Section (08) P-2
Km 73.4 - KM 75.2

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Excavation Common M	52	m^3	1	4	0	5
Embankment	508	m^3	29	17	7	53
Removal of Old Pavement	774	m	57	39	15	111
Carriageway Pavement	718	m^2	187	130	37	354
Shoulder Pavement	172	m^2	26	17	5	48
Guard Rail	145	m	144	212	18	374
Total			444	419	82	945
w/Overhead and Profit			612	475	94	1,181
Supervision			45	11	3	59
Contingency			66	49	9	124
Detailed Eng. w/Cont.			50	12	3	65
Total			773	547	109	1,429
Economic Cost			773	547	-	1,320

Section (09) P-2
Km 75.2 -KM 75.7

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Excavation Common M	53	m^3	1	4	0	5
Embankment	23	m^3	1	1	0	2
Removal of Old Pavement	684	m^2	51	35	13	99
Carriageway Pavement	635	m^2	166	115	33	314
Shoulder Pavement	152	m^2	23	15	4	42
R.C.Bridge L=10^m	1	Span	580	931	91	1,602
Guard Rail	76	m	76	111	10	197
Total			898	1,212	151	2,261
w/Overhead and Profit			1,301	1,346	179	2,826
Supervision			107	27	7	141
Contingency			141	137	19	297
Detailed Eng. w/Cont.			118	30	7	155
Total			1,667	1,540	212	3,419
Economic Cost			1,667	1,540	-	3,207

Annex Table 8-3-1

QUANTITIES AND COST: THE IMPROVEMENT PLANS SELECTED (5)

Section (10) P-2
Km 75.7 - KM 81.1

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	480	m^2	2	1	0	3
Excavation Common M	254	m^3	4	20	1	25
Excavation Soft Rock	2,727	m^3	332	206	79	617
Excavation Hard Rock	947	m^3	288	192	77	557
Embankment	872	m^3	50	30	11	91
Removal of Old Pavement	4,090	m^2	304	207	78	589
Removal of Old Masonry	667	m	36	25	8	69
Carriageway Pavement	4,821	m^2	1,259	871	249	2,379
Shoulder Pavement	1,394	m^2	212	140	38	390
R.C.Bridge T=5^m	1	Span	293	460	43	796
P.C.T.Bridge L=30^m	1	Span	3,862	4,467	937	9,266
Gravity Wall H=3^m	127	m	508	705	73	1,286
Slope Protection A	237	m^2	146	255	13	414
Seed Spraying	544	m^2	9	13	2	24
Guard Rail	553	m	549	809	70	1,428
Total			7,854	8,401	1,679	17,934
w/Overhead and Profit			11,049	9,466	1,903	22,418
Supervision			852	213	56	1,121
Contingency			1,190	968	195	2,353
Detailed Eng. w/Cont.			937	234	62	1,233
Total			14,028	10,881	2,216	27,125
Economic Cost			14,028	10,881	-	24,909

Annex Table 8-3-1

QUANTITITES AND COST: THE IMPROVEMENT PLANS SELECTED (6)

Section (11) P-3
KM 81.1 - KM81.6

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing Stripping	1,081	m^2	4	2	0	6
Excavation Common A	1,460	m^3	28	13	5	46
Excavation Common B	1,475	m^3	111	42	21	174
Excavation Soft Rock	533	m^2	65	40	16	121
Removal of Old Pavement	593	m^2	44	30	11	85
Carriageway Pavement	1,330	m^2	347	240	69	656
Shoulder Pavement	380	m^2	58	38	10	106
P.C.T.Bridge (2@30^m)	1	Place	8,475	9,796	2,053	20,324
Seed Spraying	842	m^2	14	20	3	37
Setting Pipe 900 dia.	19	m	30	36	3	69
Side Ditch	380	m	178	279	33	490
Catch Basin	2	U	4	12	1	17
Guard Rail	215	m	213	315	27	555
Total			9,571	10,863	2,252	22,686
w/Overhead and Profit			13,612	12,210	2,536	28,358
Supervision			1,077	270	71	1,418
Contingency			1,469	1,248	261	2,978
Detailed Eng. w/Cont.			1,185	297	78	1,560
Total			17,343	14,025	2,946	34,314
Economic Cost			17,343	14,025	-	31,368

Annex Table 8-3-1

QUANTITIES AND COST: THE IMPROVEMENT PLANS SELECTED (7)

Section (12) P-2
KM 81.6 - KM 83.5

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Embankment	616	m^3	35	21	8	64
Removal of Old Pavement	495	m^2	37	25	9	71
Carriageway Pavement	718	m^2	187	130	37	354
Shoulder Pavement	172	m^2	26	17	5	48
Gravity Wall H=3^m	4	m	16	22	2	40
R.C. Half Bridge	46	m	1,218	2,198	187	3,603
Guard Rail	86	m	85	126	11	222
Total			1,604	2,539	259	4,402
w/Overhead and Profit			2,388	2,801	314	5,503
Supervision			209	52	14	275
Contingency			260	285	33	578
Detailed Eng. w/Cont.			230	57	15	302
Total			3,087	3,195	376	6,658
Economic Cost			3,087	3,195	-	6,282

Section (13) P-2
KM 83.5 - KM 88.7

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	1,617	m^2	6	3	1	10
Excavation Common M	1,836	m^3	32	145	5	182
Excavation Soft Rock	1,630	m^3	198	123	47	368
Excavation Hard Rock	352	m^3	107	72	28	207
Embankment	1,184	m^3	68	40	15	123
Removal of Old Pavement	3,561	m^2	265	180	68	513
Carriageway Pavement	4,203	m^2	1,098	759	217	2,074
Shoulder Pavement	1,010	m^2	154	102	27	283
Gravity Wall H=3^m	83	m	332	461	48	841
Concrete Spraying	484	m^2	26	26	7	59
Guard Rail	505	m	501	739	64	1,304
Total			2,787	2,650	527	5,964
w/Overhead and Profit			3,849	3,004	602	7,455
Supervision			283	71	19	373
Contingency			413	308	62	783
Detailed Eng. w/Cont.			311	78	21	410
Total			4,856	3,461	704	9.021
Economic Cost			4,856	3,461	-	8,317

Annex Table 8-3-1

QUANTITIES AND COST: THE IMPROVEMENT PLANS SELECTED (8)

Section (14) P-2
KM 94.3 - KM 97.6

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	1,623	m^2	6	3	1	10
Excavation Common M	1,529	m^3	27	120	5	152
Excavation Common B	1,096	m^3	82	32	15	129
Excavation Soft Rock	1,234	m^3	150	93	36	279
Embankment	4,956	m^3	286	169	62	517
Removal of Old Pavement	3,634	m^2	271	183	69	523
Carriageway Pavement	4,348	m^2	1,135	786	228	2,146
Shoulder Pavement	1,092	m^2	166	110	29	305
Gravity Wall $H=3^m$	55	m	270	305	32	557
R.C.Bridge $L=10^m$	1	Span	580	931	91	1,602
Concrete Spraying	128	m^2	7	7	2	16
Seed Spraying	452	m^2	7	11	2	20
Guard Rail	373	m	370	546	47	963
Total			3,307	3,296	616	7,219
w/Overhead and Profit			4,593	3,725	706	9,024
Supervision			343	85	23	451
Contingency			494	381	73	948
Detailed Eng. w/Cont.			377	94	25	496
Total			5,807	4,285	827	10,919
Economic Cost			5,807	4,285	-	10,092

Section (15) P-2
KM 97.6 - KM 98.2

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Excavation Common M	58	m^3	1	5	0	6
Embankment	58	m^3	3	2	1	6
Removal of Old Pavement	864	m^2	64	44	16	124
Carriageway Pavement	802	m^2	209	145	42	396
Shoulder Pavement	192	m^2	29	19	5	53
Guard Rail	96	m	95	140	12	247
Total			401	355	76	832
w/Overhead and Profit			549	405	86	1,040
Supervision			39	10	3	52
Contingency			59	42	9	109
Detailed Eng. w/Cont.			43	11	3	58
Total			690	468	101	1,259
Economic Cost			690	468	-	1,158

Annex Table 8-3-1

QUANTITIES AND COST: THE IMPROVEMENT PLANS SELECTED (9)

Section (16) P-2
KM 98.2 - KM 100.7

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Embankment	113	m^3	6	5	1	12
Removal of Old Pavement	758	m^2	57	38	14	109
Carriageway Pavement	563	m^2	147	102	29	278
Shoulder Pavement	150	m^2	23	15	4	42
Seed Spraying	248	m^2	4	6	1	11
Guard Rail	75	m	75	110	9	194
Total			312	276	58	646
w/Overhead and Profit			427	315	66	808
Supervision			31	8	2	41
Contingency			46	32	7	85
Detailed Eng. w/Cont.			34	9	2	45
Total			538	364	77	979
Economic Cost			538	364	-	902

Section (17) P-3
KM 101.2

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	3,590	m^2	13	6	3	22
Excavation Common A	2,100	m^3	40	19	7	66
Excavation Common B	2,105	m^3	158	61	29	248
Excavation Soft Rock	1,450	m^3	176	109	42	327
Embankment	8,570	m^3	494	293	107	894
Carriageway Pavement	2,930	m^2	765	529	152	1,466
Shoulder Pavement	680	m^2	104	68	18	190
P.C.T.Bridge $L=170^m$	1	Place	48,720	44,574	10,366	103,660
R.C.Bridge $L=5^m$	1	Span	293	460	43	796
Gravity Wall $H=3^m$	80	m	320	444	46	810
Retaining Wall $H=5^m$	100	m	1,019	1,726	159	2,904
Retaining Wall $H=7^m$	170	m	3,258	5,335	507	9,100
Retaining Wall $H=10^m$	80	m	2,333	2,900	226	5,459
Slope Protection A	484	m^2	299	521	26	846
Seed Spraying	909	m^2	15	21	4	40
Setting Pipe 900 dia.	13	m	20	25	2	47
Side Ditch	620	m	290	455	54	799
Catch Basin	6	U	12	37	2	51
Guard Rail	290	m	288	424	37	749
Total			58,617	58,007	11,830	128,454
w/Overhead and Profit			81,498	65,634	13,436	160,568
Supervision			6,101	1,525	402	8,028
Contingency			8,760	6,716	1,384	16,860
Detailed Eng. w/Cont.			6,711	1,678	442	8,831
Total			103,070	75,553	15,664	194,287
Economic Cost			103,070	75,553	-	178,623

Annex Table 8-3-1

QUANTITIES AND COST: THE IMPROVEMENT PLANS SELECTED (10)

Section (18) P-2
KM102.1 - KM135.6 (UNIT: $'000)

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	62,354	m^2	235	95	43	373
Excavation Common M	34,434	m^3	607	2,713	100	3,420
Excavation Common B	25,201	m^3	1,896	724	349	2,969
Excavation Soft Rock	136,413	m^3	16,603	10,290	3,969	30,862
Excavation Hard Rock	1,125	m^3	343	229	91	663
Embankment	19,153	m^3	1,103	655	240	1,998
Removal of Old Pavement	53,026	m^2	3,949	2,679	1,012	7,640
Removal of Old Masonry	370	m	20	14	4	38
Carriageway Pavement	70,427	m^2	18,391	12,722	3,643	34,756
Shoulder Pavement	13,172	m^2	2,003	1,325	354	3,682
Gravity Wall H=3^m	150	m	600	833	86	1,519
Gravity Wall H=4^m	50	m	411	549	59	1,019
Retaining Wall H=7^m	50	m	958	1,569	149	2,676
Slope Protection A	16,442	m^2	10,146	17,703	894	28,743
Concrete Spraying	795	m^2	38	37	10	85
Seed Spraying	22,523	m^2	362	526	97	985
Setting Pipe 900 dia.	117	m	183	221	22	426
Setting Pipe 600 dia.	15	m	16	19	2	37
Side Ditch	13,562	m	6,343	9,957	1,185	17,485
Catch Basin	2	U	4	13	0	17
Guard Rail	6,606	m	6,557	9,666	834	17,057
Total			70,768	72,539	13,143	156,450
w/Overhead and Profit			98,636	81,828	15,099	195,563
Supervision			7,431	1,858	489	9,778
Contingency			10,607	8,369	1,558	20,534
Detailed Eng. w/Cont.			8,174	2,044	538	10,756
Total			124,848	94,099	17,684	236,631
Economic Cost			124,848	94,099	-	218,947

Annex Table 8-3-2

MINIMUM SCALE IMPROVEMENT (1)

Section (01)
KM 61.3 - KM 62.8

(US$'000)

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	603	m^2	2	1	1	4
Excavation Common M	610	m^3	11	48	2	61
Excavation Soft Rock	737	m^3	89	55	21	165
Embankment	170	m^3	10	6	2	18
Removal of Old Pavement	2,874	m^2	214	145	55	414
Carriageway Pavement	3,895	m^2	1,017	704	202	1,923
Shoulder Pavement	728	m^2	111	73	19	203
Gravity Wall $H=3^m$	21	m	84	117	12	213
Concrete Spraying	335	m^2	18	18	5	41
Guard Rail	364	m	361	533	46	940
Total			1,917	1,700	365	3,982

Section (02)
KM 62.8 - KM 63.9

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	1,838	m^2	7	3	1	11
Excavation Common M	4,066	m^3	72	320	12	404
Excavation Soft Rock	11,456	m^3	1,394	864	334	2,592
Excavation Hard Rock	4,115	m^3	1,253	836	332	2,421
Removal of Old Pavement	1,052	m^2	78	53	20	151
Carriageway Pavement	1,774	m^2	463	320	92	875
Shoulder Pavement	428	m^2	65	43	12	120
Gravity Wall $H=3^m$	7	m	28	39	4	71
Slope Protection A	168	m^2	104	181	9	294
Concrete Spraying	815	m^2	44	44	12	100
Seed Spraying	924	m^2	15	21	4	40
Guard Rail	214	m	212	313	27	552
Total			3,735	3,037	859	7,631

Annex Table 8-3-2

MINIMUM SCALE IMPROVEMENT (2)

(UNIT: $'000)

Section (03)
KM 65.6 - KM 68.1

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	10,103	m^2	38	15	7	60
Excavation Commom M	6,904	m^3	122	544	20	686
Excavation Common B	6,414	m^3	483	184	89	756
Excavation Soft Rock	17,140	m^3	2,086	1,293	499	3,878
Excavation Hard Rock	49,115	m^3	14,958	9,976	3,969	28,903
Embankment	217	m^3	13	7	3	23
Removal of Old Pavement	4,282	m^2	319	216	82	617
Carriageway Pavement	6,633	m^2	1,732	1,198	343	3,273
Shoulder Pavement	1,628	m^2	247	164	44	455
Gravity Wall H=3^m	60	m	240	333	35	608
Slope Protection A	1,434	m^2	885	1,544	78	2,507
Concrete Spraying	4,236	m^2	229	228	62	519
Seed Spraying	2,613	m^2	42	61	11	114
Guard Rail	762	m	756	1,115	96	1,967
Total			22,150	16,878	5,338	44,366

Section (04)
KM 68.4 - KM 69.2

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	4,974	m^2	19	8	3	30
Excavation Commom M	5,893	m^3	104	464	17	585
Excavation Commom B	5,200	m^3	391	150	72	613
Excavation Soft Rock	10,721	m^3	1,305	809	312	2,426
Excavation Hard Rock	28,123	m^3	8,565	5,713	2,272	16,550
Removal of Old Payment	1,208	m^2	90	61	23	174
Carriageway Pavement	2,205	m^2	576	398	114	1,088
Shoulder Pavement	560	m^2	85	56	15	156
Gravity Wall H=3^m	8	m	32	44	5	81
Slope Protection A	1,268	m^2	783	1,365	69	2,217
Concrete Spraying	769	m^2	42	41	11	94
Seed Spraying	2,443	m^2	39	57	11	107
Guard Rail	220	m	218	322	28	568
Total			12,249	9,488	2,952	24,689

Annex Table 8-3-2 (UNIT: $'000)

MINIMUM SCALE IMPROVEMENT (3)

Section (05)
KM 69.2 - KM 70.1

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	1,329	m^2	5	2	1	8
Excavation Commom M	760	m^3	13	60	2	75
Excavation Commom B	777	m^3	59	22	11	92
Excavation Soft Rock	1,059	m^3	129	80	31	240
Excavation Hard Rock	4,007	m^3	1,220	814	324	2,358
Removal of Old Pavement	1,480	m^2	110	75	28	213
Carriageway Pavement	2,464	m^2	643	445	128	1,216
Shoulder Pavement	644	m^2	98	65	17	180
Gravity Wall $H=3^m$	20	m	80	111	12	203
Slope Protection A	616	m^2	380	663	34	1,077
Concrete Spraying	378	m^2	21	20	5	46
Embankment	78	m^3	4	3	1	8
Guard Rail	382	m	379	559	48	986
Total			3,141	2,919	642	6,702

Section (06)
KM 70-1 - KM 72.9

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Excavation Commom M	58	m^3	1	5	0	6
Embankment	800	m^3	46	27	10	83
Removal of Old Pavement	1,654	m	123	84	31	238
Carriageway Pavement	1,764	m^2	461	319	91	871
Shoulder Pavement	430	m^2	65	43	12	120
Gravity Wall $H=3^m$	64	m	256	355	37	648
Guard Rail			213	315	27	555
Total			1,165	1,148	208	2,521

Annex Table 8-3-2

MINIMUM SCALE IMPROVEMENT (4)

(UNIT: $'000)

Section (08)
KM 73.4 - KM 75.2

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Excavation Commom M	52	m^3	1	4	0	5
Embankment	508	m^3	29	17	7	53
Removal of Old Pavement	774	m	57	39	15	111
Carriageway Pavement	718	m^2	187	130	37	354
Shoulder Pavement	172	m^2	26	17	5	48
Guard Rail	145	m	144	212	18	374
Total			444	419	82	945

Section (09)
KM 75.2 - KM 75.7

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Excavation Commom M	53	m^3	1	4	0	5
Embankment	23	m^3	1	1	0	2
Removal of Old Pavement	684	m^2	51	35	13	99
Carriageway Pavement	635	m^2	166	115	33	314
Shoulder Pavement	152	m^2	23	15	4	42
R.C.Bridge $L=10^m$	1	Span	580	931	91	1,602
Guard Rail	76	m	76	111	10	197
Total			898	1,212	151	2,261

Annex Table 8-3-2

MINIMUM SCALE IMPROVEMENT (5)

(UNIT: $'000)

Section (10)
KM 75.7 - KM 81.1

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	480	m^2	2	1	0	3
Excavation Commom M	254	m^3	4	20	1	25
Excavation Soft Rock	2,727	m^3	332	206	79	617
Excavation Hard Rock	947	m^3	288	192	77	557
Embankment	872	m^3	50	30	11	91
Removal of Old Pavement	4,090	m^2	304	207	78	589
Removal of Old Masonry	667	m	36	25	8	69
Carriageway Pavement	4,821	m^2	1,259	871	249	2,379
Shoulder Pavement	1,394	m^2	212	140	38	390
R.C.Bridge L=5^m	1	Span	293	460	43	796
P.C.T. Bridge L=30^m	1	Span	3,862	4,467	937	9,266
Gravity Wall H=3^m	127	m	508	705	73	1,286
Slope Protection A	237	m^2	146	255	13	414
Seed Spraying	544	m^2	9	13	2	24
Guard Rail	553	m	549	809	70	1,428
Total			7,854	8,401	1,679	17,934

Section (11)
KM 81.1 - KM 81.6

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Excavation Commom M	31	m^3	1	2	0	3
Embankment	347	m^3	20	12	4	36
Removal of Old Pavement	113	m^2	8	6	2	16
Carriageway Pavement	439	m^2	115	79	23	217
Shoulder Pavement	110	m^2	17	11	3	31
P.C.T.Bridge L=40^m	1	Span	5,208	5,757	1,268	12,233
Half Bridge	35	m	927	1,673	142	2,742
Gravity Wall H=3^m	5	m	20	28	3	51
Guard Rail	110	m	109	161	14	284
Total			6,425	7,729	1,459	15,613

Annex Table 8-3-2

MINIMUM SCALE IMPROVEMENT (6)

(UNIT:$'000)

Section (12)
KM 81.6 - KM 83.5

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Embankment	616	m^3	35	21	8	64
Removal of Old Pavement	495	m^2	37	25	9	71
Carriageway Pavement	718	m^2	187	130	37	354
Shoulder Pavement	172	m^2	26	17	5	48
Gravity Wall H=3^m	4	m	16	22	2	40
R.C. Half Bridge	46	m	1,218	2,198	187	3,603
Guard Rail	86	m	85	126	11	222
Total			1,604	2,539	259	4,402

Section (13)
KM 83.5 - KM 88.7

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	1,617	m^2	6	3	1	10
Excavation Commom M	1,836	m^3	32	145	5	182
Excavation Soft Rock	1,630	m^3	198	123	47	368
Excavation Hard Rock	352	m^3	107	72	28	207
Embankment	1,184	m^3	68	40	15	123
Removal of Old Pavement	3,561	m^2	265	180	68	513
Carriageway Pavement	4,203	m^2	1,098	759	217	2,074
Shoulder Pavement	1,010	m^2	154	102	27	283
Gravity Wall H=3^m	83	m	332	461	48	841
Concrete Spraying	484	m^2	26	26	7	59
Guard Rail	505	m	501	739	64	1,304
Total			2,787	2,650	527	5,964

Annex Table 8-3-2

MINIMUM SCALE IMPROVEMENT (7)

(UNIT:$'000)

Section (14)
KM 94.3 - KM 97.6

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	1,623	m^2	6	3	1	10
Excavation Commom M	1,529	m^3	27	120	5	152
Excavation Commom B	1,096	m^3	82	32	15	129
Excavation Soft Rock	1,234	m^3	150	93	36	279
Embankment	4,956	m^3	286	169	62	517
Removal of Old Pavement	3,634	m^2	271	183	69	523
Carriageway Pavement	4,348	m^2	1,135	786	228	2,146
Shoulder Pavement	1,092	m^2	166	110	29	305
Gravity Wall $H=3^m$	55	m	270	305	32	557
R.C.Bridge $L=10^m$	1	Span	580	931	91	1,602
Concrete Spraying	128	m^2	7	7	2	16
Seed Spraying	452	m^2	7	11	2	20
Guard Rail	373	m	370	546	47	963
Total			3,307	3,296	616	7,219

Section (15)
KM 96.6 - KM 98.2

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Excavation Commom M	58	m^3	1	5	0	6
Embankment	58	m^3	3	2	1	6
Removal of Old Pavement	864	m^2	64	44	16	124
Carriageway Pavement	802	m^2	209	145	42	396
Shoulder Pavement	192	m^2	29	19	5	53
Guard Rail	96	m	95	140	12	247
Total			401	355	76	832

Annex Table 8-3-2

MINIMUM SCALE IMPROVEMENT (8)

(UNIT:$'000)

Section (16)
KM 98.2 - KM 100.7

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Embankment	113	m^3	6	5	1	12
Removal of Old Pavement	758	m^2	57	38	14	109
Carriageway Pavement	563	m^2	147	102	29	278
Shoulder Pavement	150	m^2	23	15	4	42
Seed Spraying	248	m^2	4	6	1	11
Guard Rail	75	m	75	110	9	194
Total			312	276	58	646

Section (17)
KM 100.7 - KM 102.1

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	850	m^2	3	1	1	5
Excavation Commom M	252	m^3	4	20	1	25
Excavation Soft Rock	316	m^3	38	24	9	71
Embankment	379	m^3	22	13	5	40
Removal of Old Pavement	375	m^2	28	19	7	54
Carriageway Pavement	1,404	m^2	367	253	73	693
Shoulder Pavement	320	m^2	49	32	9	90
Retaining Wall H=7^m	150	m	2,874	4,708	447	8,029
Slope Protection A	496	m^2	306	534	27	867
Seed Spraying	918	m^2	15	21	4	40
Side Ditch	320	m	150	235	28	413
Guard Rail	160	m	159	234	20	413
Total			4,015	6,094	631	10,704

Annex Table 8-3-2

MINIMUM SCALE IMPROVEMENT (9)

(UNIT: $'000)

Section (18)
KM 102.1 - KM 135.6

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	62,354	m^2	235	95	43	373
Excavation Commom M	34,434	m^3	607	2,713	100	3,420
Excavation Commom B	25,201	m^3	1,896	724	349	2,969
Excavation Soft Rock	136,413	m^3	16,603	10,290	3,969	30,862
Excavation Hard Rock	1,125	m^3	343	229	91	663
Embankment	19,153	m^3	1,103	655	240	1,998
Removal of Old Pavement	53,026	m^2	3,949	2,679	1,012	7,640
Removal of Old Masonry	370	m	20	14	4	38
Carriageway Pavement	70,427	m^2	18,391	12,722	3,643	34,756
Shoulder Pavement	13,172	m^2	2,003	1,325	354	3,682
Gravity Wall $H=3^m$	150	m	600	833	86	1,519
Gravity Wall $H=4^m$	50	m	411	549	59	1,019
Retaining Wall $H=7^m$	50	m	958	1,569	149	2,676
Slope Protection A	16,442	m^2	10,146	17,703	894	28,743
Concrete Spraying	695	m^2	38	37	10	85
Seed Spraying	22,523	m^2	362	526	97	985
Setting Pipe 900 dia.	117	m	183	221	22	426
Setting Pipe 600 dia.	15	m	16	19	2	37
Side Ditch	13,562	m	6,343	9,957	1,185	17,485
Catch Basin	2	U	4	13	0	17
Guard Rail	6,060	m	6,557	9,666	834	17,057
Total			70,768	72,539	13,143	156,450

Annex Table 8-3-3

MEDIUM SCALE IMPROVEMENT (1)

(UNIT: $'000)

Section (02)
KM 62.800 - KM63.855

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	16,212	m^2	61	25	11	97
Excavation Commom A	5,720	m^3	108	52	20	180
Excavation Commom B	5,722	m^3	431	164	79	674
Excavation Soft Rock	14,598	m^3	1,777	1,101	425	3,303
Excavation Hard Rock	9,938	m^3	3,027	2,018	803	5,848
Embankment	5,340	m^3	308	183	67	558
Removal of Old Pavement	4,911	m^2	366	248	94	708
Carriageway Pavement	7,000	m^2	1,563	1,028	275	2,866
Shoulder Pavement	2,000	m^2	395	261	71	727
Concrete Spraying	2,402	m^2	130	129	35	294
Seed Spraying	9,274	m^2	149	216	40	405
Setting Pipe 900 dia.	140	m	219	264	26	509
Side Ditch	2,000	m	935	1,468	175	2,578
Catch Basin	15	U	30	94	4	128
Guard Rail	1,055	m	1,047	1,544	133	2,724
Total			10,546	8,795	2,258	21,559

Annex Table 8-3-3

MEDIUM SCALE IMPROVEMENT (2)

(UNIT: $'000)

Section (03)
KM 65.600 - KM 68.130

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	35,486	m^2	134	53	24	211
Excavation Commom A	16,640	m^3	315	150	57	522
Excavation Common B	16,677	m^3	1,255	479	231	1,965
Excavation Soft Rock	11,351	m^3	1,382	856	330	2,568
Excavation Hard Rick	151,544	m^3	46,153	30,781	12,245	89,179
Embankment	51,813	m^3	2,984	1,772	648	5,404
Removal of Old Pavement	7,403	m^2	551	374	141	1,066
Carriageway Pavement	16,394	m^2	3,660	2,409	644	6,713
Shoulder Pavement	4,684	m^2	926	612	166	1,704
R.C.Bridge L=10^m	1	Span	580	931	91	1,602
P.C.T.Bridge L=20^m	1	Span	2,394	2,940	573	5,907
P.C.T.Bridge L=30^m	1	Span	3,863	4,466	937	9,266
P.C.T.Bridge L=40^m	2	Span	10,417	11,514	2,535	24,466
P.C.T.Bridge (30^m+20^m)	1	Place	7,479	8,267	1,820	17,566
P.C.T.Bridge (2@40^m)	1	Place	11,118	12,288	2,706	26,112
Gravity Wall H=4^m	460	m	3,786	5,051	538	9,375
Retaining Wall H=10^m	580	m	16,914	21,019	1,642	39,575
Concrete Spraying	29,526	m^2	1,600	1,588	429	3,617
Seed Spraying	13,212	m^2	212	308	57	577
Setting Pipe 900 dia.	230	m	359	435	43	837
Side Ditch	4,746	m	2,220	3,484	414	6.118
Catch Basin	25	U	50	156	7	213
Guard Rail	2,342	m	2,342	3,427	296	6,047
Total			120,676	13,360	26,574	260,610

Annex Table 8-3-3

MEDIUM SCALE IMPROVEMENT (3)

Section (04)
KM 68.384 - KM 69.228

(UNIT:$'000)

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing,Stripping	17,833	m^2	67	27	12	106
Excavation Common A	19,500	m^3	369	176	67	612
Excavation Common B	19,558	m^3	1,472	562	271	2,305
Excavation Soft Rock	3,550	m^3	432	268	103	803
Excavation Hard Rock	29,768	m^3	9,066	6,046	2,405	17,517
Embankment	6,467	m^3	372	221	81	674
Removal of Old Pavement	2,592	m^2	193	131	49	373
Carriageway Pavement	4,403	m^2	983	647	173	1,803
Shoulder Pavement	1,258	m^2	249	164	44	457
P.C.T.Bridge L=20^m	1	Span	2,394	2,940	573	5,907
Gravity Wall H=4^m	64	m	527	702	75	1,304
Retaining Wall H=7^m	30	m	575	941	89	1,605
Concrete Spraying	3,240	m^2	176	174	47	397
Seed Spraying	13,633	m^2	219	318	58	595
Setting Pipe 900 dia.	80	m	125	151	15	291
Side Ditch	1,290	m	603	947	113	1,663
Catch Basin	8	U	16	50	2	68
Guard Rail	629	m	624	920	80	1,624
Total			18,462	15,385	4,257	38,104

Annex Table 8-3-3

MEDIUM SCALE IMPROVEMENT (4)

Section (06)
K70.1 - K71.3

(UNIT:$'000)

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	8,324	m^2	31	13	6	50
Excavation Common A	1,500	m^3	28	14	5	47
Excavation Common B	1,670	m^3	126	48	23	197
Excavation Soft Rock	5,105	m^3	621	385	149	1,155
Excavation Hard Rock	5,008	m^3	1,525	1,108	404	2,947
Embankment	14,316	m^3	824	490	179	1,493
Removal of Old Pavement	2,780	m^2	207	141	53	401
Carriageway Pavement	7,700	m^2	2,011	1,391	398	3,800
Shoulder Pavement	2,200	m^2	335	221	59	615
P.C.T.Bridge L=40^m	1	Span	5,208	5,757	1,268	12,233
P.C.T.Bridge (2@40^m)	1	Span	11,118	12,288	2,706	26,112
Gravity Wall H=4^m	240	m	1,975	2,635	281	4,891
Retaining Wall H=10^m	130	m	3,791	4,711	368	8,870
Seed Spraying	4,678	m^2	75	109	20	204
Setting Pipe 900 dia.	70	m	109	133	13	255
Side Ditch	1,230	m	576	903	107	1,586
Catch Basin	7	U	14	44	2	60
Guard Rail	910	m	903	1,332	115	2,350
Total			29,477	31,633	6,156	67,266

Annex Table 8-3-3

MEDIUM SCALE IMPROVEMENT (5)

Section (07)
K71.3 - K72.9

(UNIT:$'000)

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing,Stripping	15,053	m^2	57	23	10	90
Excavation Common A	3,000	m^3	57	27	10	94
Excavation Common B	2,998	m^3	226	86	41	353
Excavation Soft Rock	6,938	m^3	844	523	202	1,569
Excavation Hard Rock	25,805	m^3	7,859	5,242	2,085	15,186
Embankment	5,254	m^3	303	180	65	548
Removal of Old Pavement	3,609	m^2	269	182	69	520
Carriageway Pavement	8,260	m^2	2,157	1,492	427	4,076
Shoulder Pavement	2,360	m^2	359	237	64	660
R.C.Bridge L=10^m	1	Span	580	931	91	1,602
Gravity Wall H=4^m	115	m	947	1,263	134	2,344
Retaining Wall H=10^m	60	m	1,750	2,174	170	4,094
Seed Spraying	2,497	m^2	40	58	11	109
Setting Pipe 900 dia.	100	m	156	189	19	364
Side Ditch	2,130	m	996	1,564	186	2,746
Catch Basin	11	U	22	69	3	94
Guard Rail	1,370	m	1,360	2,005	173	3,538
Sub-Total			17,982	16,245	3,760	37,987
K72 Tunnel	790	m	87,604	94,433	26,099	208,136
Corrugate Pipe 4.5^m dia.	25	m	1,404	207	281	1,892
Sub-Total			89,008	94,640	26,380	210,028
Total			106,990	110,885	30,140	248,015

Annex Table 8-3-3

MEDIUM SCALE IMPROVEMENT (6)

Section (08)
K73.4 - K75.2

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	20.148	m^2	76	30	14	120
Excavation Common A	13,540	m^3	256	123	46	425
Excavation Common B	13,541	m^3	1,109	389	188	1,596
Excavation Soft Rock	2,976	m^3	362	224	87	673
Excavation Hard Rock	766	m^3	233	156	62	451
Embankment	14,503	m^3	835	497	181	1,513
Removal of Old Pavement	3,743	m^2	279	188	71	538
Carriageway Pavement	11,060	m^2	2,888	1,998	572	5,458
Shoulder Pavement	3,160	m^2	481	317	85	883
P.C.T.Bridge L=20^m	1	Span	2,394	2,940	573	5,907
P.C.T.Bridge L=40^m	2	Span	10,417	11,514	2,535	24,466
P.C.T.Bridge (2@30^m)	1	Place	7,885	8,716	1,919	18,520
Gravity Wall H=3^m	460	m	1,839	2,555	265	4,659
Retaining Wall H=10^m	300	m	8,749	10,872	849	20,470
Seed Spraying	15,531	m^2	250	362	67	679
Setting Pipe 900 dia.	118	m	183	223	22	428
Side Ditch	3,145	m	1,471	2,309	275	4,055
Catch Basin	12	U	24	75	3	102
Guard Rail	1,359	m	1,349	1,988	172	3,509
Total			40,990	45,476	7,986	94,452

Annex Table 8-3-3

MEDIUM SCALE IMPROVEMENT (7)

Section (09)
K75.2 ← K75.7

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	462	m^2	2	1	0	3
Excavation Common A	605	m^3	11	6	2	19
Excavation Soft Rock	31	m^3	4	2	1	7
Embankment	2,172	m^3	125	74	28	227
Removal of Old Pavement	655	m^2	49	33	13	95
Carriageway Pavement	910	m^2	238	164	47	449
Shoulder Pavement	260	m^2	40	26	7	73
Gravity Wall H=3^m	65	m	260	361	37	658
Retaining Wall H=10^m	20	m	583	724	57	1,364
Seed Spraying	467	m^2	8	10	2	20
Setring Pipe 900 dia.	20	m	31	38	4	73
Side Ditch	215	m	100	158	19	277
Catch Basin	2	U	4	13	1	18
Guard Rail	238	m	236	348	30	614
Sub-Total			1,691	1,958	248	3,897
K75 Bridge L=170^m	1	Place	45,197	34,965	8,808	88,970
Approach of Bridge	1	Lump	1,168	1,462	292	2,922
Sub-Total			46,365	36,427	9,100	91,892
Total			48,056	38,385	9,348	95,789

Annex Table 8-3-3

MEDIUM SCALE IMPROVEMENT (8)

Section (10)
K75.7 - K81.1

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	39,348	m^2	148	60	27	235
Excavation Common A	34,360	m^3	650	310	119	1,079
Excavation Common B	34,371	m^3	2,586	987	477	4,050
Excavation Soft Rock	20,778	m^3	2,529	1,567	605	4,701
Excavation Hard Rock	33,195	m^3	10,110	6,742	2,682	19,534
Embankment	45,338	m^3	2,611	1,550	568	4,729
Removal of Old Pavement	10,606	m^2	790	537	202	1,529
Carriageway Pavement	26,334	m^2	6,876	4,757	1,363	12,996
Shoulder Pavement	7,524	m^2	1,144	757	202	2,103
P.C.T. Bridge L=20^m	2	Span	4,787	5,881	1,146	11,814
P.C.T. Bridge L=30^m	1	Span	3,863	4,466	937	9,266
P.C.T. Bridge L=40^m	1	Span	5,208	5,757	1,268	12,233
P.C.T. Bridge (2@40^m)	2	Place	22,236	24,577	5,411	52,224
P.C.T. Bridge (2@30^m)	4	Place	34,614	38,258	8,424	81,296
P.C.T. Bridge (30m + 20m)	2	Place	14,958	16,533	3,641	35,132
P.C.T. Bridge (30m + 40m)	1	Place	9,886	10,926	2,406	23,218
P.C.T. Bridge (3@30m + 40m)	1	Place	20,616	22,786	5,018	48,420
P.C.T. Bridge (2@40m + 30m)	1	Place	16,483	18,218	4,012	38,713
P.C.T. Bridge (3@30m)	1	Place	14,019	15,495	3,411	32,925
Gravity Wall H=3^m	865	m	3,459	4,804	499	8,762
Retaining Wall H=10^m	660	m	19,247	23,918	1,868	45,033
Seed Spraying	30,046	m^2	482	702	129	1,313
Setting Pipe 900 dia.	3,339	m	5,220	6,311	623	12,154
Side Ditch	5,950	m	2,783	4,368	520	7,671
Catch Basin	34	U	67	212	10	289
Guard Rail	3,850	m	3,821	5,634	486	9,941
Sub-Total			209,193	226,113	46,054	481,360
K76 Tunnel	790	m	89,627	96,961	26,605	213,193
Corrugate Pipe 4.5 ^{m} dia.	25	m	1,404	207	281	1,892
Sub-Total			91,031	97,168	26,886	215,085
Total			300,224	323,281	72,940	696,445

Annex Table 8-3-3

MEDIUM SCALE IMPROVEMENT (9)

Section (11) P-3
KM81.1 - KM81.6

(UNIT:$'000)

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	1,081	m^2	4	2	0	6
Excavation Common A	1,460	m^3	28	13	5	46
Excavation Common B	1,475	m^3	111	42	21	174
Excavation Soft Rock	533	m^2	65	40	16	121
Removal of Old Pavement	593	m^2	44	30	11	85
Carriageway Pavement	1,330	m^2	347	240	69	656
Shoulder Pavement	380	m^2	58	38	10	106
P.C.T.Bridge (2@30^m)	1	Place	8,475	9,796	2,053	20,324
Seed Spraying	842	m^2	14	20	3	31
Setting Pipe 900 dia.	19	m	30	36	3	69
Side Ditch	380	m	178	279	33	490
Catch Basin	2	U	4	12	1	17
Guard Rail	215	m	213	315	27	555
Total			9,571	10,863	2,252	22,686

Annex Table 8-3-3

MEDIUM SCALE IMPROVEMENT (10)

Section (13)
K83.475 - K88.650

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	51,456	m^2	194	78	35	307
Excavation Common A	63,800	m^3	1,208	575	220	2,003
Excavation Common B	65,006	m^3	4,891	1,867	902	7,660
Excavation Soft Rock	27,424	m^3	3,338	2,068	798	6,204
Excavation Hard Rock	61,235	m^3	18,649	12,438	4,948	36,035
Embankment	62,424	m^3	3,595	2,135	781	6,511
Removal of Old Pavement	4,525	m^2	337	229	96	662
Carriageway Pavement	22,155	m^2	5,785	4,002	1,146	10,933
Shoulder Pavement	6,330	m^2	1,090	719	190	1,999
P.C.T. Bridge L=20^m	1	Span	2,394	2,940	573	5,907
P.C.T. Bridge L=40^m	2	Span	10,417	11,514	2,535	24,466
P.C.T. Bridge (3@40^m +20m)	1	Place	21,905	24,211	5,332	51,448
P.C.T. Bridge (2@30^m)	1	Place	8,653	9,565	2,106	20,324
P.C.T. Bridge (20^m+30^m)	2	Place	14,958	16,533	3,641	35,132
P.C.T. Bridge (3@30^m)	1	Place	14,019	15,494	3,412	32,925
P.C.T. Bridge (30^m+40^m)	1	Place	9,886	10,926	2,406	23,218
Gravity Wall H=3^m	50	m	200	278	29	507
Gravity Wall H=4^m	610	m	5,020	6,698	714	12,432
Retaining Wall H=5^m	25	m	255	432	39	726
Retaining Wall H=10^m	450	m	13,123	16,307	1,274	30,704
Seed Spraying	43,349	m^2	697	1,012	186	1,895
Setting Pipe 900 dia.	50	m	78	95	9	182
Side Ditch	6,560	m	3,068	4,817	573	8,458
Catch Basin	6	U	12	37	2	51
Guard Rail	3,165	m	3,141	4,631	400	8,172
(Sub-Total)			(146,913)	(149,601)	(32,347)	(328,861)
K Tunnel	250	m	28,556	30,925	8,469	67,950
Corrugate Pipe 4.5^m dia.	25	m	1,404	207	281	1,892
(Sub-Total)			(29,960)	(31,132)	(8,750)	(69,842)
Total			176,873	180,733	41,097	398,703

Annex Table 8-3-3

MEDIUM SCALE IMPROVEMENT (11)

Section (15)
K97.500-

(UNIT:$'000)

Item	Quantity	Unti	FC	LC	TAX	TOTAL
Clearing, Stripping	484	m^2	2	1	0	3
Embankment	3,400	m^3	250	148	54	452
Carriageway Pavement	770	m^2	201	139	40	380
Shoulder Pavement	220	m^2	38	25	7	70
P.C.T. Bridge L=170^m	1	Span	37,864	29,292	7,379	74,535
Retaining Wall H=5^m	80	m	815	1,381	127	2,323
Retaining Wall H=7^m	70	m	1,341	2,197	209	3,747
Retaining Wall H=10^m	20	m	583	724	57	1,364
Setting Pipe 900 dia.	15	m	24	28	3	55
Side Ditch	220	m	103	162	19	284
Guard Rail	220	m	218	322	28	568
Total			41,439	34,419	7,923	83,781

Annex Table 8-3-3

MEDIUM SCALE IMPROVEMENT (12)

Section (17) P-3
KM101.2

(UNIT:$'000)

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Stripping	3,590	m^2	13	6	3	22
Excavation Common A	2,100	m^3	40	19	7	66
Excavation Common B	2,105	m^3	158	61	29	248
Excavation Soft Rock	1,450	m^3	176	109	42	327
Embankment	8,570	m^3	494	293	107	894
Carriageway Pavement	2,930	m^2	765	529	152	1,466
Shoulder Pavement	680	m^2	104	68	18	190
P.C.T. Bridge $L=170^m$	1	Place	48,720	44,574	10,366	103,660
R.C.Bridge $L=5^m$	1	Span	293	460	43	796
Gravity Wall $H=3^m$	80	m	320	444	46	810
Retaining Wall $H=5^m$	100	m	1,019	1,726	159	2,904
Retaining Wall $H=7^m$	170	m	3,258	5,335	507	9,100
Retaining Wall $H=10^m$	80	m	2,333	2,900	226	5,459
Slope Protection A	484	m^2	299	521	26	846
Seed Spraying	909	m^2	15	21	4	40
Setting Pipe 900 dia.	13	m	20	25	2	47
Side Ditch	620	m	290	455	54	799
Catch Basin	6	U	12	37	2	51
Guard Rail	290	m	288	424	37	749
Total			58,617	58,007	11,830	128,454

Annex Table 8-3-4

LARGE SCALE IMPROVEMENT (1)

Priced Bill of Quantity: Girardot Bypass A1-B1 Route

(UNIT: $'000)

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Grubbing	813,000	m^2	992	447	179	1,618
Stripping	813,000	m^2	2,073	789	374	3,236
Excavation Common A	266,660	m^3	5,048	2,405	920	8,373
Embankment	266,660	m^3	6,381	3,093	1,053	10,527
(Sub-Total)			(14,494)	(6,734)	(2,526)	(23,754)
Subbase Course	156,100	m^3	51,849	41,220	14,475	107,544
Base Course	53,660	m^3	27,320	18,230	5,827	51,377
Carriageway Pavement	189,700	m^2	34,281	22,172	4,885	61,338
Shoulder Pavement	54,200	m^2	3,527	2,319	489	6,335
(Sub-Total)			(116,977)	(83,941)	(25,676)	(226,594)
R.C.Bridge L=5^m	6	Span	1,758	2,759	261	4,778
R.C.Bridge L=10^m	2	Span	1,161	1,861	183	3,205
P.C.T.Bridge L=40^m	1	Span	5,208	5,757	1,268	12,233
P.C.T.Bridge L=110^m	1	Place	27,003	20,866	5,235	53,104
P.C.T.Bridge L=260^m	1	Place	102,745	66,360	13,840	182,945
(Sub-Total)			(137,875)	(97,603)	(20,787)	(256,265)
Box Culvert 1.2m x 1.0m	2,448	m	14,020	21,719	2,026	37,765
Side Ditch	2,710	m	1,267	1,990	237	3,494
Catch Basin	54	U	107	337	16	460
Setting of Guard Rail	800	m	794	1,171	101	2,066
(Sub-Total)			(16,188)	(25,217)	(2,380)	(43,785)
Total			285,534	213,495	51,369	550,398
w/Overhead and Profit			383,574	246,175	58,249	687,998
Supervision			26,144	6,536	1,720	34,400
Contingency			40,972	25,271	5,997	72,240
Detailed Eng. w/Cont.			28,758	7,190	1,892	37,840
Total			479,448	285,172	67,858	832,478
Economic Cost			479,448	285,172	-	764,620

Annex Table 8-3-4

LARGE SCALE IMPROVEMENT (2)

Priced Bill of Quantity: Ibague Bypass A Route

(UNIT: $'000)

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Clearing, Grubbing	98,000	m^2	120	54	21	195
Stripping	98,000	m^2	250	95	45	390
Excavation Common M	46,020	m^3	811	3,626	134	4,571
Excavation Common B	92,040	m^3	6,925	2,644	1,277	10,846
Excavation Soft Rock	73,520	m^3	8,948	5,546	2,139	16,633
Embankment	205,330	m^3	11,825	7,022	2,571	21,418
(Sub-Total)			(28,879)	(18,987)	(6,187)	(54,053)
Carriageway Pavement	45,850	m^2	14,833	10,117	2,778	27,728
Shoulder Pavement	13,100	m^2	1,993	1,317	352	3,662
(Sub-Total)			(16,826)	(11,434)	(3,130)	(31,390)
R.C.Bridge L=10^m	1	Span	580	931	91	1,602
P.C.T.Bridge L=20^m	2	Span	4,787	5,881	1,146	11,814
P.C.T.Bridge L=80^m	2	Place	22,235	24,575	5,412	52,222
P.C.T.Bridge L=110^m	1	Place	27,003	20,866	5,235	53,104
(Sub-Total)			(54,605)	(52,253)	(11,884)	(118,742)
Retaining Wall H=7^m	200	m	3,832	6,276	597	10,705
Retaining Wall H=10^m	200	m	5,832	7,248	566	13,646
Box Culvert 4.5m x 4.0m	150	m	5,226	7,702	771	13,699
Slope Protection A	12,120	m^2	7,479	13,049	659	21,187
Seed Spraying	60,320	m^2	969	1,408	259	2,636
Setting Pipe 600mm	660	m	695	836	79	1,610
Setting Pipe 900mm	120	m	188	227	22	437
Side Ditch	5,500	m	2,572	4,038	480	7,090
Catch Basin	37	U	74	231	10	315
Guard Rail	4,200	m	4,169	6,146	530	10,845
(Sub-Total)			(31,036)	(47,161)	(3,973)	(82,170)
Total			131,346	129,835	25,174	286,355
w/Overhead and Profit			182,353	146,837	28,754	357,944
Supervision			13,602	3,400	895	17,897
Contingency			19,595	15,024	2,965	37,584
Detailed Eng. w/Cont.			14,962	3,740	985	19,687
Total			230,512	169,001	33,599	433,112
Economic Cost			230,512	169,001	-	399,513

Annex Table 8-3-4

LARGE SCALE IMPROVEMENT (3)

Priced Bill of Quantity: Coello Bypass

(UNIT: $'000)

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Earthwork						
Clearing, Stripping	110,400	m^2	416	168	75	659
Excavation Common A	349,000	m^3	6,607	3,148	1,240	10,959
Excavation Common B	351,975	m^3	26,483	10,112	4,882	41,477
Excavation Soft Rock	675,520	m^3	82,218	50,954	19,658	152,830
Excavation Hard Rock	187,930	m^3	57,236	38,172	15,185	110,593
Embankment	33,555	m^3	1,932	1,148	420	3,500
(Sub-Total)			(174,892)	(103,702)	(41,424)	(320,018)
Pavementwork						
Carriageway Pavement	184,000	m^2	48,048	33,238	9,518	90,804
Shoulder Pavement	69,000	m^2	11,884	7,837	2,075	21,796
(Sub-Total)			(59,932)	(41,075)	(11,593)	(112,600)
Bridgework						
R.C. Half Bridge	1,900	m	50,309	90,791	7,724	148,830
P.C.T.Bridge $L=20^m$	3	Span	7,181	8,822	1,719	17,722
P.C.T.Bridge $L=30^m$	1	Span	3,863	4,467	936	9,266
(Sub-Total)			(61,353)	(104,080)	(10,379)	(175,818)
Drainage and Structure						
Box Culvert 4.5m x 4.0m	30	m	1,045	1,540	154	2,739
Gravity Wall $H=3^m$	4,070	m	16,275	22,605	2,348	41,228
Concrete Spraying	239,180	m^2	12,964	12,861	3,473	29,298
Seed Spraying	45,960	m^2	739	1,073	197	2,009
Slope Protection A	117,150	m^2	72,291	126,131	6,371	204,793
Setting Pipe 900 dia.	2,238	m	3,499	4,230	418	8,147
Setting Pipe 600 dia.	9,500	m	10,006	12,033	1,130	23,169
Side Ditch	23,300	m	10,898	17,106	2,035	30,039
Catch Basin	380	U	756	2,372	109	3,237
Guard Rail	4,300	m	4,268	6,292	543	11,103
(Sub-Total)			(13,741)	(206,243)	(16,778)	(355,762)
Tunnel						
Coello Tunnel	950	m	108,028	116,199	32,044	256,271
Total Direct Cost			536,946	571,305	112,218	1,220,469

LARGE SCALE IMPROVEMENT (4)

Priced Bill of Quantity: La-Linea Bypass (UNIT: $'000)

Item	Quantity	Unit	FC	LC	TAX	TOTAL
Earthwork						
Clearing, Stripping	139,470	m^2	526	212	95	833
Excavation Common A	640,000	m^3	12,115	5,773	2,208	20,096
Excavation Common B	641,286	m^3	48,250	18,424	8,895	75,569
Excavation Soft Rock	149,530	m^3	18,199	11,279	4,351	33,829
Excavation Hard Rock	228,665	m^3	69,642	46,447	18,476	134,565
Embankment	806,361	m^3	46,438	27,578	10,096	84,112
(Sub-Total)			(195,170)	(109,713)	(44,121)	(349,004)
Pavementwork						
Carriageway Pavement	210,495	m^2	54,966	38,024	10,889	103,879
Shoulder Pavement	57,160	m^2	9,845	6,492	1,719	18,056
(Sub-Total)			(64,811)	(44,516)	(12,608)	(121,935)
Bridgework						
P.C.T. Bridge L=20^m	2	Span	4,787	5,881	1,146	11,814
P.C.T. Bridge L=30^m	2	Span	7,725	8,934	1,874	18,533
P.C.T. Bridge L=40^m	7	Span	36,460	40,298	8,874	85,632
P.C.T. Bridge (40m + 30m)	1	Place	9,886	10,926	2,406	23,218
P.C.T. Bridge (2@40m + 30m)	1	Place	16,483	18,218	4,012	38,713
P.C.T. Bridge (2@40m + 20m)	2	Place	30,617	33,840	7,451	71,908
(Sub-Total)			(105,958)	(118,097)	(25,763)	(249,818)
Drainage and Structure						
Retaining Wall H=5m	3,720	m	37,896	64,204	5,931	108,031
Retaining Wall H=7m	1,590	m	30,467	49,898	4,743	85,108
Retaining Wall H=10m	790	m	23,038	28,629	2,236	53,903
Gravity Wall H=3m	550	m	2,199	3,055	317	5,571
Seed Spraying	409,000	m^2	6,573	9,550	1,755	17,878
Slope Protection A	21,232	m^2	13,102	22,860	1,154	37,116
Setting Pipe 900 dia.	2,860	m	4,471	5,406	534	10,411
Setting Pipe 600 dia.	14,300	m	15,062	18,113	1,700	34,875
Side Ditch	57,160	m	26,735	41,964	4,992	73,691
Catch Basin	572	U	1,137	3,571	164	4,872
Guard Rail	24,230	m	24,049	35,455	3,061	62,565
(Sub-Total)			(184,729)	(282,705	(26,587)	(494,021)
Tunnel						
La-Linea Tunnel	890	m	101,216	108,875	30,023	240,114
Total Direct Cost			651,884	663,906	139,102	1,454,892

Annex Table 8-4

Quantities of Materials to be Procured

	Improvement Plan	Girardot Bypass	Ibague Bypass	Total
1) Portland Cement	$6{,}000^{t}$	$5{,}000^{t}$	$3{,}700^{t}$	$14{,}700^{t}$
2) Asphalt	$1{,}100^{t}$	$1{,}700^{t}$	600^{t}	$3{,}400^{t}$
3) Asphalt Liquid	160^{t}	450^{t}	110^{t}	720^{t}
4) Reinforcing Steel	550^{t}	500^{t}	340^{t}	$1{,}390^{t}$
5) P.C. Steel Cable	130^{t}	310^{t}	90^{t}	530^{t}
6) Diesel	$120{,}000^{gal.}$	$155{,}000^{gal.}$	$70{,}000^{gal.}$	$345{,}000^{gal.}$
7) Gasoline	$14{,}000^{gal.}$	$8{,}000^{gal.}$	$4{,}000^{gal.}$	$26{,}000^{gal.}$
8) Motor Oil	$2{,}100^{gal.}$	$2{,}200^{gal.}$	$1{,}300^{gal.}$	$5{,}600^{gal.}$
9) Transmission Oil	$470^{gal.}$	$670^{gal.}$	$330^{gal.}$	$1{,}470^{gal.}$
10) Hydraulic Oil	$320^{gal.}$	$430^{gal.}$	$230^{gal.}$	$980^{gal.}$
11) Grease	$1{,}000^{kg}$	$2{,}100^{kg}$	820^{kg}	$3{,}920^{kg}$
12) Plank	$1{,}700^{m3}$	500^{m3}	900^{m3}	$3{,}100^{m3}$
13) Explosive	50^{t}	0	6^{t}	56^{t}

Annex Table 8-5

Required Quantity of Principal Equipment

		Improvement Plan	Girardot Bypass	Ibague Bypass	Total
1) Bulldozer	D6D	1	1	1	3
2) Bulldozer	D7G	2	4	2	8
3) Bulldozer	D8K w/r	2	0	1	3
4) Wheel Loader	1.8 m3	0	1	0	1
5) Motor Scraper	16 m3	1	0	0	1
6) Motor Grader	3.7 m	0	2	0	2
7) Asphalt Plant	70 T/H	1	1	1	3
8) Asphalt Finisher	2.4m-4.3m	1	1	1	3
9) Concrete Mixer, Portable	0.7 m3	5	4	3	12
10) Road Roller, Tire	20 ton	1	4	1	6
11) Road Roller, Macadam	10 ton	1	2	1	4
12) Vibration Roller	10 ton	0	3	1	4