Timor-Leste Road Network Upgrading Project
ADB LOAN NO: 2857-TIM

Draft Feasibility Study Report:

Manatuto to Natarbora Road

Katahira & Engineers International in association with

Kai Watu Kmanek-Consultant Lda

EXECUTIVE SUMMARY

1. Objectives and Scope of the Project

This Feasibility Study applies to the National Road A-09 (Sections 01-04), Manatuto to Natrabora (79.5 km), as well as to the District Road C-15, Laclubar-Jnc. to Laclubar, (10.3 km).
The Manatuto-Laclubar-Natarbora road section was identified by the "Strategic Development Plan, 2011-2030" of the Government as a "Priority Section," providing essential mid-country cross-road between the North and the South of Timor Leste. It is considered by the Government to become particularly important in line with the large planned investment in Gas & Petroleum facilities, by Timor GAP, on the southern coast.
Geographically, the Manatuto-Laclubar-Natarbora Road, is situated right the in the middle of the country. Thus, conceptually, it is the most appropriate route for a major North-South connection. However, the current conditions of this road are very poor, and hence it cannot fulfill its expected strategic role.
The GoTl wishes to upgrade the road to all weather, surfaced two-lane road with shoulders, adhering to international standards; which will enable it, among others, to carry, at the minimum, 20-foot container trucks. The Project includes plans to strengthen and widen the existing pavement to about six (6) meters, by asphalt-cement surfacing; plus one (1) meter shoulders on each side.
The Project in its entirety includes two parts:
(i) Feasibility Study (2.5 months)
(ii) Detailed Design for the upgrading of the Manatuto–Laclubar– Natarbora road to International Standards (8.0 months)
For expediency sake, the two parts have been carried out in parallel, from the outset of the Project.

Figure 1 – Study Area - Location Map

Collaboration with Other Road Projects
The timing of this Road Feasibility Study (February-April, 2013) coincides with another feasibility study, financed and carried out directly by ADB: Feasibility Study for the North-Eastern National Road Sections (Dili-Manatuto-Bacau-Lautan-Los Palos, and Bacau-Viqueque), TA 8146-TIM. Team Members of this and the other ADB Project cooperated closely. Among others, the two studies used the same traffic survey instruments, divide between themselves the survey execution, and shared the survey findings. Similarly, the two studies coordinate on agreed-upon input data to the RED Program for Economic Analysis.

2. Methodology and Report Structure

Methodology

The Feasibility Study assesses the feasibility of reconstructing the Manantuto-Natarbora road (A09-1), including the branch road Laclubar Junction-Laclubar (C-15).

At the very end, the feasibility is focused on the Economic Analysis, in particular the economic indices of: (i) Net Present Value (NPV), and (ii) Economic Internal Rate of Return (EIRR), shown below.

However, the Feasibility Study in its entirety includes review of all components which are contributing, affecting and being affected by the reconstruction of this road.

They include (but are not limited to):

- Poverty and Social Assessment of the Manatuto District, including:
  - Public Consultation
  - Gender Assessment
  - Social Action Plan
  - Indicators for Monitoring
- Initial Environmental Examination (IEE), including:
  - Description of the Environment
  - Screening of Potential Environmental Impacts and Mitigation Measures
  - Environmental Management and Monitoring Plan
  - Public Consultations and Information Disclosure
  - Findings and Recommendations
- Environmental Assessment Review Procedure (EARP), including:
  - Assessment of Legal Framework and Institutional Capacity
  - ADB's SPS 2009, and ADB Environmental Guidelines and Policy of 2003 Anticipated Environmental Impacts
  - Environmental Assessment for Subprojects and/or Components
  - Consultation, Information Disclosure, and Grievance Redress Mechanism
  - Institutional Arrangement
  - Monitoring and Reporting
- Engineering: Technical Investigation & Project Design, including:
  - Introduction & Description of Project Roads
  - Technical Field Investigation
  - Technical Design Standards and Guidelines
  - Bio-Engineering Measures
  - Climate Change Adaptation
  - Proposed Road Upgrading Alternatives
  - Cost Estimate and Contract Packaging
  - Detailed Technical Engineering Appendices
- Reviews of Existing Traffic Studies, including:
  - Review of the "2009 Road Master Plan," TA 7100
  - Timor GAP Traffic Study
- 2013 Travel Surveys and Analyses, (Conducted by this Feasibility Study and by TA 8146-TIM), including:
  - Background and Data Sources
  - Survey Methodology
  - Average Daily Traffic (ADT) & Average Annual Daily Traffic (AADT)
  - Road Side Survey (O-D), Road A01-01, Dili - Manauto Rd.
  - Estimated Induced Traffic from South Coast (Regression Equation)
  - Estimated Traffic Growth Rate for RED

All of these efforts are culminating in the:

- Economic Evaluation, including:
  - Analytical Scenarios/Alternatives

- Road Characteristics & Cost Estimates of Alternative Scenarios
- Unit Costs and Operating Data, by Vehicle Type - Input to RED
- Traffic
  - Normal Traffic
  - Generated Traffic
  - Induced Traffic
  - Traffic Growth Rates
- Road-Based Quantifiable Benefits
  - Savings on Vehicle Operating Costs (VOC)
  - Savings on Value of Time (VOC)
- Other Quantifiable Benefits
  - Multiplier & Retainer Local Share of Investment/Maintenance Costs
  - Proxy for Social Benefits and Affected Population
  - Residual Share of Bridges and Special Culverts
- Standard Economic Analysis, 12% Discount Rate
- Alternative Economic Analysis - at 5% Discount Rate
- Sensitivity Analysis
- Distribution of Benefits
- Risk Analysis
- Conclusion and Recommendations

Report Chapters

Al in all, this Feasibly Study includes the following Chapters:

Chapter 1 – Introduction
Chapter 2 - Socio-Economic Review
Chapter 3 - Strategic Development Plan
Chapter 4 - Engineering: Technical Investigation & Project Design
Chapter 5 - Social & Poverty Assessment (PSA), and Safeguards
Chapter 6 - Initial Environmental Examination (IEE)
Chapter 7 - Environmental Assessment Review Procedure (EARP)
Chapter 8 - Climate Change Adaptation
Chapter 9 – Traffic – Reviews of Existing Studies
Chapter 10 – Traffic: 2013 Travel Surveys and Analysis
Chapter 11 - Economic Evaluation

3. Background Information: Population and Land Area – Study Area

Table 1 shows population and land area of Timore Leste and of the Study Area – Manatuto District, and Figure 2 shows the Manatuto District and Sub-Districts

The population of Timor Leste is slightly above 1.0 million (2010 Census), and the land area about 15,000 sq.km. Of these totals, Manatuto District, with a land area of 1,782 sq.km (12.0% of total), had population of only about 43,000 people (4.1% of total).

The Manatuto District includes six Sub-Districts. Of which, two towns – Manatuto Town and Laclubar (on relatively small land area), account for more than half of the district's population. Each of them account for about 12,000 populations. Total population in these two towns is 23,715 (54.8% of total). Excluding these two towns, only 19,537 people (44.2% of total) live in this vast area.

In summary, the vast area of the Manatuto District is very sparsely populated, inhabited mainly by subsistence farmers, and is expected to remain that way also in the foreseeable future. For example, the Strategic Development Plan, 2011-2030 (SDP), which provides vision and guideline for TL development, designates the core of Manatuto mountainous area as "protected forest". It does not include any significant plans to alter the subsistence farming character of this vast country[*1].

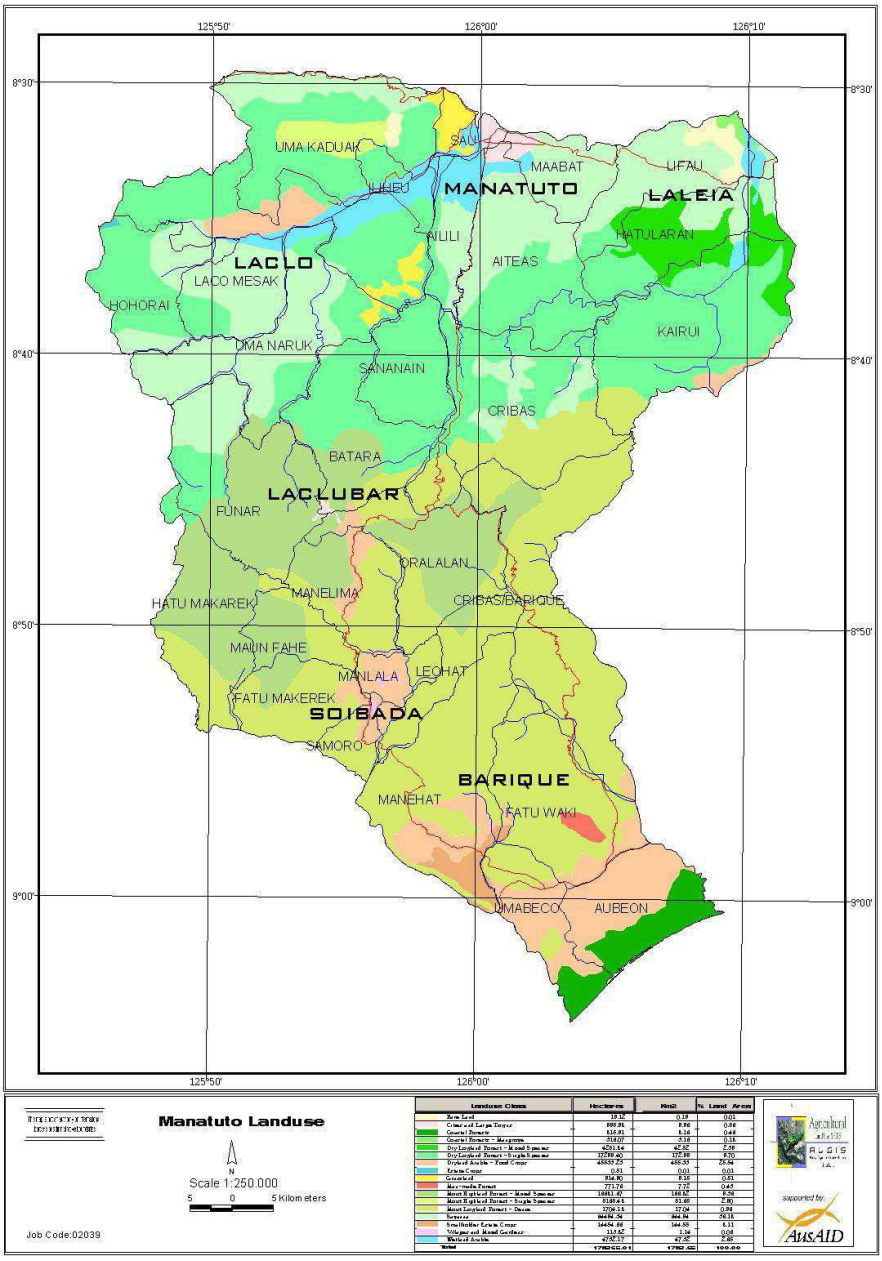
[*1] Discussions with a World Bank Agricultural Expert indicated that planting commercial forest as "cash crop" in this area (say of Philippine Tik), is the only viable agricultural means to alleviate poverty in mountainous area. However, the current SDP does not include such plans. And, besides, first forest crop takes at least 14 years between planting and first harvest.

Table 1. Populations and Land Area

Administrative Unit	Population					Area		Density
	2004		2010		Annual	2010		2010
	Number	% of Tot	Number	% of Tot	Growth 2004-10 (%)	Sq. km	% of Tot	Pop per Sq. km
Timor Leste-Total	923,240	100.0%	1,066,582	100.0%	2.4%	14,920	100.0%	71.5
Manatuto District	36,897	4.0%	43,246	4.1%	2.7%	1,783	12.0%	24.3
Sub-Districts		% of Dist		% of Dist			% of Dist	
Barique/Natarbora	4,874	13.2%	5,077	11.7%	0.7%	397	22.3%	12.8
Lacio	7,558	20.5%	7,939	18.4%	0.8%	368	20.6%	21.6
Laclubar	8,039	21.8%	11,376	26.3%	6.0%	391	21.9%	29.1
Laleie	3,211	8.7%	3,470	8.0%	1.3%	226	12.7%	15.4
Manatuto (Town)	10,455	28.3%	12,339	28.5%	2.8%	271	15.2%	45.5
Soibada	2,760	7.5%	3,051	7.1%	1.7%	130	7.3%	23.5

Source: 2010 Census, OCHA/UNMIT Integrated Humanitarian Coordination Team

Figure 2. Manatuto District, Sub-Districts and Sucos



4. Background Information: National Economic Accounts

Table 2 shows selected National (macro) economic statistics, derived from the IMF and the Strategic Development Plan (SDP), 2010:

A. National Income: Budget 2007-201; Forecast 2013-2016; and Average Growth 2008-12, and 2012-17.
B. Non-oil, Growth Domestic Product by Sector, 2007-2010

Growth trends of the national accounts in recent years, and projections of these accounts into the future, contributed, in part, to estimating annual traffic growth rates in the next 20 years.

Table 2 – National Accounts

A. National Income

	Budget						Forecast				5-Year Aveg. Growth	
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2008-12	2012-17
Real Non-oil GDP growth (%)		14.6%	12.8%	9.5%	10.6%	10.9%	10.4%	9.9%	10.8%	11.5%		
Total government expenditure (million US$)		594	627	794	1,206	1,763	1,804	1,855	1,506	1,564	31.3%	
(% of non-oil GDP)		93.6%	79.4%	90.7%	114.5%	140.8%	121.3%	105.0%	71.7%	62.7%		
Non-oil overall balance (% of non-oil GDP)		-85.3%	-71.1%	-81.1%	-104.0%	-130.0%	-110.6%	-94.5%	-61.4%	-52.4%		
Petroleum Fund balance (millions US$)		4,197	5,377	6,904	9,338	10,565	11,674	12,509	13,854	15,242	26.0%	9.6%
GDP at current prices (millions US$)	1,808	3,035	2,634	3,199	4,315	4,073	4,161	4,190	4,630	5,009	7.6%	5.3%
Non-oil GDP (million US$)	494	635	790	876	1,054	1,252	1,487	1,767	2,099	2,494	18.5%	18.8%
Non-oil GDP (% of Total GDP)	27.3%	20.9%	30.0%	27.4%	24.4%	30.7%	35.7%	42.2%	45.3%	49.8%		
Oil GDP (million US$)	1,313	2,400	1,845	2,323	3,261	2,821	2,674	2,423	2,530	2,515	4.1%	-2.8%
Oil GDP (% of Total GDP)	72.6%	79.1%	70.0%	72.6%	75.6%	69.3%	64.3%	57.8%	54.6%	50.2%		
Consumer Price Index % increase)	10.3%	9.0%	0.7%	6.8%	13.5%	8.0%						

Source: IMF

B. Non-Oil Gross Domestic Product by Sector (% Shares)

	2007	2008	2009	2010
Agriculture Forestry and Fisheries	31%	31%	31%	28%
Industry	3%	3%	3%	3%
Services	29%	29%	28%	31%
Public Sector (exc.UN)	38%	38%	38%	39%
Total	100%	100%	100%	100%

Source:IMF and "Stategic Development Plan", 2010, Ministry of Finance

5. Review of The Strategic Development Plan 2011-2030

The "Strategic Development Plan, 2011-2030" (SDP), published in 2010, provides a stated official vision by the Government of Timor Leste (GoTL) for the National Development Plan of the country during the twenty year period, 2011-2030.

The Consultant reviewed this plan with respect to two main issues:

(i) Role of the Road Sector, in general, and of the Mamatuto-Natarbora road in particular, in the strategic development plan of Timor Leste.

(ii) Review of plans for Petroleum Facilities developments on the South Cost, administered by Timor GAP, and their implications to Induced Traffic on the upgraded Mamatuto-Natarbora road.

It is important to note that road development is considered by the GoTL a preliminary pre-requisite and essential top-priority step in the implementation of the SDP. The following section is extracted, as is, from the SDP Report:

> ***"Physical infrastructure development, par*ticularly road network improvement is recognized by the Government of Timor-Leste as one of the top priorities to accelerate the *country's new economic opportunities and poverty reduction."***

Figure 2 shows plans for the National Road Network, where the Study Area road, Road A-09 is defined as a mid-country connector. Figure 4 shows Plans for three Petroleum Clusters on the South Coast.

Figure 3. National Planning Networks

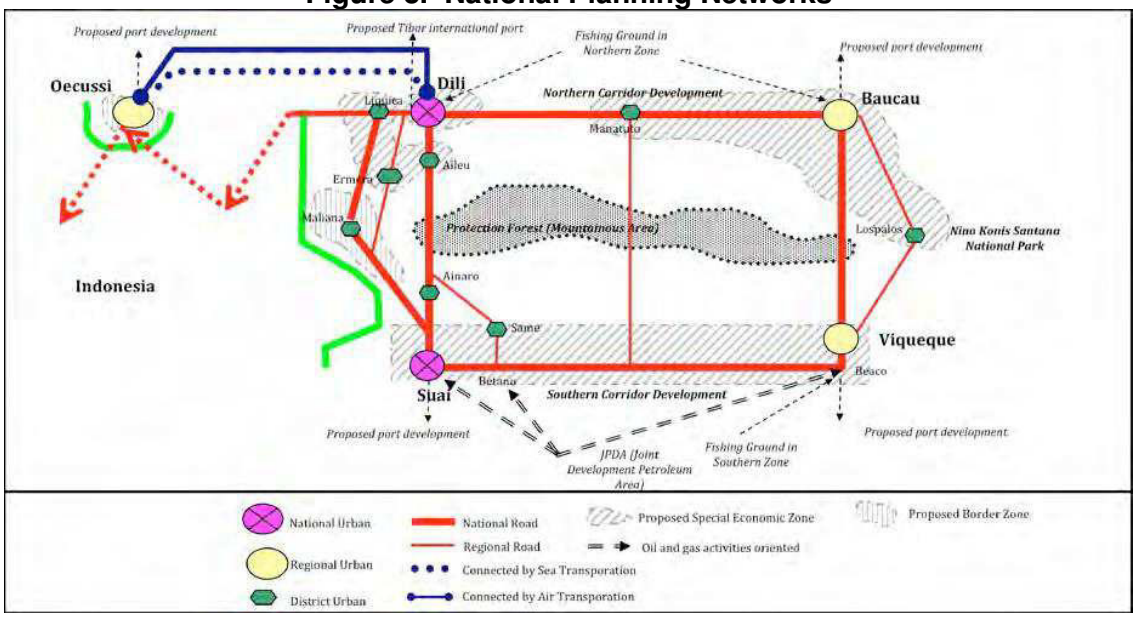


Figure 4 Petroleum Development Clusters

Among others, the development plans for the South Coast including plans for:

- Constructing a new town of Nova Suai, with 6,000 People, adjacent to the Suai Supply Base Cluster.
- Constructing a new town of Nova Betano, with target population of 30,000, adjacent to the Refinery/Petrochemical Cluster in Betano.
- Constructing a new town of Nova Beaco, with 6,400 people, adjacent to the LNG Plant in Viqueque.
- Constructing a 4-lane highway connecting these three clusters.

In turn, the Feasibility Study estimated future Induced Traffic between these clusters and Dili, via the Manatuto-Natarbora road.

6. The 2013 Traffic Surveys and Analyses

6.1 General

To assess existing traffic on the A-09 and C-15 roads, and to establish the traffic base-line for projecting future traffic growth on these roads, the Feasibility Study conducted three (3), twelve-

hour (12 hrs) Traffic Count on the Study area roads, as well as one (1) Road Side (O-D) Survey on Road A01-01, on the approach to the Manatuto Junction (A01-01/A09-01)[*2]. The Traffic counts were converted to Average Annual Vehicle Traffic (AADT), using a conversion factor from 12 to 24 hours.
The following sections provide selected highlight findings from these surveys.

6.2 Traffic Counts – Highlights

- Traffic volume (all Categories 1-9) on the Manatuto-Natarbora Rd is very low, varying between 148 AADT on A09-01, to 65 AADT on A09-04 (including Motorcycle).
- Motorcycle (Category 1) has the largest share of AADT. On all links (with the exception of A09-04 with 61.4%), Motorcycle accounts for about 75% of total AADT.
- The most dominant vehicle type, excluding Motorcycle, is Jeep/4WD (Category 3), accounting for about 20% of total AADT on A09-01, 02, and 03, and about 12% on A09-04.
- The second dominant mode is Light Truck (Category 7), accounting for about 15% on all links.
- There are very few Medium Trucks (Category 8): Only 2 on link A09-01, and none on the other links; and no Heavy Trucks, at all, on any link.
- There were exceptionally few Buses (either Micro/Minibus, or Medium/Large). On all five links combined there were only 5 AADT buses. This is because Light Trucks act a "Semi-Buses" on the Manatuto-Natarbora road, due to the poor road conditions.

6.3 Road Side Survey – Highlights

- The Road survey included 418 vehicles, out of total count of 868; this represents an overall sampling ratio of 48%.
- The ratios, by vehicle type, were used later to expand the traffic survey O-D matrices into full population (of vehicle) matrices.
- The survey samples 212 bus passengers, from 75 buses surveys. The sample included the first front passengers in each bus.
- Average number of passengers per vehicle varied by vehicle type, as expected. For example:
  - Motorcycle: 1.3
  - Car, 4WD and Pickup/Van: 3.9-3.4
  - Small bus: 10.9
  - Large bus: 26.5
  - Med Truck:6.1
  - Large & Heavy Truck:2.8-2.5
- Trip purpose for bus passengers (Categories 5-6) was about one half "Work" and one half "Leisure" (50%-50%; and 38%-62%, respectively).
- Trips are quite long; average trip length is over 100km, and average travel time about 5.0 hours.
- Truck Load : Average truck load was:
  - Large bus: 32%
  - Med Truck:51%
  - Large & Heavy Truck:65%

[*2] To increase the number of survey stations, increase sample size, and achieve more comprehensive results for the entire centre and north-eastern roads, the team of this feasibility study, ADB 2857-TIM, cooperated fully with the team for ADB feasibly study TA 8146-TIM. The two teams developed and utilized identical survey instruments (forms), and divided between them the execution of the surveys at the survey stations, as well as the analysis of the results, later on.

6.4 Estimated Induced Traffic from the South Coast

This study estimated two types of "Induced Traffic" from/to the South Coast, along the Manatuto-Natarbora road:

1. **General Traffic**. This traffic estimates potential traffic linkages between The South Coast and Dili, where population sizes act as proxies for the strength of the linkages. It includes a mix of traffic vehicles (excluding motorcycles), derived from the Road Side Survey (O-D) conducted by the Consultant. This general traffic includes both people and goods movements, and is expected to grow at the same annual rates as "normal" traffic.
2. **Fuel Hauling Traffic**. This traffic is based on estimates of fuel hauling traffic, by road, between the Refineries in Betano and the North Coast. It is based on input provided by Timor Gap Management. All of this traffic is by heavy (3 axle) tanker-trucks. This traffic remains constant from year 2017 onwards, as it depends on a fixed production capacity of the refineries (30,000 PBD) in the foreseeable future.

6.5 Estimated Traffic Growth Rate

Table 3 shows estimated annual growth rates per annum, by vehicle type, use as input to RED. The estimated growth rates are aderived from a combination of considerations including: Growth rates, by vehicle type, for the period 2009-2013, derived from the traffic counts; changes in vehicle ownership over the period 2009-2013; and changes in GDP over recent years and IMF projections into the future.

Table 3. Annual Growth Rates, 2013 – 2034, for RED

	2014-2018	2019-2023	2024-2028	2029-2033
Motorcycle	10.0%	7.5%	5.0%	2.5%
Cars, 4WD, Pickup/Van	7.5%	7.5%	7.5%	7.5%
Buses	7.5%	7.5%	7.5%	7.5%
Trucks	20.0%	15.0%	10.0%	10.0%

6.6 Projected Traffic 2014-2033

Table 4 shows summary of projected traffic for the period 2014-2033.
The table is divided into three types of traffic categories:

1. Normal Traffic
2. Generated and Induced Traffic
3. Total Traffic (sum of the two above)

Within each traffic category, there is a further division into:

1. Total Traffic, including Motorcycle (Inc-MC)
2. Traffic excluding Motorcycle (Exc-MC)

Highlights

- Recall, Induced General Traffic does not include Motorcycle (too long a trip to Dili on motorcycle). And Induced Traffic by Tanker-Trucks obviously does not include motorcycles.
- Similarly, Generated Traffic does not include many motorcycles (as the reduced travel cost by motorcycle is too small to generate significant new motorcycle traffic).
- The result, as shown below is the increasing share of non-motorcycle traffic over time. It grows on the main line-haul road, A-09, from about 40% in 2014, to about 80% of total volume in 2033.

Table 4. Traffic by Year, 2014 – 2033 by Link; Normal and Generated & Induces; Include/Exclude Motorcycle

A09-01

No	Year	Normal		Genert		Induced		All Traff	
		Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC
1	2014	152	63	0	0	0	0	152	63
2	2015	169	71	0	0	0	0	169	71
3	2016	188	81	34	15	0	0	223	95
4	2017	210	92	39	17	193	193	442	302
5	2018	235	105	43	19	202	202	480	326
6	2019	257	117	48	22	211	211	516	350
7	2020	281	131	53	24	221	221	555	377
8	2021	308	146	58	28	232	232	599	406
9	2022	338	164	64	31	244	244	646	439
10	2023	371	184	71	35	257	257	699	476
11	2024	397	201	76	38	272	272	745	511
12	2025	425	219	82	42	287	287	794	548
13	2026	455	239	88	46	304	304	847	589
14	2027	488	261	95	51	322	322	904	633
15	2028	523	284	102	56	341	341	967	681
16	2029	555	310	109	61	362	362	1027	734
17	2030	590	339	117	67	386	386	1092	792
18	2031	627	370	125	74	411	411	1163	854
19	2032	668	404	134	81	438	438	1240	923
20	2033	711	441	144	89	467	467	1323	998

A09-02

No	Year	Normal		Genert		Induced		All Traff	
		Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC
1	2014	122	46	0	0	0	0	122	46
2	2015	135	52	0	0	0	0	135	52
3	2016	150	58	34	13	0	0	185	72
4	2017	167	66	39	15	193	193	399	274
5	2018	186	75	43	17	202	202	431	294
6	2019	203	83	48	20	211	211	462	314
7	2020	221	93	53	22	221	221	495	336
8	2021	241	103	58	25	232	232	532	360
9	2022	264	115	64	28	244	244	572	388
10	2023	289	129	71	32	257	257	617	418
11	2024	308	140	76	35	272	272	656	446
12	2025	329	153	82	38	287	287	698	478
13	2026	352	167	88	42	304	304	743	512
14	2027	376	182	95	46	322	322	792	549
15	2028	402	198	102	50	341	341	845	590
16	2029	425	216	109	55	362	362	897	634
17	2030	450	235	117	61	386	386	952	682
18	2031	476	257	125	67	411	411	1012	735
19	2032	505	280	134	74	438	438	1077	792
20	2033	536	305	144	82	467	467	1147	855

A09-03

No	Year	Normal		Genert		Induced		All Traff	
		Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC
1	2014	87	33	0	0	0	0	87	33
2	2015	96	37	0	0	0	0	96	37
3	2016	107	42	34	13	0	0	141	55
4	2017	119	47	39	15	193	193	350	255
5	2018	132	53	43	17	202	202	377	272
6	2019	144	59	48	20	211	211	403	289
7	2020	157	65	53	22	221	221	431	309
8	2021	171	73	58	25	232	232	461	330
9	2022	187	81	64	28	244	244	495	353
10	2023	204	90	71	31	257	257	532	379
11	2024	218	98	76	34	272	272	565	404
12	2025	232	107	82	38	287	287	601	432
13	2026	248	117	88	41	304	304	640	462
14	2027	265	127	95	45	322	322	681	494
15	2028	283	138	102	50	341	341	727	530
16	2029	299	151	109	55	362	362	771	568
17	2030	317	164	117	61	386	386	819	611
18	2031	335	179	125	67	411	411	871	657
19	2032	355	195	134	74	438	438	927	707
20	2033	377	213	144	81	467	467	988	761

A09-04

No	Year	Normal		Genert		Induced		All Traff	
		Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC
1	2014	87	33	0	0	0	0	87	33
2	2015	96	37	0	0	0	0	96	37
3	2016	107	42	34	13	0	0	141	55
4	2017	119	47	39	15	193	193	350	255
5	2018	132	53	43	17	202	202	377	272
6	2019	144	59	48	20	211	211	403	289
7	2020	157	65	53	22	221	221	431	309
8	2021	171	73	58	25	232	232	461	330
9	2022	187	81	64	28	244	244	495	353
10	2023	204	90	71	31	257	257	532	379
11	2024	218	98	76	34	272	272	565	404
12	2025	232	107	82	38	287	287	601	432
13	2026	248	117	88	41	304	304	640	462
14	2027	265	127	95	45	322	322	681	494
15	2028	283	138	102	50	341	341	727	530
16	2029	299	151	109	55	362	362	771	568
17	2030	317	164	117	61	386	386	819	611
18	2031	335	179	125	67	411	411	871	657
19	2032	355	195	134	74	438	438	927	707
20	2033	377	213	144	81	467	467	988	761

C-15

No	Year	Normal		Genert		Induced		All Traff	
		Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC
1	2014	74	20	0	0	0	0	74	20
2	2015	83	23	0	0	0	0	83	23
3	2016	93	27	34	10	0	0	127	38
4	2017	104	32	39	12	0	0	143	44
5	2018	117	38	43	14	0	0	160	52
6	2019	128	43	48	16	0	0	176	59
7	2020	140	49	53	18	0	0	193	67
8	2021	154	56	58	21	0	0	212	77
9	2022	169	63	64	24	0	0	233	87
10	2023	186	72	71	27	0	0	256	100
11	2024	198	79	76	30	0	0	274	109
12	2025	212	87	82	33	0	0	294	120
13	2026	227	95	88	37	0	0	315	132
14	2027	242	104	95	41	0	0	337	145
15	2028	259	115	102	45	0	0	362	160
16	2029	274	126	109	50	0	0	383	176
17	2030	290	138	117	56	0	0	407	193
18	2031	307	151	125	62	0	0	432	213
19	2032	326	166	134	68	0	0	460	234
20	2033	346	182	144	76	0	0	490	258

7. Engineering Surveys and Assessments

Engineering work includes (but is not limited) to the following:

7.1 Assessment of Existing Road and Major Drainage Structures

The Consultant carried out field inspections during the month of February, 2013 to assess the existing road and structures (On-going road realignment, reconstruction and restoration works were noted on several sections). The adequacy of these sections should be verified during the detailed engineering and to be coordinated with MPW-PMU. Between km 80 & km95, about 5 sections need to define the suitable horizontal alignment. The Consultant's road design engineer has delineated the appropriate alignment in order that the survey team could stake out and take topographic survey.

7.2 Road Roughness Survey

With the joint effort from ABD, PMU-MPW and Consultant, a road roughness survey was conducted on February 8, 2013 in the two project roads using the vehicle-mounted Romdas bump integrator with roughness reading every 100 meters in one direction only. The International Roughness Index (IRI) of each homogenous Road Link was calculated by taking the average index value every kilometer. The existing average value was used as input for RED "without" Project.

7.3 Technical Design Standards and Guidelines

The geometric standards of the Ministry of Public Works (MPW) draft specifications for road & bridges, the AASHTO 2011 and other accepted internationally recognized standards were harmonized to come up with proposed technical standards suitable for use in the detailed engineering design.

7.4 Proposed Road Upgrading Alternates

The existing project roads were sectioned into seven (7) homogenous sections taking into account varying terrain characteristics along the route and conditions/features of the road.
The Consultant Engineers proposed the following three alternatives for reconstructing the Study area Roads

- **Alternate 1** - Repair/Rehab and Reconstruct with 4.5m TST Surfacing (and 1m shoulder on each side of the road)
- **Alternate 2** - Reconstruct with 4.5m TST Surfacing (and 1m shoulder on each side of the road)
- **Alternate 3** - Reconstruct with 6m Asphalt Concrete Surfacing (and 1m shoulder on each side of the road)

The engineering assessment estimated the construction cost and annual maintenance cost for each alternative, and converted them into cost per-km per Road Link, as required by RED.

7.5 Project Cost

Road Characteristics and cost summaries for each of the three alternatives (Scenarios) "With Project", as well as for the "without Project" are shown in Table 5-A ($1000 per-km)—by Link and by Project Total. Total Project Costs (US$ 1,000) per Link and per Project Total are shown in Table 5-B.
Total construction costs (road works and bridges) for the entire project (89.8 km) are:

- Scenario 1: about US$ 52.3 million
- Scenario 2: about US$ 55.4 million
- Scenario 3: about US$ 76.2 million

Total annual maintenance costs for the entire project (89.8 km) are:

- Scenario 0: about US$ 1.50 million per annum
- Scenario 1: about US$ 0.43 million per annum
- Scenario 2: about US$ 0.42 million per annum
- Scenario 3: about US$ 0.37 million per annum

Scenario 1 ("without project) requires about US$ 1.5 per annum to keep the road "passable", still under harsh conditions (IRRs only slightly better that the existing ones). In contrast, the other Scenarios ("with" Project) require only about US$ 0.40 per annum (less than a third of Scenario 1), to maintain a reconstructed, high-quality, well surfaced road.

Table 5-A. Engineering Input Data for Economic Analysis –Road Characteristics & Costs Per Km (1000$)

Road Name			Manatuto - Natarbora								Jct Laclubar - Laclubar	
Road ID No.			A09								C15	
Road Section Name			Manatuto to Cribas			Cribas to Jct Laclubar	Jct Laclubar to Mane Hat	Mane Hat to Natarbora			Jct Laclubar to Laclubar	Total
Road Section ID No			A09-1			A09-2	A09-3	A09-4			C15	A09 + C15
Road Sub-Section			A09-1a	A09-1b	Wt Avg.	-	-	A09-4a	A09-4b	Wt Avg.	-	
From (km)			65.2	82.0	65.2	88.0	99.5	133.0	140.5	133.0	0.0	
To (km)			82.0	88.0	88.0	99.5	133.0	140.5	144.7	144.7	10.3	
Length (km)			16.8	6.0	22.8	11.5	33.5	7.5	4.2	11.7	10.3	**89.8**
Rd Width (m)	Existing		4.5	4.5	4.5	3.5 to 4.0	3.0 to 3.5	4.5	4.5	4.5	3.0 to 3.5	
	Proposed	Alt 0	4.5	4.5	4.5	3.5 to 4	3 to 3.5	4.5	4.5	4.5	3 to 3.5	
		Alt 1	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		Alt 2	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		Alt 3	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Shoulder Width (m)	Existing		0.5 to1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0 to 0.5	
	Proposed	Alt 0	0.5 to 1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0 to 0.5	
		Alt 1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
		Alt 2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
		Alt 3	1.0	1.0	1.0	0.5 to 1.0	0.5 to 1.0	1.0	1.0	1.0	0.5 to 1.0	
Road Roughness (IRI Value)	Existing		11.0	10.0	10.8	27.4	31.4	29.0	10.4	22.3	34.0	
	Post-work	Alt 0	9.4	8.5	9.2	23.3	26.7	24.7	8.8	19.0	28.9	
		Alt 1	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
		Alt 2	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
		Alt 3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Road Works Cost/km (1000$)	Alt 0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Alt 1		528.80	199.06	442.03	714.01	677.67	515.37	208.41	405.18	633.91	
	Alt 2		528.80	512.73	524.57	714.01	677.67	515.37	502.97	510.92	633.91	
	Alt 3		719.13	705.17	715.45	982.89	931.20	716.66	701.78	711.32	876.29	
Annual Maint. Cost/km (1000$)	Alt 0 (Essential)		12.66	8.31	11.51	14.17	19.12	19.12	9.76	15.76	23.73	
	Alt 1 (Normal)		4.22	5.14	4.46	4.22	5.14	4.22	5.14	4.55	5.14	
	Alt 2 (Normal)		4.22	4.22	4.22	4.22	5.14	4.22	4.22	4.22	5.14	
	Alt 3 (Normal)		3.69	3.69	3.69	3.69	4.48	3.69	3.69	3.69	4.48	

Table 5-B. Engineering Input Data for Economic Analysis – Total Construction and Maintenance Cost (1000$)

Road Name		Manatuto - Natarbora								Jct Laclubar - Laclubar	
Road ID No.		A09								C15	
Road Section Name		Manatuto to Cribas			Cribas to Jct Laclubar	Jct Laclubar to Mane Hat	Mane Hat to Natarbora			Jct Laclubar to Laclubar	Total
Road Section ID No		A09-1			A09-2	A09-3	A09-4			C15	A09 + C15
Road Sub-Section		A09-1a	A09-1b	Wt Avg.	-	-	A09-4a	A09-4b	Wt Avg.	-	
From (km)		65.2	82.0	65.2	88.0	99.5	133.0	140.5	133.0	0.0	
To (km)		82.0	88.0	88.0	99.5	133.0	140.5	144.7	144.7	10.3	
Length (km)		16.8	6.0	22.8	11.5	33.5	7.5	4.2	11.7	10.3	**89.8**
Total Works Cost (1000$)	Alt 0 (Essential)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Alt 1 (Normal)	8,883.87	1,194.37	10,078.24	8,211.09	22,702.07	3,865.27	875.32	4,740.59	6,529.31	**52,261.30**
	Alt 2 (Normal)	8,883.87	3,076.38	11,960.25	8,211.09	22,702.07	3,865.27	2,112.49	5,977.76	6,529.31	**55,380.49**
	Alt 3 (Normal)	12,081.36	4,230.99	16,312.35	11,303.28	31,195.15	5,374.92	2,947.49	8,322.41	9,025.80	**76,158.99**
Tot Annual Maint. Cost (1000$)	Alt 0 (Essential)	212.62	49.83	262.45	162.98	640.37	143.37	40.97	184.34	244.42	**1,494.56**
	Alt 1 (Normal)	70.87	30.85	101.72	48.51	172.24	31.64	21.59	53.23	52.96	**428.66**
	Alt 2 (Normal)	70.87	25.31	96.18	48.51	172.24	31.64	17.72	49.36	52.96	**419.25**
	Alt 3 (Normal)	62.01	22.15	84.16	42.45	150.16	27.68	15.50	43.19	46.17	**366.12**

8. Economic Analysis

8.1 General Methodology

The Economic Analysis uses, for the most part ADB's guidelines for project economic evaluation: Evaluate discounted streams of Project Costs and Benefits for a period of 20 years, at a discount rate of 12%. A project passes the thresholds if it produces a positive Net Present Value (NPV), and generates Economic internal Rate of Return (EIRR) larger than 12%.
In addition, the analysis evaluated the project at 5% discount rate –- A discount rate above the "opportunity cost of capital" for the Timor Leste "Petroleum Fund".
Most of the input for this RED model is derived from the Road Engineering Surveys, Analysis and Assessment, reported in Chapter 4 of the Report; and from Transport/Traffic Surveys, Analysis and Assessment, reported in Chapter 10 of the Report.
Other inputs to RED, such as vehicle characteristics, cost and utilization (by vehicle type), as well as vehicle occupancy and Value of Time (VOT) for work and leisure, were prepared by the Consultant, mainly as a 2013 update to 2009 values reported in TA 7100.
The basic unit of analysis, in RED, is the Road Link. Five road links were analyzes: A09-01 (22.8 km); A09-02 (11.5 km); A09-03 (33.5 km); A09-04 (11.7 km); and C-15 (10.3 km). They were later combined into full project, using distance (km) as a base for estimating weighted average values.
The economic analysis is based on three proposed scenarios "with "project:

- **Scenario 1** - Repair/Rehab and Reconstruct with 4.5m TST Surfacing (and 1m shoulder on each side of the road)
- **Scenario 2** - Reconstruct with 4.5m TST Surfacing (and 1m shoulder on each side of the road)
- **Scenario 3** - Reconstruct with 6m Asphalt Concrete Surfacing (and 1m shoulder on each side of the road)

The analysis evaluates each of the three alternative scenarios "with" project against the "without" project scenario.

8.2 Costs & Road Roughness (IRI)

Cost per-link (in $1000 per-km), for construction and for annual maintenance, are derived from the Engineering Assessment, show in Table 4-A above.
Existing and projected road roughness, expressed in International Roughness Index (IRI) is also derived from m the Engineering Assessment, shown in Table 5-A.

8.3 Traffic

Traffic is derived from the Traffic Assessment, described above. Total traffic is composed of:

- Normal Traffic
- Generated Traffic
- Induced Traffic

For annual growth rates (applied to each of these traffic categories) see Table 3 above, and for summary traffic see Table 4 above.

8.4 Quantifiable Road Benefits

1. Savings on Vehicle Operating Costs (VOC). The difference in VOC due to improved road conditions (lower IRI), "with" vs. "without" project. This difference is calculated by RED.
2. *Saving on Passengers' Value of Time (VOT).* The difference in VOT due to improved road conditions (shorter travel time), "with" vs. "without" project

8.5 Other Quantifiable Benefits

1. Share of local labour/local economy in road investment costs (5% of investment costs spent locally, compounded by multiplier factor of 1.2).
2. Share of local labour/local economy in road maintenance costs (30% of maintenance costs "with" project are spent on local labour intensive maintenance, compounded by the 1.2 multiplier factor).
3. Proxy for "social benefits" - To account for better access to markets, education, health commercial and administrative facilities (assume US$ 15.0, per person per year, in the affected area).
4. Residual value of bridges and special culverts. Economic life of new bridges and special culvert is more than 20 years (at least 40 years). Thus, their residual value in current prices is a benefit in year 20.
5.

8.6 Standard Economic Analysis, 12% Discount Rate - Summary Results

Table.6 shows summery results of the economic analysis, following the standard ADB guidelines for economic analysis (NPV>0, EIRR>12.0%).
Results are shown, first, for each of the five links; and later (bottom of table) for the entire Project. They are calculated as follows:

- The Total NPV is an arithmetic sum of the results for each link
- The average EIRR is a weighted average of the EIRRs for each link, where the distance (km) is the weighting factor.

Table 6 Standard Economic Analysis (12% Discount Rate) – Summary Results

Link	From To	Distance (km)	Economic Index	Senario 1	Senario 2	Senario 3
				4.5 m TST	4.5 m TST	6.0m Asph-Conc
A09-01	Mantuto Cribas	22.8	NPV - (million $) at 12%	-0.810	-2.293	-5.365
			EIRR - (%)	10.2%	7.7%	4.6%
A09-02	Cribas Laclubar	11.5	NPV - (million $) at 12%	2.224	2.224	-0.055
			EIRR - (%)	16.8%	16.8%	11.9%
A09-03	Laclubar Mane Hat	33.5	NPV - (million $) at 12%	4.144	4.144	-4.169
			EIRR - (%)	15.4%	15.4%	9.3%
A09-04	Mane Hat Natarbora	11.7	NPV - (million $) at 12%	2.481	1.507	-0.203
			EIRR - (%)	22.4%	16.9%	11.5%
C-15	Junc Laclubar	10.3	NPV - (million $) at 12%	1.638	0.664	-1.088
			EIRR - (%)	19.0%	14.2%	9.4%
Total		89.8				
All Links			NPV - (million $) at 12% Total -All 5 Links	9.678	6.246	-10.880
			EIRR - (%) Weigted Avg (by km) - All 5 Links	15.6%	13.7%	8.8%

Highlights

- Scenario 2 Scenario 3, based on 4.5m road-way and TST pavement passed the standard economic threshold; and the less expensive Scenario 1, did better than Scenario 2 (the more expensive between them).
- In contract, Scenario 3, based on 6.0m road-way and asphalt-concrete pavement, did not pass the standard economic threshold; it's total cost is too high with respect to the benefits that the road can produce.

- All in all, given the relatively low volume of projected traffic and associated road benefits on the Manatuto-Natarbora road, the least expensive scenario, Scenario 1, produces the best results, as discussed below.
- Scenario 1 produces the highest EIRR of 15.6% and a positive NPV of US$ 9.678 million. It passes the ADB's required threshold of 12.0% EIRR.
- Scenario 2 produces the second level EIRR, of 13.7%, and NPV of US$ 6.246 million.
- Scenario 3 produces an EIRR of just 8.8%, and has a negative NPV of about US$ 10.9 million. Using standard ADB guidelines (positive NPV and EIRR>12%), Scenario 3 does not pass the economic analysis.

8.7 Alternative Economic Analysis - at 5% Discount Rate

The analysis above (section 11.12) used a discount rate of 12%, as dictated by the ADB guidelines. However, there is room to review the project also in terms of "Opportunity Cost of Capital" to the GoTL, which seems to be significantly lower than the 12% dictated by the ADB.
Currently the "Petroleum Fund," the main source of internal investment funds for Timor Leste is invested largely in US Government Bonds (or other countries' bonds). The return on these bonds is approximately 2.5%. This rate is actually lower (or about equal) than the US inflation rate[*3]. This means that at the most the "Petroleum Fund" is breaking even (if not losing its real value). Thus, any direct investment by the GoTL in infrastructure (or human resources), which provide a significant return above 2.5% is preferable.
To test this hypothesis, with respect to the Manatuto-Natarbora road, this Study also estimated the NPV and EIRR under an alternative 5.0% discount rate (instead of 12.0%). The 5.0% discount rate was selected because it is about twice as large as the prevailing return rate on the "Petroleum Fund".
Table 7 shows the results of this alternative economic evaluation, as well as a comparison with the results obtained by the standard economic analysis at 12% discount rate.

Highlights

- NPVs at 5.0% are (as expected) significantly higher than those at 12%.
- EIRRs remain (as expected) identical[*4], for all three scenarios.
- The most significant change is with respect to Scenario 3:
  - The NPV (at 5.0%) is positive, valued over US$ 25.0 million, Vs. a negative NPV of about US$ -10.8 million (at 12.0%).
  - The IRR remains identical, 8.8%; however it is now larger than the (revised) threshold of 5.0%.

[*3] The inflation rate in Timor Leste is about twice or three times as large.
[*4] IRR is the discount rate which equalizes the total (discounted) streams of benefits and costs. It remains identical in both cases, so long as the two steams remain identical; which they are here.

Table 7 Economic Analysis Comparison – 5% Vs. 12% Discount Rate

Link	From To	Distance (km)	Economic Index	A. Discount Rate 12%			B. Discount Rate 5%			C. Difference (B-A)		
				Senario 1	Senario 2	Senario 3	Senario 1	Senario 2	Senario 3	Senario 1	Senario 2	Senario 3
				4.5 m TST	4.5 m TST	6.0m Asph-Conc	4.5 m TST	4.5 m TST	6.0m Asph-Conc	4.5 m TST	4.5 m TST	6.0m Asph-Conc
A09-01	Mantuto Cribas	22.8	NPV - (million $) at 12%	-0.810	-2.293	-5.365	3.858	2.348	-0.431	4.668	4.642	4.934
			EIRR - (%)	10.2%	7.7%	4.6%	10.2%	7.7%	4.6%	Same		
A09-02	Cribas Laclubar	11.5	NPV - (million $) at 12%	2.224	2.224	-0.055	9.169	9.169	7.005	6.945	6.945	7.060
			EIRR - (%)	16.8%	16.8%	11.9%	16.8%	16.8%	11.9%	Same		
A09-03	Laclubar Mane Hat	33.5	NPV - (million $) at 12%	4.144	4.144	-4.169	21.121	21.121	10.716	16.976	16.976	14.885
			EIRR - (%)	15.4%	15.4%	9.3%	15.4%	15.4%	9.3%	Same		
A09-04	Mane Hat Natarbora	11.7	NPV - (million $) at 12%	2.481	1.507	-0.203	7.292	6.302	4.694	4.811	4.795	4.897
			EIRR - (%)	22.4%	16.9%	11.5%	22.4%	16.9%	11.5%	Same		
C-15	Junc Laclubar	10.3	NPV - (million $) at 12%	1.638	0.664	-1.088	5.777	4.787	3.103	4.139	4.123	4.191
			EIRR - (%)	19.0%	14.2%	9.4%	19.0%	14.2%	9.4%	Same		
Total		89.8										
All Links			NPV - (million $) at 12% Total -All 5 Links	9.678	6.246	-10.880	47.217	43.728	25.087	37.540	37.482	35.967
			EIRR - (%) Weigted Avg (by km) - All 5 Links	15.6%	13.7%	8.8%	15.6%	13.7%	8.8%	Same		

8.8 Conclusion and Recommendations

A. Assessment - Based on ADB Guidelines

Based on the standard ADB guidelines (NPV>0, EIIR>12%), only the two scenarios based on 4.5m road-way width and TST paving, Scenario 1 and Scenario 2 pass the threshold of economic analysis. Both produce positive NPVs of US$ 9.687 and US$ 6.246, respectively; and EIRRs of 15.6 % and 13.7% respectively.
Scenario 3 (6.0m Asphalt-Concrete), the alternative which was originally proposed by the GoTL, does not meet the economic threshold set by the ADB (NPV>0.0 and EIRR> 12%). It produces a negative NPV of US$ -10.880 million, and EIRR of only 8.8 %.

B. Assessment - Based on Opportunity Cost of Capital

The Study also estimated the NPV and EIRR under an alternative 5.0% discount rate (instead of 12.0%). The 5.0% discount rate was selected because it is about twice as large as the prevailing return rate on the "Petroleum Fund".
The most significant change under this scheme, particularly with respect to Scenario 3 (6.0m Asphalt-Concrete) is that the latter becomes an attractive investment because:

(i) The NPV (at 5.0%) is positive, valued at over US$ 25.0 million (versus a negative NPV of about US$-19.9 million, at 12.0%).

(ii) The IRR remains identical, 8.8% (as under the 12% scheme). However, it is now larger than the (proposed) threshold of 5.0%; and definitely larger than the "Opportunity Cost of Capital" for the GoTL, of 2.5%.

The combination of these two facts implies that if the GoTL decides to invest directly, only out of its own "Petroleum Fund" in the Manatuto-Natarbora road, it should do so.
In this case the 6.0m reconstructed asphalt-concrete sealed road will offer a significantly higher engineering standard for a cross-country road between Manatuto and Natarbora, compared to the 4.5m Scenarios; truly in line with International Standard for National Roads.

C. Recommendations

The recommendations are divided into two:

1. **For an ADB Loan** - The Consultant recommends adopting Scenario 1 or 2. This scenario includes a 4.5m reconstructed road sealed with TST, with 1.0 m shoulder on each side.
   This is because, under ADB guidelines, in the foreseeable future a 6.0m asphalt-concrete road is not economically feasible, and because a 4.5m road will be able to serve efficiently (though as "second best") the projected traffic demand within the next 20 years.

2. **For Direct Financing Solely by The GoTL** (with no ADB loan) - The Consultant recommends adopting Scenario 3. This scenario includes a 6.0m reconstructed asphalt-concrete sealed road, with 1.0 m shoulder on each side.
   Unquestionably, this type of road provides superior engineering standards, adhering to International Standards, and in line with TL vision for a long-tem National Road Network.
   The only limitation is that this recommendation requires an investment solely by the GoTL (or by an alternative loaning institution which will accept a discount rate of about 5.0%).

In addition, given the difficulties between qualifying for an ADB loan only for a 4.5m road, on one hand, and the true desire of the GoTL for a 6.0m road, on the other; the Consultant also recommends the following step in the short-run:

3. **Either Way: Reserve Now a 6.0m+ Right-of-Way**. - A corollary recommendation is to reserve now a right-of-way for a 6.0m road plus 2.0 m shoulders, to allow for easier widening of the road into a 6.0m road-way, in the future, if the ADB loan for 4.5m is selected now.

CHAPTER 1 : INTRODUCTION

1.1 Background

Physical infrastructure development, particularly road network improvement is recognized by the Government of Timor-Leste (GoTL) as one of the top priorities to accelerate the country's new economic opportunities and poverty reduction.

The core road network of Timor Leste is comprises of about 1,430 km of National Roads, and 870 km of District Roads. The National Road Network, which links the country's 13 National Districts, is comprises of the East-West Northern Coastal Road, the East-West Southern Coastal Road, and five North-South Roads, which connect with the two Coastal Roads.

Considering the need of a comprehensive and sustainable development of road network, the Government of Timor Leste (GoTL) is ensuing implementation of the "Road Network Upgrading Project" (RNUP), with financial assistance from the Asian Development Bank (ADB) through ADB Loan Nos. 2857-TIM and 2858-TIM.

The project intends to support upgrading the Timor-Leste's "Priority Sections" of the National Road Network to accommodate rapid economic and social development. It focuses on financing High-Priority Road Links identified by the "Medium-Term Road Network Development Program," prepared under ADB's TA.

1.2 Objectives and Scope of the Project

This Feasibility Study applies to the National Road A09 (Sections 01-04), Manatuto to Natrabora (79.5 km), as well as to the District Road C-15, Laclubar-Jnc. to Laclubar, (10.3 km). Total Project length is 89.8 km. For Study Area location map see Figure 1.1.

The 79.5 km of the Manatuto to Matarbora road is traversing from a flat to rolling terrain in the North, meandering the high mountainous spine of the country (elevation up to 1,400 m. above sea level) in the Centre, and descending towards the coastal plain in the South.

The Manatuto-Laclubar-Natarbora road section was identified by the "Strategic Development Plan, 2011-2013" of the Government as a "Priority Section," providing essential mid-country cross-road between the North and the South of Timor Leste. It is considered by the Government to becomes particularly important in line with the large planned investment in Gas & Petroleum facilities, by Timor GAP, on the southern coast.

Geographically, the Manatuto-Laclubar-Natarbora Road, is situated right the in the middle of the country. Thus, conceptually, it is the most appropriate route for a major North-South connection. However, the current conditions of this road are very poor, and hence it cannot fulfill its expected strategic role. For example, the Team observed[*1] that current travel on the road section Manatuto to Matarbora, a distance of about 80 km, takes about six hours of punishing travel (on vehicles and travelers). Obviously, at these poor conditions and slow speed, it cannot fulfill its strategic role.

The GoTl wishes to upgrade the road to all weather, surfaced two-lane road with shoulders, adhering to international standards; which will enable it, among others, to carry, at the minimum, 20-foot container trucks. The Project includes plans to strengthen and widen the existing pavement to about six (6) meters, by asphalt-cement surfacing; plus one (1) meter shoulders on each side.

Vulnerability to damage from the effect of climate change is addressed through appropriate engineering countermeasures and interventions. Likewise, the project conforms to all applicable ABD policies with respect to anticorruption measures, safeguards, gender, procurement, consulting services and disbursement, as indicated in the PAM and loan documents.

The Project in its entirety includes two parts:

(i) Feasibility Study (2.5 months)
(ii) Detailed Design for the upgrading of the Manatuto – Laclubar – Natarbora road to International Standards (8.0 months)

For expediency sake, the two parts have been carried out in parallel, from the outset of the Project.

[*1] 2 February, 2013, initial road inspection, , by 4WD vehicle

Figure 1.1 – Study Area - Location Map

1.3 Collaboration with Other Road Projects

This Feasibility Study collaborated with several road projects conducted now (and recently) in Timor Leste, as described below.
The timing of this Road Feasibility Study (February-April, 2013) coincides with another feasibility study, financed and carried out directly by ADB: Feasibility Study for the North-Eastern National Road Sections (Dili-Manatuto-Bacau-Lautan-Los Palos, and Bacau-Viqueque), TA 8146-TIM. Team Members of this and the other ADB Project cooperated closely. Among others, the two studies used the same traffic survey instruments, divide between themselves the survey execution, and shared the survey findings. Similarly, the two studies coordinate on agreed-upon input data to the RED Program for Economic Analysis.

1.4 Terms of Reference – Feasibility Study

A feasibility study will be prepared to fully inform the GoTL and the ADB on the engineering, economic, environmental, and social aspects of upgrading the road.
Economic Analyses will be carried separately for each of the following components:
(i) The Project as a whole[*2]
(ii) From Manatuto to Laclubar
(iii) From Laclubar turnoff to Natarbora

The associated tasks for this Feasibility Study comprise, but are not necessarily limited, to (**bold highlight** by the Consultant):
(i) **Social analysis** of the project that are of influence to determine numbers of beneficiaries and socio-economic profiles. Assessment of suppressed demand if any for road transport services.
(ii) **Field surveys of the road**, including preliminary topographic, pavement, drainage and structures. Preliminary assessment of slope stability and identification of options for mitigation of existing instability and areas of potential instability which may result from upgrading.
(iii) **Undertaking of traffic surveys**. Preparation of traffic forecasts taking into account existing and proposed developments in the project area of influence as well as any findings related to suppressed demand.

[*2] Eventuallt the Economic Analysis was carried out for the Project as a whole, because carrying out in two separate sections, can not include the Induced Traffic from the South Coast Petroleum Facilities.

(iv) **Determination of sources of construction materials** including potential quarry sites (including verification of material quality)
(v) **Preparation of an economic evaluation** of the proposed road upgrading options, including varying carriageway and shoulder configurations.
(vi) **Preparation of an economic evaluation of the proposed road upgrading options** following **ADB's Guidelines** for Economic Analysis of Projects, including switching value calculations, sensitivity analysis for variations in key parameters and budget constraints. Undertake risk analysis in accordance with ADB's Handbook for Integrating Risk Analysis of Projects
(vii) Based on the economic analysis, **estimation of the expected distribution of project net benefits** among freight transport users, passenger transport users, labor, the government and the economy in general.
(viii) **Assessment of land acquisition and resettlement needs** in accordance with the Resettlement Framework (prepared by others) and prepare a resettlement plan.
(ix) **Preparation of an initial poverty and social assessment** and screening for resettlement impact and indigenous peoples issues in line with ADB guidelines.
(x) **Assessment of potential environmental impacts** in accordance with the Environmental Assessment and Review Framework (EARF).

In parallel, as well as afterwards, detailed engineering design will be prepared for the whole length of the Manatuto-Natarbora Road, and for the Feeder Road to Laclubar. For construction purposes, the design will be based on National Standards and Ministry of Public Works (MPW) specifications for road and bridge works.

1.5 Report Structure

The "Feasibly Study Road A09/C12" includes the following Chapters, Sub-Chapters, and Appendices:

Chapter 1 – Introduction (this section)
1.1. Background
1.2. Objectives and Scope of the Project
1.3. Terms of Reference – Feasibility Study
1.4. Report Structure

Chapter 2 - Socio-Economic Review
2.1. Introduction
2.2. National Economic Accounts
2.3. District Population and Land Area
2.4. Transport Implications – Vicious Cycle
2.5. Selected Socio Economic Characteristics: Sub-Districts & Sucos

Chapter 3 - Strategic Development Plan
3.1. General
3.2. A National Planning Framework
3.3. National Roads Network – Goals & Strategy
3.4. Priority National Roads
3.5. National Highway Ring Road
3.6. Petroleum & Petroleum Industry Facilities
3.7. The National Petroleum Company – Timor GAP

Chapter 4 - Engineering: Scope of Work, Technical Investigation & Project Design
4.1. Introduction & Description of Project Roads
4.2. Technical Field Investigation
4.3. Technical Design Standards and Guidelines
4.4. Geotechnical Assessment
4.5. Bio-Engineering Measures

4.5. Climate Change Adaptation
4.6. Proposed Road Upgrading Alternative Scenarios
4.7. Cost Estimate and Contract Packaging
4.8. Engineering Appendices:
- Appendix 4.1. Assessment of Existing Road Condition
- Appendix 4.2. Assessment of Major Drainage Structures
- Appendix 4.3. Processed Road Roughness Index
- Appendix 4.4. Materials Source Maps
- Appendix 4.5. Proposed Technical Design Standards and Guidelines
- Appendix 4.6. Cost Estimates

Chapter 5 - Social & Poverty Assessment (PSA), and Safeguards
5.1. Socio-Economic Context of Regions and Districts
5.2. National Poverty Reduction Strategy
5.3. Causes and Characteristics of Poverty
5.4. Poverty in the Project Area
5.5. Socio-Economic Profile of the Manatuto District
5.6. Consultation Meetings
5.7. Beneficiary Profile
5.8. Poverty and Social Impact Assessment (PSA)
5.9. Gender Assessment
5.10. Social Action Plan
5.11. Indicators for Monitoring
5.12. Resettlement Framework
5.13. Conclusions
5.14. Social Appendices
- Appendix 5.1 - Involuntary Resettlement Screening Form 300609
- Appendix 5.2 – Indigenous People (IP) Form & Categorization Form
- Appendix 5.3 - Resettlement Due Diligence
- Appendix 5.4 - Revised-Resettlement Framework-RF
- Appendix 5.5 - Summary Resettlement Framework
- Appendix 5.6 - Summary of poverty reduction and social strategy

Chapter 6 - Initial Environmental Examination (IEE)
6.1. Introduction
6.2. Description of the Project
6.3. Description of the Environment
6.4. Screening of Potential Environmental Impacts and Mitigation Measures
6.5. Environmental Management and Monitoring Plan
6.6. Public Consultations and Information Disclosure
6.7. Findings and Recommendations
6.9. Environmental Appendices
- Appendix 6.1 - Guideline No. 2 Mechanized Sand and Gravel Extraction from Rivers and Borrow Pits
- Appendix 6.2 - Environmental Management Plan and Environmental Monitoring Plan
- Appendix 6.3 - Sample of Environmental Compliance Inspection and Monitoring Form
- Appendix 6.4 - Minutes of Public Consultation
- Appendix 6.5 - Proposed Locations for Bio-Engineering Locations

Chapter 7 - Environmental Assessment Review Procedure (EARP)
7.1. Introduction
7.2. Assessment of Legal Framework and Institutional Capacity
7.3. ADB SPS 2009, and ADB Environmental Guidelines and Policy of 2003
7.4. Anticipated Environmental Impacts
7.5. Environmental Assessment for Subprojects and/or Components

CHAPTER 2: SOCIO-ECONOMIC REVIEW

2.1 Introduction

This section provides socio-economic background review of the Study area. The Study Area includes only one district—the Manauto District, as the Manatuto-Natarbora Rd. runs only within that district. The socio-economic data are assessed on three levels:

- National
- Manatuto District
- Manatuto Sucos

These data, directly or indirectly, are used as input to various analyses of this Feasibility Study, in particular to the traffic and economic analyses

More detailed analysis of socio-economic characteristics, focusing on the Manatuto District and its Sucos, is provided in Chapter 5 - Social & Poverty Assessment (PSA), and Safeguards. Chapter 5 includes data, assessments and reports on issues of livelihood, poverty, gender, impacted population, resettlement, and community consultation.

The population of Timor Leste is slightly above 1.0 million (2010 Census), and the land area about 15,000 sq.km. Of these totals, Manatuto District, with a land area of 1,782 sq.km (12.0% of total), had population of only about 43,000 people (4.1% of total). The Manatuto-Natarbora road (A09-1) is the main section of the National Road Network running through the District, and is serving most of its Sub-Districts (in addition to serving a national North-South connection).

The sections below review first, national economic accounts followed by review of socio-economic characteristics of the Manatuto District and Sub-Districts.

2.2 National Economic Accounts

Table 2.1 shows selected National (macro) economic statistics, derived from the IMF and the Strategic Development Plan (SDP), 2010:

A. National Income: Budget 2007-201; Forecast 2013-2016; and Average Growth 2008-12, and 2012-17.
B. Non-oil, Growth Domestic Product by Sector, 2007-2010

2.2.1 Highlights

This section provides highlights of these national accounts.

- **GDP Growth Rate** - Timor Leste is a fast growing economy. Non-oil GDP has been growing at about 10% per-annum, or more, during the period 2007-2012, and is expected to grow at a similar rate during the period 2012-2017.
- **Inflation**- However, during the period 2007-2012 TL has also experienced in most of these years high inflation rate. The consumer Price Index (CPI) ranged between 10.3% in 2007 to 8.0% in 2012.
- **Total Government Expenditure** – Government expenditure has shown a constant growth, from US$ 594 million in 2007 to US$ 1,206 million in 2011, and US$ 1,763 in 2012. This is a five year average growth of 31.3%. It is expected to be contained, at about US$1,500 million per year, by 2015-2016.
- **Gov. Expenditure As % of non-oil GDP** – It has been about 100% or more of Non-oil GDP, contributing, among other to the relatively high inflation rate. Thus, it intended to be contained by 2015.
- **2012 GDP (None-oil & Oil)** - Oil and Gas are the main resources of TL. However, most of the petroleum revenues are retained, by National Law, for future generations, at the "Petroleum Fund" (see below). GDP statistics are, thus, divided between:
- **Non-oil GDP**, which reflects the real total of all domestic goods and services produced by TL people and companies, in the island. In 2012, it was US$ 1,252 (30.7% of Total GDP).
- **Oil GDP** – Revenues from Oil& Gas; not a real product of the island's internal economy. In 2012, it was US$ 2,821(69.3% of Total GDP).

- Total GDP – The total of these two components above. It was US$ 4,703 million in 2012 (100.0%).
- **Non-oil GDP Volumes/Trends** – Non-oil GDP (islands' good and services) has been steadily growing, from US$ 494 million in 2007, to US$ 1,252 million in 2012 (average growth 18.5%). It is expected to continue growing in about the same rate: US$ I,487 million in 2013 to US$ 2,494 million in 2016 (average growth 18.8%).
- **Traffic Implication** - These growth rates have direct implications to projections of traffic growth in the traffic/economic analysis of this Feasibility Study. A "rule of thumb" is that traffic tends to grow at about 1.5 times the rate of the GDP.
- **Oil GDP Values/Trends** - Oil GDP (Petroleum contribution to the GDP) has been steadily growing, from US$ 1,313 million in 2007, to US$ 2,821 million in 2012 (average growth 4.1%). It is expected to slow it growth in the period 2013-2016: US$ 2,674 million in 2013 to US$ 2,515 million in 2016 (average growth -2.8%).
- **Petroleum Fund** – The Petroleum Fund balance, after contribution to the National Budget, has been steadily growing, from US$ 4,197 million in 2007, to US$ 10,565 million in 2012 (average growth 20.6%). It is expected to continue growing, though at a lower rate: US$ 11,674 million in 2013 to US$ 15,242 million in 2016 (average growth 9.5%). Further discussion of the Petroleum Fund is below.
- **Non-0il GDP by Sector** – In general, the Timorese None-oil GDP is divided in about equal shares, among three sectors: (i) Agriculture, forestry and fishery, (ii) Services, and (iii) Public Sector. In 2010 the division was: 28%, 31%, and 39%, respectively. Industry is still at its infancy, contributing only 3.0% of the Non-oil GDP.

Table 2.1 – National Accounts

A. National Income

	Budget						Forecast					5-Year Aveg. Growth	
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2008-12	2012-17
Real Non-oil GDP growth (%)		14.6%	12.8%	9.5%	10.6%	10.9%	10.4%	9.9%	10.8%	11.5%			
Total government expenditure (million US$)		594	627	794	1,206	1,763	1,804	1,855	1,506	1,564		31.3%	
(% of non-oil GDP)		93.6%	79.4%	90.7%	114.5%	140.8%	121.3%	105.0%	71.7%	62.7%			
Non-oil overall balance (% of non-oil GDP)		-85.3%	-71.1%	-81.1%	-104.0%	-130.0%	-110.6%	-94.5%	-61.4%	-52.4%			
Petroleum Fund balance (millions US$)		4,197	5,377	6,904	9,338	10,565	11,674	12,509	13,854	15,242		26.0%	9.6%
GDP at current prices (millions US$)	1,808	3,035	2,634	3,199	4,315	4,073	4,161	4,190	4,630	5,009		7.6%	5.3%
Non-oil GDP (million US$)	494	635	790	876	1,054	1,252	1,487	1,767	2,099	2,494		18.5%	18.8%
Non-oil GDP (% of Total GDP)	27.3%	20.9%	30.0%	27.4%	24.4%	30.7%	35.7%	42.2%	45.3%	49.8%			
Oil GDP (million US$)	1,313	2,400	1,845	2,323	3,261	2,821	2,674	2,423	2,530	2,515		4.1%	-2.8%
Oil GDP (% of Total GDP)	72.6%	79.1%	70.0%	72.6%	75.6%	69.3%	64.3%	57.8%	54.6%	50.2%			
Consumer Price Index % increase)	10.3%	9.0%	0.7%	6.8%	13.5%	8.0%							

Source: IMF

B. Non-Oil Gross Domestic Product by Sector (% Shares)

	2007	2008	2009	2010
Agriculture Forestry and Fisheries	31%	31%	31%	28%
Industry	3%	3%	3%	3%
Services	29%	29%	28%	31%
Public Sector (exc.UN)	38%	38%	38%	39%
Total	100%	100%	100%	100%

Source:IMF and "Stategic Development Plan", 2010, Ministry of Finance

2.2.2 Petroleum Fund & Opportunity Cost of Capital

Timor Leste has invested much of the royalties from its off-shore oil and gas industry into a trust-fund – The "Petroleum Fund". As indicated above, at end of 2012, the fund had a balance of US$ 15,242 million. Currently the fund has a balance of over US$ 11.0 billion (US$ 11.054 million).
The latest quarterly report of the "Petroleum Fund of Timor Leste" indicates that:

- Since its inception it has earned an average annual return of 4.10% per year; and
- It is currently earning an annual equivalent return of just 2.01%.

These are low rates of return. The fund's trustees are, however, required to make largely risk-free investments. If the Government were prepared to accept a higher level of risk then the return might be a little higher.
There are clearly domestic projects where the investment would yield an economic return well in excess of the above. A prudent Government might, for example, choose to invest money from the fund in any domestic project that had an estimated return in the above base levels of, say, 5% - 10%. Such rates are rather higher than currently being obtained from the "Petroleum Fund" but there would, of course be some risk attached to the investments.
The extent of risk can, however, often be measured, and in the transport sector can frequently be estimated in terms of the probability the rate of return exceeds a specified level:

Low Risk Projects: These might be defined as when the estimated rate of return has an 80% chance of being within a range deviating +/-20% on the forecast central rate of return – funding might in these circumstances be accepted if the rate of return exceeded 5%;

Medium Risk Projects: These might be defined as when the estimated rate of return has a 50% chance of being within a range deviating +/-20% on the forecast central rate of return– funding might in these circumstances be accepted if the rate of return exceeded 7.5%;

High Risk Projects: These might be defined as when the estimated rate of return has only a 30% chance of being within a range deviating +/-20% on the forecast central rate of return -funding might in these circumstance be accepted if the rate of return exceeded 10%;

These safeguards would protect Government. They would take advantage of the "Petroleum Fund" and allow Government to invest prudently in projects with expected returns well below the rate of return that organizations such as the ADB seek when lending for projects.
Typically the annual economic return sought by the ADB would be 12%[*1]. ADB is, of course, seeking to finance projects in a wider region and with a limited budget and it wishes to ensure that its projects produce maximum benefits for the money invested.

2.3 District Population and Land Area

Table 2.2 shows population and land area of Timor Leste, Manatuto District and Sub-District, based on the latest census, the 2010 Census.
The 2010 population of Timor Leste was slightly above 1.0 million, and the land area is about 15,000 sq.km. Manatuto District, with a land area of 1,782 sq.km (12.0% of total), accounted in 2010, for only about 43,000 people (4.1% of total). This proportion of Manatuto population remained practically unchanged since 20004 (4.0% of total).
The population density of Manatuto District is low: 24.3 people/sq.km,, compared to the National average of 71.5. The Manatuto District includes six Sub-Districts (see Table 1.1, and Figure 1.1). Of which, two towns – Manatuto Town and Laclubar (on relatively small land area), account for more than half of the district's population. Each of them account for about 12,000 populations. Total population in these two towns is 23,715 (54.8% of total). Excluding these two towns, only 19,537 people (44.2% of total) live in this vast area. And even not all of them are expected to be

[*1] Though in some circumstances, sub-projects within a package generating lower estimated returns might also be accepted.

affected by the planned upgrading of the road (assuming impact within 5.0 km from either side of the road).

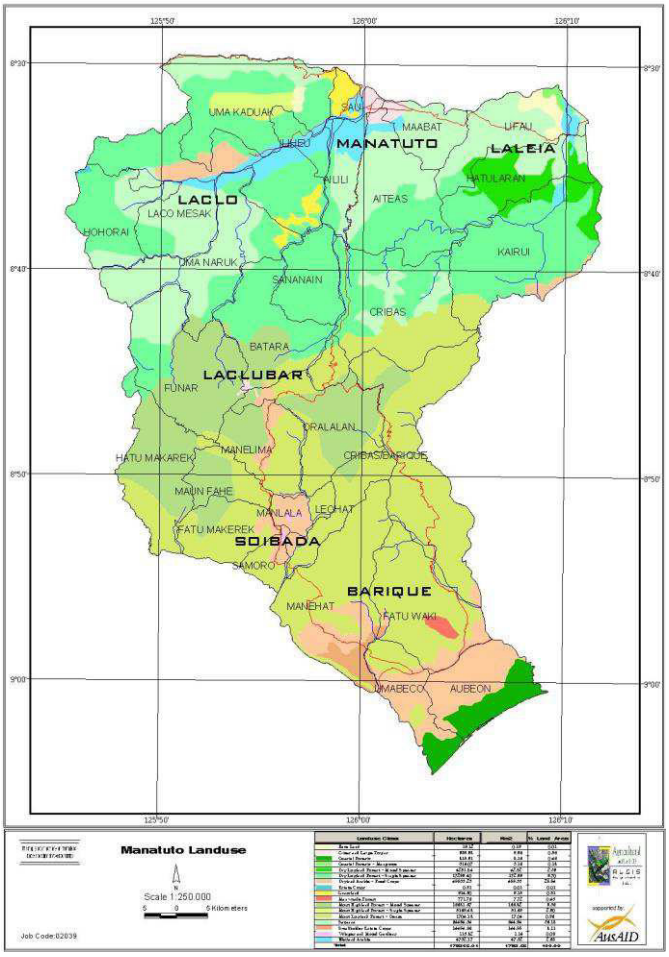
In summary, the vast area of the Manatuto District is very sparsely populated, inhabited mainly by subsistence farmers, and is expected to remain that way also in the foreseeable future. For example, the Strategic Development Plan, 2011-2030 (SDP), which provides vision and guideline for TL development, designates the core of Manatuto mountainous area as "protected forest". It does not include any significant plans to alter the subsistence farming character of this vast country[2].

Table 2.2 Populations and Land Area

	Population					Area		Density
Administrative Unit	**2004**		**2010**		**Annual**	**2010**		**2010**
	Number	**% of**	**Number**	**% of**	**Growth**	**Sq. km**	**% of**	**Pop per**
		Tot		**Tot**	**2004-10 (%)**		**Tot**	**Sq. km**
Timor Leste-Total	923,240	100.0%	1,066,582	100.0%	2.4%	14,920	100.0%	71.5
Manatuto District	36,897	4.0%	43,246	4.1%	2.7%	1,783	12.0%	24.3
Sub-Districts		**% of Dist**		**% of Dist**			**% of Dist**	
Barique/Natarbora	4,874	13.2%	5,077	11.7%	0.7%	397	22.3%	12.8
Lacio	7,558	20.5%	7,939	18.4%	0.8%	368	20.6%	21.6
Laclubar	8,039	21.8%	11,376	26.3%	6.0%	391	21.9%	29.1
Laleie	3,211	8.7%	3,470	8.0%	1.3%	226	12.7%	15.4
Manatuto (Town)	10,455	28.3%	12,339	28.5%	2.8%	271	15.2%	45.5
Soibada	2,760	7.5%	3,051	7.1%	1.7%	130	7.3%	23.5

Source: 2010 Census, OCHA/UNMIT Integrated Humanitarian Coordination Team

Figure 2.1 Manatuto District, Sub-Districts and Sucos



[2] Discussions with a World Bank Agricultural Expert indicated that planting commercial forest as "cash crop" in this area (say of Philippine Tik), is the only viable agricultural means to alleviate poverty in mountainous area. However, the current SDP does not include such plans. And, besides, first forest crop takes at least 14 years between planting and first harvest.

2.4 Transport Implications – Vicious Cycle

The low population and population density, and the existence of only two towns of reasonable size (Mamantuto and Laclubar), implies that the District lacks significant production/attraction centers to generate significant traffic, on its own. Most of the District's population (with the exception of Manatuto Town) lives on subsistence farming, which does not produce surpluses, needing truck transport. One view here a vicious cycle: The significantly small population served, results in low investment in the road system ("why invest for so few people?"), which leads to low vehicular-traffic. And low traffic during the base year, cannot produce much traffic in the future either (even under high growth rate assumptions). Low traffic leads to low estimated benefits attributed to road improvement (saving on vehicle operating costs and value of time) to justify new investment. And… the vicious cycle repeats itself.
Furthermore, functionally, Manatuto Town is more part of the Northern Corridor (focusing on Dili), than part of the Manatuto-Natarbora Corridor. Thus, even a significant growth in Manatuto Town is not expected to drastically alter vicious cycle restrictive characteristics.
One of the objectives of this study is to plan for intervention for breaking this vicious cycle.

2.5 Selected Socio Economic Characteristics: Sub-Districts & Sucos

Table 2.3 shows s selected socio-economic characteristics of Sub-Districts and Sucos of the Manatuto District, based on the 2010 Census.

2.5.1 Characteristics

The selected characteristics are listed by the following categories:

- Language Spoken (Tetun, Galoken, Bunak IDate)
- Population (total and density)
- Literacy (adult rate)
- Labor & Employment (participation rate & employment rate)
- Crop Production (% in crop production, % in rice production)
- Housing (2010 Index, % change in index, electricity use , and good roofing)
- PCA Index 2010 (PCA 2010 % change, rank, and asset group)
- Travel Time in Wet Season (to Dili, and on passable road)
-

2.5.2 Highlights

- In general, there is large variability among Sucos.
- For the most part, the Sucos' population varies between about 500 and 2,500 (with few exceptions). Densities are low.
- There is a definite difference between characteristics of semi-urban Manatuto Town (better) and the rural Sucos (worst).
- These data reinforces the notion that for the most part (with the exception of Manatuto Town) this District includes poor rural population, making its living on subsistence farming.
- About 90% of the adult population (age 15-64) in the rural Sucos is involved in crop production; however participation in the labor force averages only in the 50 percentiles (probably because there is not enough work to go around).
- Rice, which is expected to be the "expanded crop" in Timor Leste (see SDP), is not a major crop in most of the Sucos, for the simple reason that it is largely a steep mountainous area. Thus rice is not expected to increase demand for traffic here.
- Adult literacy varies from below 20% in the extreme rural areas, to 67% in urban Manatuto Town
- Electricity use for lighting varies 85% in towns and along the main road to almost none in far away Sucos.
- The 2010 PCA Asset Index show more reductions (negative %) and gains (positive %)

- Housing with "good roof" varies as well; from below 10% to over 80%.
- Travel time (2001 Data) is somewhat outdated. However; it shows that travel time during the wet season is long.

As indicated above, more detailed analysis of socio-economic characteristics, focusing on the Manatuto District and its Sucos, is provided in Chapter 5 - Social & Poverty Assessment (PSA), and Safeguards. Section E includes data, assessments and reports on issues of livelihood, poverty, gender, impacted population, resettlement, and community consultation.

Table 2.3: Selected Socio-Economic Characteristics of the Manatuto District, Sub-District an Sucos (2010 Census)

Administrative Unit			anguage	Population		Literacy	Labor & Emplyment		Crop Production	
District	Subdistrict	Suco	Main languag e spoken	Populati on (number)	Populatio n density (persons per square km)	Adult literacy rate (%)	Labor force participatio n rate of population aged 15-64 (%)	Employme nt rate of economical ly active population aged 15-64 (%)	HH involved in crop prod (%)	HHs involved in rice prod (%)
Manatuto	Barique	Abat Oan	Tetun	1,046.0	12.9	76.1	45.9	94.3	78.0	12.0
Manatuto	Barique	Aubeon	Galolen	796.0	13.9	65.2	49.3	97.7	96.1	85.4
Manatuto	Barique	Barique	Tetun	478.0	4.2	41.5	77.9	96.8	100.0	67.4
Manatuto	Barique	Manehat	Tetun	695.0	6.7	49.8	72.7	99.2	94.3	84.4
Manatuto	Barique	Uma Boco	Tetun	1,753.0	42.3	74.3	41.3	92.7	77.8	54.9
Manatuto	Laclo	Hohorai	Galolen	909.0	17.7	43.2	47.3	90.1	92.3	0.0
Manatuto	Laclo	Lacumesac	Galolen	2,857.0	21.8	35.1	55.4	92.4	48.3	24.7
Manatuto	Laclo	Uma Naruc	Galolen	885.0	10.0	38.4	52.5	97.8	53.3	37.5
Manatuto	Laclo	Umacaduac	Galolen	2,967.0	30.3	49.1	55.8	93.3	65.2	32.7
Manatuto	Laclubar	Batara	Bunak	1,766.0	27.2	28.5	45.5	91.7	70.6	8.0
Manatuto	Laclubar	Fatumaquerec	Idate	544.0	6.8	26.5	63.7	98.7	91.3	1.0
Manatuto	Laclubar	Funar	Bunak	1,790.0	19.6	19.5	73.3	97.8	84.5	4.5
Manatuto	Laclubar	Manelima	Bunak	2,468.0	52.5	31.5	49.0	82.4	46.9	1.7
Manatuto	Laclubar	Orlalan	Bunak	4,522.0	65.9	44.6	62.0	96.2	89.7	5.9
Manatuto	Laclubar	Sanana'in	Bunak	592.0	14.7	36.9	50.9	96.6	69.9	48.7
Manatuto	Laleia	Cairui	Galolen	1,730.0	15.5	55.0	50.0	92.8	57.8	51.7
Manatuto	Laleia	Haturalan	Galolen	542.0	9.5	68.8	45.4	79.9	42.3	35.8
Manatuto	Laleia	Lifau (ML)	Galolen	817.0	14.3	58.9	48.5	99.1	71.9	61.5
Manatuto	Manatuto	Ailili	Galolen	429.0	15.3	45.5	47.6	97.2	85.0	60.0
Manatuto	Manatuto	Aiteas	Galolen	806.0	9.8	53.6	53.3	91.6	57.3	42.8
Manatuto	Manatuto	Cribas	Galolen	2,025.0	20.7	40.0	51.8	88.4	88.1	24.7
Manatuto	Manatuto	Iliheu	Galolen	1,427.0	86.1	58.3	46.6	90.8	78.3	65.9
Manatuto	Manatuto	Ma'abat	Galolen	1,888.0	59.6	73.2	53.1	83.7	43.5	37.9
Manatuto	Manatuto	Sau	Galolen	5,980.0	406.3	75.8	44.3	80.6	33.8	24.4
Manatuto	Soibada	Fatumacerec	Galolen	736.0	18.4	47.6	55.3	83.3	39.5	16.0
Manatuto	Soibada	Leo Hat	Tetun	890.0	27.6	67.2	53.0	92.1	76.9	56.2
Manatuto	Soibada	Manlala	Galolen	439.0	26.3	66.4	50.5	75.3	86.7	66.7
Manatuto	Soibada	Manufahi	Tetun	485.0	17.9	63.8	51.5	96.7	80.5	5.2
Manatuto	Soibada	Samoro	Tetun	480.0	33.5	62.3	40.4	91.9	43.3	34.3

Administrative Unit			Housing				PCA Index, 2010			Travel Time, 2001	
District	Subdistrict	Suco	2010 housing index (%)	Annual change in the housing index from 04 to 10 (%)	HH using electricity for lighting (%)	Houses with good roofs in 2004 (%)	2010 suco PCA asset index	2010 suco PCA asset rank	2010 suco PCA asset group	In 2001, average time to vera Cruz in Dili in the wet season	In 2001, average time to vehicle passable road in the wet season
Manatuto	Barique	Abat Oan	3.1	−15.3	85.3	82.7	5.5	383	5	300	105
Manatuto	Barique	Aubeon	2.4	−14.7	0.6	21.6	-2.3	202	3	420	450
Manatuto	Barique	Barique	20.4	−3.4	1.1	57.4	-7.9	12	1	100	135
Manatuto	Barique	Manehat	33.1	0.8	0.0	32.6	-2.1	217	3	330	2
Manatuto	Barique	Uma Boco	33.2	−6.8	55.3	82.1	3.6	363	5	450	30
Manatuto	Laclo	Hohorai	8.8	−2.7	0.0	25.2	-6.6	38	1	165	300
Manatuto	Laclo	Lacumesac	20.5	−0.6	31.3	22.6	-1.6	234	3	195	2
Manatuto	Laclo	Uma Naruc	14.3	−3.2	37.5	0.9	-5.2	81	1	100	1
Manatuto	Laclo	Umacaduac	31.4	−1.5	27.1	47.7	1.3	318	4	240	120
Manatuto	Laclubar	Batara	33.3	1.1	21.8	37.0	-4.7	108	2	200	15
Manatuto	Laclubar	Fatumaquerec	18.1	−2.5	1.0	41.1	-6.0	53	1	300	180
Manatuto	Laclubar	Funar	8.8	13.5	1.4	5.6	-7.6	17	1	300	120
Manatuto	Laclubar	Manelima	17.0	0.2	21.4	26.3	-7.8	14	1	90	1
Manatuto	Laclubar	Orlalan	35.3	5.2	15.5	47.5	-2.7	191	3	360	180
Manatuto	Laclubar	Sanana'in	35.7	−4.0	0.0	59.3	-7.0	30	1	95	50
Manatuto	Laleia	Cairui	17.7	−6.9	4.7	54.2	-5.0	89	1	180	45
Manatuto	Laleia	Haturalan	55.6	−4.1	83.7	78.5	6.2	389	5	110	2
Manatuto	Laleia	Lifau (ML)	32.5	−9.2	3.9	91.6	17.4	422	5	150	2
Manatuto	Manatuto	Ailili	39.2	−8.1	57.5	66.7	7.0	392	5	120	3
Manatuto	Manatuto	Aiteas	65.7	−2.4	85.5	82.9	9.7	401	5	120	5
Manatuto	Manatuto	Cribas	47.7	0.2	0.6	84.0	-4.5	120	2	100	45
Manatuto	Manatuto	Iliheu	42.2	0.7	45.8	35.0	3.1	360	5	195	3
Manatuto	Manatuto	Ma'abat	78.4	−0.5	90.9	92.3	13.7	413	5	120	6
Manatuto	Manatuto	Sau	76.7	0.3	89.2	96.1	17.3	420	5	90	1
Manatuto	Soibada	Fatumacerec	20.7	4.8	16.0	22.1	-5.2	83	1	280	2
Manatuto	Soibada	Leo Hat	41.6	−3.6	37.2	81.3	-3.6	156	2	375	240
Manatuto	Soibada	Manlala	36.7	−7.6	81.7	74.3	-2.1	218	3	270	210
Manatuto	Soibada	Manufahi	57.6	−5.3	72.7	71.2	2.2	345	4	270	210
Manatuto	Soibada	Samoro	29.9	−9.0	56.7	70.5	0.4	290	4	450	360

CHAPTER 3: STRATEGIC DEVELOPMENT PLAN

3.1 General

The "Strategic Development Plan, 2011-2030" (SDP), published in 2010, provides a stated official vision by the Government of Timor Leste (GoTL) for the National Development Plan of the country during the twenty year period, 2011-2030. It is a follow-up to the previous National Development Plan, published 2002, "Timor-Leste 2020, Our Nation Our Future".
The SDP also reflects the views of the thousands of Timorese people who contributed to the national consultation on the Summary Strategic Development Plan, From Conflict to Prosperity, in 2010.
The Strategic Development Plan provides a framework for identifying and assessing priorities and a guide to implementing recommended strategies and actions. The newly established "National Development Agency" will be responsible for providing detailed costing advice on major infrastructure projects to the government of the day, and relevant ministries will provide advice on sector program costing and implementation.
Timor-Leste's Strategic Development Plan is an integrated package of strategic policies to be implemented in three time periods:

(i) Short-Term: 1-5 years
(ii) Medium Term: 5-10 years
(iii) Long-Term: 10 - 20 years

The Strategic Development Plan covers three key areas:

(i) Social Capital
(ii) Infrastructure Development
(iii) Economic Development

This summary review of SDP 2011-2030, is derived from the official report by the GoTL, published in 2010. The review concentrates on the on Infrastructure and Economic Development, in particularly of the National Road Network, and of the Petroleum Industry which is expected to affect the road network in general, and of Manatuto-Natarbora road in particular.
It is important to note that road development is considered by the GoTL a preliminary pre-requisite and essential top-priority step in the implementation of the SDP.
The following section is extracted, as is, from the SDP Report:
"Physical infrastructure development, particularly road network improvement is recognized by the Government of Timor-Leste as one of the top priorities to accelerate the country's new economic opportunities and poverty reduction."
Further review of the road development goal is provided in the sections below.

3.2 A National Planning Framework

3.2.1 Present Economy and Future Vision

Currently, Timor-Leste is a low income country, concentrating primarily on agricultural production, largely for subsistence, limited economic diversification, and just an emerging private sector.
However, the vision of the SDP for 2030, is that Timor-Leste becomes a modern, diversified, middle income economy; with high quality infrastructure including roads, power, ports and telecommunications.
Subsistence agriculture, which currently dominates the economic-base of the population, is to be replaced by commercial, smallholder agriculture sector. By 2030 Timor-Leste is expected to be self-sufficient in food, as well as producing a range of agricultural products for export: staples, livestock, fruit and vegetables, other cash crops, as well as forestry and fisheries products.
Development of the Timor-Leste economy will be built around the growth of three critical industries: Agriculture, Petroleum and Tourism (in particular eco-tourism). The Petroleum Sector, including oil and gas production and downstream industries, will provide an industrial base to the Timorese economy.

3.2.2 Regional Development Corridors

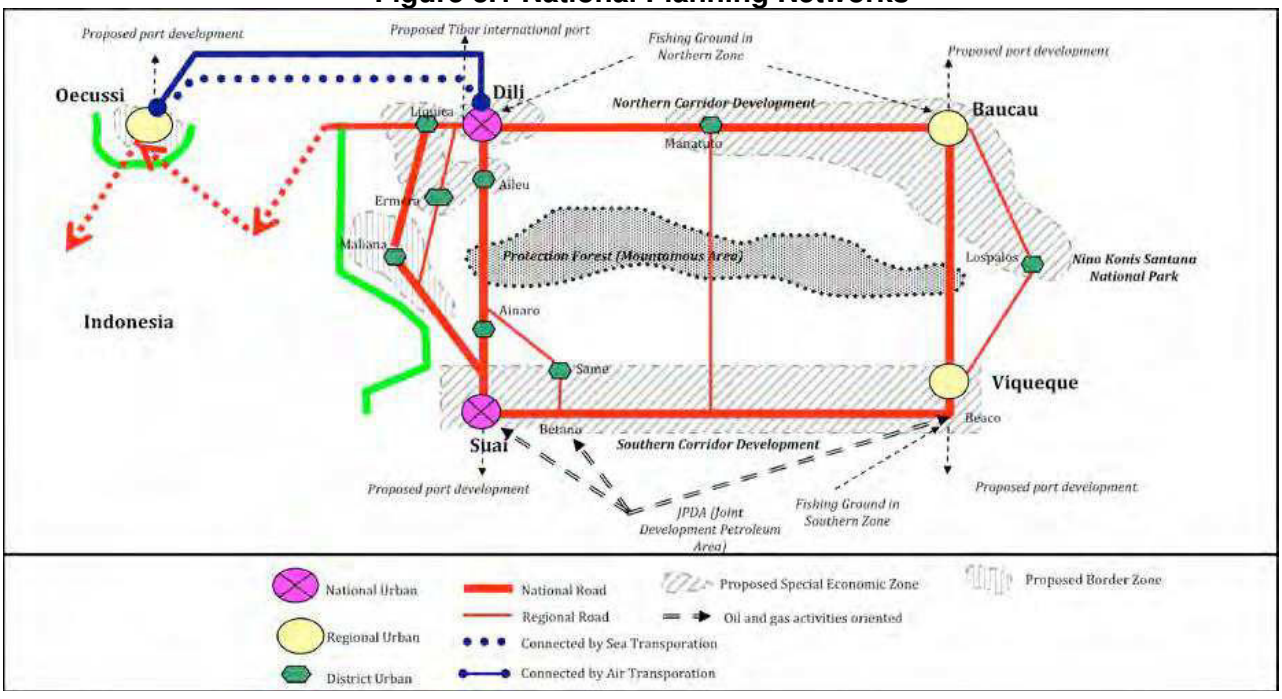
Geography, has largely dictated the distribution of economic activities in the country. Timor-Leste has a land area of about 15,000 km2. Most of the land area in the centre of the country, stretching from east to west, is highly mountainous. As a result of the extremely mountainous terrain, socio-economic activities have concentrated predominantly along the plains in the northern and southern coastal corridors, where most major urban centres, including the capital Dili, are located. Lacking dependable roads, the central mountainous regions remain isolated, and traffic tended to circumvent them along the coastal area, further reinforcing the dominance of the coastal settlements. This results in substantial urban-rural and inter-regional economic imbalance.

To address this imbalance, the SDP goal is to develop, by 2015, a National Planning Framework to guide acceleration of equitable and sustainable economic development. The framework includes two Regional Development Corridors, (i) the Northern Corrido and (ii) the Southern Corridor, as well as a number of special zones, to guide development upon specific characteristics of certain regions.

Timor-Leste's Northern Regional Development Corridor will stretch westward from Dili to Liquiça, Batugade and Mota'Ain, and eastward from Dili to Hera, Manatuto and Baucau. The Southern Regional Development Corridor will stretch from Suai to Beaço encompassing the areas to be developed by the petroleum industry. Figure 3.1 (derived from the SDP) shows the Development Corridors, as well as the National Road Network connecting them.

It should be noted that the Manatuto-Natarbora Road is an important link in this plan, connecting the Southern and Northern Corridors. The Mountainous area of Manatuto District is designated as a "Protection Forest".

Figure 3.1 National Planning Networks



3.3 National Roads Network – Goals & Strategy

The outset of the SDP chapter on Road and Bridges states that:

"An extensive network of quality and well maintained roads is essential to connect our communities, promote rural development, industry and tourism, and provide access to markets" (highlight in the original report). Roads are the primary mode of transport and allow development and the delivery of resources to urban as well as rural areas. They are critical to most other sectors and support the delivery of community services, health care and education"

The SDP vision for National Road infrastructure in Timor-Leste is to include:

- Implementing Comprehensive Roads Maintenance Program

- Rehabilitating all Existing Roads
- Constructing New Bridges to provide all-weather access on major routes within 5 years, and the remainder of national and district roads by 2030
- Building Road Infrastructure to Support the Development of the South Coast
- Establishing National Ring Road standards and establish a ring road to these standards by 2030.

The Strategic Development Plan road program aims to fully rehabilitate all National and District Roads to an International Standard by 2020. This standard includes a road width of about 7 m. plus a shoulder, as well as drainage and slope protection works, to stabilise roads in mountainous areas.
In addition, the road rehabilitation and construction program is also to include a Bridge Construction Program, to construct and rehabilitate bridges that are in need of replacement or repair. It will involve about 3,200 linear meters of bridges throughout the nation.

3.4 Priority National Roads

Selected numbers of National and District Road links are designated as "Priority Roads" by the SDP and are considered to be implemented first to International Standard. Together they include six projects. As shown below, the Manatuto-Natarbora road links are included in that list.
The High Priority Road Links are listed and summarized below. Note, that the description of the Manauto –Natarbora Road is extracted and quoted in full from the SDP. This is in order to highlight the importance that the GoTL attaches to that road, in spite of its poor conditions and low traffic at the present. Underlying key words and attributes of that road was added, here, by the Consultant.

3.4.1 Manatuto – Natarbora Road Link

"The Manatuto-Natarbora Road (81 km) is a Key North South Road Link. The road is in very poor condition, which is a major barrier to the development of the Manatuto District. The lack of a fast and reliable north south road link is also hindering the development of the South Coast.
The Manatuto-Natarbora road link will be Fully Upgraded To International Standards, including widening where technically feasible. This project was expected to cost in excess of $60 million, with the final amount to be determined following the undertaking of the final design and costing assessment (i.e. this Feasibility Study). This project was expected to commence in 2012 and will be completed in 2015.
This road project is expected to provide a critical connection between the North and The South Coast. While there are other north south road links through the centre of the nation, these other routes travel through mountainous terrain. While the development of these alternative routes to International Standards will be fully examined, it is likely that they would be very expensive due to the need to build bridges and tunnels. Therefore, at least until 2015, it is likely that the upgraded Manatuto-Natarbora road link will be the Primary North South Link."

3.4.2 Dili – Manatuto – Baucau Road Link[*1]

The north coast road from Dili to Manatuto (58 km) and Manatuto to Baucau (60 km) is generally in fair condition; but its narrow width, poor alignment and vulnerability to potholes and landslips, pose a major constraint to access, rural development and tourism in the east of the country.
The Dili to Baucau road link will be fully upgraded to international standards, including widening where technically feasible. Work will commence in 2012 and will be completed in 2015 at a cost of around $100 million.
The SDP indicates that once this project commences and progress is reviewed, planning will begin to extend the road work past Baucau up to Lospalos and Com. The road from Lautem-Moro to

[*1] A Feasibility Study for the North Eastern Coastal Road and braches, TA 8146-TIM, "Road Network Upgrading (Sector) Project" is currently carried by the ADB, in parallel to the Manatuto-Natarbora Feasibility Study. The Teams for these two studies collaborated closely, to ensure compatibility in methodology, in particularly of Traffic Surveys, and input to RED Model for Economic Analysis.

Lospalos and to Tutuala/WaIu will also be rehabilitated. These roads will provide access to rural feeder roads to support rural and regional development.

3.4.3 Dili – Liquiça – Bobonaro Road Project

This road project will involve the full rehabilitation and installation of an overlay of 230 km of roads from Dili to the Indonesian border at Mota'Ain, as well as Tibar to Maliana via Gleno and additional roads in the Cova Lima district.
Work was expected to commence in 2012 on the Dili to Mota'Ain route, which will become the western part of the Great Northern Coastal Road. This section is expected to promote tourist access and provide the key road and trade link to Indonesia.
This project will cost around $82 million. It wa expected to commence in 2012 and be completed by 2014.

3.4.4 Dili – Aileu – Maubisse – Aituto – Ainaro – Cassa

This road project provides another key North South Corridor, opening up access to central Timor-Leste and promoting tourism by providing an improved link to the Maubisse tourist zone.
Work on this road link is currently under progress. Financed by the World Bank, detailed design is under work, and construction is due to proceed thereafter.

3.4.5 Suai–Cassa–Hatu Udo–Betano–Natarbora–Viqueque–Beaço

The Suai to Beaço south coast route will be developed to support the growth of the Petroleum Industry, and to open up this coastline to allow economic development and the delivery of social services. This major road project will be undertaken in stages, with each stage being developed according to economic need and the growth of the Petroleum Industry on the South Coast. The project is expected to commenced by 2015 and be completed by 2020.
Timor GAP, a Government Company, was assigned the task of planning and managing the development of the Petroleum Industry on the South Cost. Among others, it has developed a plan for a Duall-Carrigeway (4 lane Highway) along the South Cost, connecting the three planned hubs of Petroleum facilities—Suai, Betano and Viqueque. Further details on that plan are given in the following chapter.

3.4.6 Pante Makassar–Oesilo, Pante Makassar–Citrana, Oesilo-Tumin

The Oe-Cusse Ambeno District, is a TL enclave, surrounded by Indonesia (and the sea), and thus presents a special transport challenge, due to lack of land access to the rest of the country. It had an area of 815 km^2 and a coastline of 48 km, and is divided into four sub-districts -- Nitibe, Oesilo, Passabe, and Pante Macassar, where the District Capital is located.
Therefore, major road rehabilitation projects was expected to commence in 2011 and completed in 2012. These projects are: Pante Makassar to Oesilo, Pante Makassar to Citrana and Oesilo to Tumin. All of these rehabilitation projects are aimed at improving access to services and stimulate economic activity within Oe-Cusse Ambeno.

3.5 National Highway Ring Road

The SDP argues that the economic and social development of Timor-Leste requires an integrated National Highway Ring-Road, located along the coastal areas. This Ring Road is to be connected by several upgraded North-South Links, such as the Manatuto-Natarbora Road. Together, the fully upgraded road links are to provide a unified National Highway Network, which will make the country a single entity (rather than isolated areas), fully accessible to all.
The vision is that in the long-run (according to the SDP, by 2030) the TL Ring Road will have two lanes in each direction, and be capable of taking a full length container at an average speed of 60 km per hour. However, the SDP agrees and accepts that the first stage will involve construction of only

one lane in each direction. To accomplish the long-run vision that SDP calls for reserving sufficient right-of-way for two extra lanes; and design planning and costing for the full 4-lane highway.
The targets year. set by the SDP for the TL Road Sector, in particularly for the National Road Network, are as follows:

2015

- Dili – Manatuto – Baucau Road Links -- fully upgraded and widened to international standards.
- The Manatuto-Natarbora Road Links -- fully upgraded and widened to international standards.
- Dili – Liquiça – Bobonaro Road links -- fully rehabilitated.
- Pante Makassar – Oesilo | Pante Makassar – Citrana | Oesilo – Tumin Road llinks – completed.
- All rural roads -- rehabilitated by locally based contractors.
- Road condition monitoring surveys -- carried out each year on all improved roads to determine maintenance needs.
- Plan for National Ring Road – completed.

2020

- All National and Regional Roads -- fully rehabilitated to International Standards.
- Dili – Aileu – Maubisse – Aituto – Ainaro – Cassa -- rehabilitation completed.
- Suai – Cassa – Hatu Udo –Betano – Natarbora – Viqueque – Beaço -- rehabilitation completed.

2030

- Double Carriage Ring Road capable of taking a full length container at an average speed of 60 km per hour –- completed.
- All bridges – fully rehabilitated.

3.6 Petroleum & Petroleum Industry Facilities

3.6.1 Overview

The SDP states that:
"The Petroleum Sector In Timor*-Leste is Designated by the Strategic Development Plan as a Key *Pillar for The Country's Future Development"
Currently, and the foreseeable future, Timor-Leste is highly dependent on revenue from Oil and Natural Gas, which contributes almost 90% of total budget. The oil revenues have been steadily growing, resulting in increasing balances for the "Petroleum Fund," which aims at managing this revenue for the benefit of current and future generations.
The "Petroleum Fund" balance was $370 million at the end of 2004, $6.9 billion by the end of 2010, and reached about US$ 11.0 Billion by 2012.
The following steps are proposed by the SDP to make the most of the Gas & Oil reserves, and revenues.

- Revenue from petroleum will continue to be fully transparent and used to support social and economic development.
- A petroleum industry will be developed that operates with the maximum participation of Timorese citizens and businesses.
- The human resources necessary for the operation of the petroleum industry will be improved and developed.
- The south coast will be developed to support the expansion of TL domestic petroleum industry, including the establishment of core infrastructure.

The following sections concentrate on plans by the SDP for development of the Gas & Oil on the South Coast, as they are expected to be major determinants of future traffic on the Manatuto-Natarbora Road.

3.7 The National Petroleum Company – Timor GAP

Central to the strategy of developing the TL petroleum industry was the establishment of a National Petroleum Company – Timor Gas and Petroleum E.P., commonly known as Timor GAP. Timor Gap is designated to lead the development of the industry through direct participation, ownership and

investment in our petroleum sector. Among others, Timor Gap concentrates on building local human resources and domestic petroleum expertise to allow Timorese ownership and participation.

3.7.1 Tasi Mane Project

To bring petroleum development into TL shores, and provide direct local economic benefits, substantial petroleum infrastructure facilities are planned for development on the South Coast of Timor-Leste, to be led by the Tasi Mane Project. This Project includes three industrial clusters on the south coast, from Suai to Beaço, which together will form the backbone of the Timor-Leste petroleum industry.
Tasi Mane clusters to include: (i) Suai Supply Base (ii) Betano Refinery and Petrochemical Industry, and (iii) Beaço LNG-Plant. Each cluster will also include construction of New Town, to house the administrative staff and the workers: (i) Nova Suai (ii) Nova Betano, and (iii) Nova Viqueque, respectively. Figure 3.2 shows the location of these clusters.

Figure 3.2 Development Clusters

Source: Timor GAP

To connect these three clusters and support growth of the petroleum industry, a new Double Carriage, four-lane Highway is planned, along the South Coast, from Suai to Beaço, a distance of about 155 km. According to MOF, estimated cost, including construction of grade separated interchanges, about USD 1.52 billion.
Based on the SDP, the Tasi Mane Project is planned to commence by 2015 and be completed by, at least, 2020.

3.7.2 Suai Logistic Supply Base

Extensive public sector investment will establish a logistics base for the petroleum sector in Suai. The logistic supply base in Suai is planned as the main entry point for the materials and equipment needed to build petroleum industry infrastructure and plants on the South Coast. It will also support the establishment of petroleum centres at Betano and Beaço.
Planned public investment in Suai includes:

- Sea port in Kamanasa, Suai, including container park, warehouse logistics area, office spaces and fuel storage facilities
- Heavy metals workshop
- Shipbuilding and repair facilities
- Rehabilitated Suai airport.
- **Nova Suai, a New Town**, to house up to **6,000 People**.

3.7.3 Betano Refinery and Petrochemical Industry

The Betano cluster will consist of an Industrial Park containing Refinery and related Petrochemical Industries. The refinery will have, at its initial phase a capacity of 30,000 barrels per-day, to progressively increase to 100,000 barrels per-day. The refinery will primarily supply domestic fuels needs such as diesel, gasoline, jet-fuel and asphalts. In addition, it is expected to export some products, largely to the Asian-Pacific Region

The establishment of a Refinery and Petrochemical Industries is expected to be achieved through cooperation between the public sector – largely Timor GAP, and the private sectors – International Oil & Petrochemical corporations. . The development area has been designated a "Joint Petroleum Development Area" (JPDA).

- A **New Town, Nova Betano**, will be developed around this Industrial Complex. This town is envisaged to be the largest of the new towns, with a target **population is 30,000**. It will be the "Petroleum Administration City". It is targeted for completion in 2017.

3.7.4 Beaço LNG-Plant cluster

The Beaço LNG-Plant cluster will be located in the area where the natural gas pipeline, from the sea, reaches Timor-Leste. This cluster will incorporate the LNG-Plant complex and the Nova Beaço and Nova Viqueque developments.

The LNG-Plant, during its first phase, is planned to have a production capacity of 5 million tonnes per-annum (MPTA) or one train, which can be expanded in the future to a capacity of up-to 20 MTPA or four trains).

The existing airport at Viqueque will be refurbished with the capacity to operate as a fly-in-fly-out airport for LNG Plant operators, as well as serving as a regional airport.

Tow residential developments/new tows are planned for this area:

- **Nova Viqueque**: To be located about 2km south of present Viqueque. It will service the proposed LNG facility. The town's target **population is 6,400**.
- **Nova Beaco**: It s envisaged to accommodate the residents of villages who will have to be resettled because of the construction of the LNG facility

3.7.5 Planned Development Stages and Target Years

The Tasi Mane project is planned to be constructed over a 20-year period, in four stages:

- **Stage 1, 2011-2013**: Commencement of the first phase of Suai Supply Base, to include construction of a seaport with breakwater in the Kamanasa area, warehouses; office space and utilities; rehabilitation of the Suai airport; and rehabilitation of connecting roads in the Suai/Kamanasa area.
- **Stage 2, 2013-2016**: Completion of the first phase of Suai Supply Base, and commencement of the second phase to include: Extension of the breakwater (to cover a more protected berth area); construction of the new city of Suai, which will provide housing and accommodation for workers; start constructing the first phase of the refinery project in Betano, with a capacity of 30,000 barrels per day; commence construction of the road Suai- and Betano; and commence Phase1 of Nova Betano.
- **Stage 3, 2017-2023**: Completing first phase of the refinery project in Betano; and the extension of the Betano - Beaço Highway. Also, constructing the LNG plant in Beaço , Nova Viqueque and Nova Beaço; and refurbishing/enlarging the regional Viqueque airport.
- **Stage 4, 2024-2030**: Completing Phase 3 of the Suai Supply Base; Phase 2 & 3 of the Petroleum Administration City; continued growth of petrochemical industries; and further expansion of the LNG-plant to accommodate additional trains if further gas discoveries are made.

The following are targets, by year:

2015

- • Construction of the Suai Port – completed.
- • Suai airport –fully rehabilitated.
- • Refinery Phase 1 – commenced.

- • First section of Suai-Betano Road – commenced.
- • Nova Suai development—completed.
- Phase 1 of Nova Betano -- commenced

2020

- • Phase 2 of the Suai Supply Base -- completed
- • Phase 1 of the Refinery -- completed
- • Beaço Port -- completed

2030

- The Tasi Mane Project –Completed; including an integrated Petroleum Industry, connected by a four-lane Highway on the South Coast of Timor-Leste.

3.7.6 Fuel Outputs and Hauling Methods

Further information on outputs, by type; and conceptual assessment of exports and domestic consumption of petroleum products, as well as of fuel hauling from the three clusters, was provided by Timor GAP Management[*2], as follows:

Liquefied Natural Gas (LNG) - All LNG output (up to 5 million tons per-annum) will be shipped, by water, from the specialized LNG Port to be constructed in Nova Viqueque. This port will handle solely LNG, and most of the LNG output will be for export.

LNG to the Refineries – If LNG will be delivered to the refineries, for production of various liquid fuels and/or fertilizers, it will be carried-out via a pipe-line.

***Refineries' Liquid Fuels* Output** - Table 3.1 shows planed output of the refineries, by product type (in Barrels Per Day, BPD), as well as estimates by Timor GAP Management for share of exports and local consumption in Timor Leste. Total daily output is about 30,000 BPD, of which the largest share is of Naphta, about 20,000 BPD, solely for export. The other 10,000 BPD products are divided, in various shares, between export and domestic consumption, as shown in the table.

Hauling Methods - For Export, liquid fuels will be delivered via a pipe-line from the refineries in Betano to Suai Port, and from there by vessels overseas. As for domestic consumption of liquid fuels, there are no definite plans, as of now, for delivery means (coastal-water or road). However, Timor GAP agreed that a 50%-50% share between water and land hauling is reasonable.

Subsequently, these shares were used by the Consultant, to estimate number of fuel-hauling tanker-trucks over the Natarbora-Manatuto road (see last two columns Table 3.1).

Table 3.1 Refineries Output, by Type and Destination (Export or Local)

Refinery	Outpot	Export/Local Share		Local Consumption & Haul by Road				Estimated Trucks/day	
Output	Per Day			BPD	Share	BPD	Tons	one-way	two-ways
Type	(BPD)	Export	Local	Total	by Road	by Road	by Road	Haul Fuel	(Inc Empty)
LPG	1,500	67%	33%	495	50%	248	37.13	4	7
Naphta	20,200	100%	0%	–	–	–	–	–	
Gasoline	900	50%	50%	450	50%	225	33.75	3	7
Jet Fuel	2,600	75%	25%	650	50%	325	48.75	5	10
Diesel	4,500	0%	100%	4,500	50%	2,250	337.50	34	68
Import Reformer	500	NA	NA						–
(Gasoline Blending)									–
Total	**30,200**			**6,095**		**3,048**	**457**	**46**	**91**
Source: Timor Gap, CEO				Source: Estimates by Consultant					
				Assumptions			150 kg/br	10 Ton/Truck	

[*2] Meetings with Timor GAP CEO, Francisco de Costa Monteiro, March 26 and April 3, 2013.

CHAPTER 4: ENGINEERING: SCOPE OF WORK, TECHNICAL INVESTIGATION & PROJECT DESIGN

4.1 Introduction & Description of Project Roads

The Government of Timor Leste (GoTL) in its Strategic Development Plan, 2011-2013, identified the provision of upgraded north to south road links essential for integrated national development. Currently, all north-south links are in poor condition, hindering the integrated development. Given this background, and as a continuation of the "Road Network Upgrading Project" (RNUP), the GoTL, with financial assistance from the Asian Development Bank (ADB), have undertook the Feasibility Study and Detailed Design of National Road A-09, from Manatuto to Natarbora, including District road C-15 between Laclubar junction and Laclubar.

Geographically, the 81 km, Manatuto – Natarbora road is a central north-south link. It conditions is a major barrier to the development of the Manatuto District, and hinders the development of the south coast, due to lack of a reliable north-south connection.

Starting from the north, National Road A-09 begins at the roundabout intersection of Manatuto, at elevation +/- 50m. From there it veers inland in a southern direction, traversing from a flat to rolling terrain during the first 22 km, as it gradually ascend to the Cribas Sub-District, at elevation +/-400m. It continues to ascend in the same southern direction, till reaching the Laclubar junction at elevation +/- 1200m, almost 35km from the Manatuto roundabout. From this point, the road descends, while the road-way becomes narrower, from 4.5m to 3m. It traverses winding mountainous terrain up to the Manehat District, at elevation +/- 850m, about 65kms from Manatuto. The road continues to descend the rolling terrain till it crosses the Lamera River, About km75 from Manatuto Junction, at elevation +/- 150m. From that point onwards, the road traverses a flat terrain, with fair asphalt surfacing, and a wider width of about 4.5m, up to the junction with National Roads A-14 & A-07, in Natarbora.

District Road C-15, from Laclubar junction to Laclubar, with a length of about 10.3km, traverses a mountainous terrain at elevation +/- 1200m, in a westerly direction. This road link is in very poor condition: The existing asphalt surface is heavily deteriorated, and seemingly becomes a gravel road, with narrower road-way of about 3m to 3.5m.

4.2 Technical Engineering Field Investigation

4.2.1 Assessment of Existing Road and Major Drainage Structures

During the month of February, 2013, the Consultant carried out field inspections to assess conditions of the existing road and its structures. Among others, during the inspection the Consultant noted on-going road realignment, reconstruction and restoration works, on several sections.

The adequacy of these reconstructed sections will be verified during the detailed engineering phase, and will be coordinated with the MPW-PMU. For example, between km 80 & km 95, about 5 sections are in need to define their suitable horizontal alignment. The Consultant Road Design Engineer has delineated the appropriate alignment, in order that a survey team could stake-out and take a topographic survey.

Predominantly, in the mountain ranges of Orlalan and Laclubar Sub-Districts, between km 97 and km 139, significant road slope failures have been observed. The failures are generally triggered by water and highly plastic clayey soils in the road cuts. Eroded shoulders and embankment seem to be attributed to lack of proper drainage system, particularly the absence of lined side ditches. In most earth-cut sections, the back slopes are not shaped and trimmed correctly, and are thereby susceptible to erosion. They become unstable when saturated, and then gradually slide.

The extent of remedial works on these failures can be prevented, if not eliminated, by designing appropriate drainage system to circumvent prolonged saturation of the soils, and by constructing adequate slope protection works, including bio-engineering solutions.

Sealed pavements are composed of large stones; hand placed and locked- in, with smaller stones, with a penetration macadam surface. The road-way surface, which ranges in width between 3m and 5m, is relatively rough, due to heavy deterioration, including significant potholes caused by lack of

periodic maintenance works. The shoulders are mostly covered with vegetation, and with intermittent gravel to earth shoulder approaching communities. Due to heavy vegetation of the shoulder, side ditches could hardly be seen, and were not included in the assessment.
The existing cross drainage pipes are of different kinds, including corrugated steel pipe, reinforced concrete pipes, or reinforced concrete slab seated on stone masonry wall. Generally, the steel cross pipes are deformed, due to inadequate fill-cover and all cross drainage culverts accommodate only the width of existing narrow road. The Consultant recommends removing all existing pipes and replacing them with appropriate RC pipe or box culvert.
Furthermore, the drainage system of the proposed project road should be studied comprehensively, during the detailed design phase.
Findings and assessment of the existing road conditions, including photographs, are summarized in **Appendix 4.1,** in the form of straight-line diagram. Assessment of existing major drainage structures, including photographs, is shown in **Appendix 4.2**.

4.2.2 Road Roughness Survey

A road roughness survey, using a vehicle-mounted Romdas Bump Integrator, with roughness reading every 100 meters (in a single direction), was conducted on February 8, 2013, on the two project road links. The survey was conducted as a joint-effort by the PMU-MPW, ADB and the Consultant. The International Roughness Index (IRI) of each homogenous section was calculated by taking the average index value every kilometer. The adopted RI value is determined by the formula:
RI value = Average IRI every kilometer
With an aid of the Excel formats, the corresponding IRI values, used as input to the RED economic evaluation model, are summarized in Table 4.1. The processed road roughness index data are provided in **Appendix 4.3**.

Table 4.1 Road Section Roughness (IRI)

Section	From - To	Length (km)	Existing Average International Roughness Index (IRI)
A-09-01a	Km65.2-km82	16.80	11.04
A-09-01b	Km82-km88	6.00	10.03
A-09-02	Km88-km99.5	11.50	27.44
A-09-03	Km99.5-km133	33.50	31.45
A-09-04a	Km133-km140.5	7.50	28.99
A09-04b	Km140.5-km144.7	4.20	10.41
C-15	Km0.00-km10.30	10.30	34.03

The post-work IRI, ranging between 2.5 for asphalt-concrete surfacing, to d 3.5 for TST surfacing, was established together with the Transport Economist, after discussions with the ADB.

4.2.3 Traffic Survey and Cumulative Equivalent Standard Axles

The Consultant conducted a Classified Traffic Counts and Origin-Destination (OD) surveys, during the period February 19 to March 1, 2013, along and adjacent to the Manatuto-Natarbora Road. Classified traffic count surveys were carried out in three (3) stations: (i) At km 70.0, about 4.7km south of the Manatuto roundabout; (ii) at km 99.5, Laclubar junction; and (iii) at km 141.0, after crossing Lamara river. Origin-Destination (OD) survey was conducted on the Dili-Manatuto road (A01-01) about 5 km west of Manatuto roundabout. For further details see Chapter 10.

Traffic survey results indicate that current traffic is low, and so are the cumulative axle loads over the 20 year design period. The Cumulative Equivalent Standard Axles (CESAL) for heavy vehicle, over the next 20 years (starting after the expected opening reconstruction year 2016), say until the year 2035, based on "normal" traffic growth is less than 0.6 x 106. This means significant lower loading with respect to pavement design. However, with the additional "generated" and "induced" traffic, from the south coast, the CESAL over the 20 year pavement-life is expected to increase substantially.

4.2.4 Sources of Construction Materials

The Consultant has explored existing material sources for construction, and suitability of local materials; potential quarry sources; selected borrow pits; and assessed the quantity and quality of materials. This is to ensure that the design of each road project is based on the most economical use of available materials, with good environmental design practices.

The Consultant identified two commercial crushers: one in Manatuto (Suai Indah Company), and the other in Natarbora (Instutuisao Dos Gestao Equipamento); and several potential quarries or materials sources, shown in maps in **Appendix 4.4.** The maps indicate approximate distance and accessibility to the project. Among others, the Sumasse River in the north section, and the Lamara River in the south section, located within reach of the project, have unlimited source of quality sand materials.

During the detailed engineering phase, sampled material will be gathered and tested, by the Consultant. The test to include:

a) Grain size distribution and plasticity characteristics
b) Unit weight and water absorption
c) Los Angeles Abrasion
d) CBR
e) Soundness
f) Sand Equivalent
g) Other tests as required

Test results and estimated quantity of materials will be logged and documented. The Consultant will also recommend suitable quarrying methods, for optimum utilization of each proposed source, as well as considerations for environmental impacts.

For existing quarries, the Consultant will assess output capacities of the quarrying operations and their ability to supply the project roads, in light of competing demands from other projects.

4.3 Technical Design Standards and Guidelines

The geometric standards of the Ministry of Public Works (MPW), Draft Specifications for Road & Bridges, the AASHTO 2011, and other accepted internationally recognized standards were harmonized by the Consultant, to come up with proposed technical standards, suitable for use in the detailed engineering design phase, as shown in **Appendix 4.5**. The Consultant's proposed technical design standard and guidelines includes, but not limited to, the following:

- Geometric Design Standard
- Pavement Design Guidelines
- Hydrology and Drainage Design Criteria
- Bridge Design Guidelines
- Other Design Considerations
- Typical Road Cross Section

The Consultant's proposal may be adjusted during the course of detailed design phase, to meet the specific requirements of the Project.

4.4 Geotechnical Assessment

4.4.1 General Topographic and Geological Setting

Topography

The Manatuto-Laclubar-Natarbora Road is one of the north south connector across the mountainous spine/ridge. Starting from the north, in the first section, the road rises, falls and sometimes winds up/down gentle hill slope, with an altitude of maximum of 320m from Sta. 65+200 to Sta. 81+200 out of alluvial fan in Manatuto.

In the next section, the road runs through a flat plane, which is called "River Terrace", spreading out to around STA. 91+000. After going to steep mountainous area, height of around 1,200m, the road reaches the intersection crossing with the way to Laclubar and Natarbora (STA.99+500; 1,120m above sea level). The way to Laclubar runs through the ridge to the distance of 10.5km in the west.

The way to Natarbora rises, descends and winds up/down mountain slope up to Sta 117+000 of elevation 460m. In the next section, the road seems as "Skyline" runs continuously on the mountain ridge up to Sta.127+500.

The road descends and winds down mountain slope to Sta.134+000, turns to the west and goes over the small mountain (450m above sea level) to Alluvial flat, which receives the Alluvium deposited in the River Lamara during flood. The end of the road (Sta.144+800) is located on the Alluvial flat around Natarbora.

Geology

Geologically, Timor is a part of Banda Arc, which was formed by a complex sub-duction setting. The Timor Trough is running parallel to the southern coast of Timor Island. Australia continental crust extends to the northern edge of Timor. The collision began in the late Miocene, about 11.6 to 5.3 million years ago. Timor has older geology and lacks the volcanic nature of the northern Lesser Sunda Islands. Timor Island built up with contributions from the Australian continental plate, the mélange and the ophiolitic Banda terrane.

In this area, geological basement consist of the Pre-Permian Lolotoi Complex which has thrusted over the younger formations, Permian Atahoc and Cribas FM, Triassic Aitutu FM, Jurassic-Cretaceous Wailuli FM and Middle Miocene Bobonaro Scaly Clay (Fig.1 & 2).

Lolotoi Complex is composed mostly of basic schist and amphiborite (Laclubar metamorphic massif). Atahoch and Cribas Formation are black pyritic shale, silty shale, limestone and sandstone etc. exposed in only small area around Atahoc village. Aitutu Formation includes a calcilutite, shale and sandstone sequence and contains a basal radiolarian limestone. Wailuli Formation is predominantly clay, marine shale, marl and fine-grained limestone. The origin that preceded the deposition of the Viqueque Formation (upper Miocene) resulted in the placement Scaly Clay of large thrust sheets of Permian rocks and the placement of a huge gravity-slide deposit, the Bobonaro Scaly Clay.

From the geotechnical viewpoint, not only the basic rocks and also subsurficial deposits important for road design. In this area, the two kinds of detritus sediments is located on the basic rocks; the gravels occur in River Sumasse Terrace and the talus consist of rock fragments of any size or shape (usually coarse and angular) derived from and lying at the base of a cliff or very steep, rocky slope.

Figure 4.1- Schematic Stratigraphic Profile Through Timor

Figure 4.2 Type Area for the Permian units in Timor

4.4.2 Geotechnical Assessment

(1) General Aspects

Since the road improvements require widening, three (3) measure works are to be considered: (i) cutting in mountainside slope; (ii) filling in valley ward slope; and (iii) both works. In addition, the countermeasures for the potential landslides, which consist of landslide, slope failure and debris flow shall be considered.

(2) Filling

The existing road sections have two types of damage: (i) deformed retaining wall (stone masonry and gabion) and (ii) landslide.

In order to circumvent the problem on the retaining wall, adequate compaction on the soil materials as desirable backfill (coarse-grained soils in Unified Soil Classification) and considering sufficient safety factors in the design for overturning, sliding and bearing capacity are required. Adequate load-bearing layer is necessary during construction.

(3) Debris Flow

Because the road runs almost along the mountain ridge and through flat hill, the potential debris flow is low to small catchments area from the intersection of road and torrent. If there is a flow of debris in the area, the return period of occurrence is probably over 100 years, hence, countermeasures are not indispensable because it is not of high risk.

However, debris flows have cascaded in few places at low lands and it need adequate countermeasure for those road crossing structures in order to have enough capacity taking into account the debris flow.

(4) Cutting

Many artificial cut slopes exist along the entire length of the project road. These existences are of various conditions, i.e. geomorphology, geology, weathering and soil, with various shapes, i.e. height, width and inclination, and also in different time.

4.4.3 Critical Issues for Consideration during Detail Design

Sta 65+200 to Sta 81+200

This area is underlain by "Scaly Clay", river terrace deposits and alluvial sediments. The road runs along River Carlilo at left side.

Three kinds of critical conditions are pointed out, as follows:

(1) The shoulder of existing road have been eroded and washed away in low places by the course of flood of River Carlilo.

(2) Many landslides and slope failures have occurred in the cutting and natural slope composed of Bobonaro "Scaly Clay". Generally, these failures are relatively small sizes and these slip surfaces pass over the surface of road.

(3) In this area there are four landslides, which are 100-150m length, 30-50m width and 5-20m depth (estimated). Three failures are active and countermeasure works such as lined ditch and gabion protection have been carried out while the other one is initially occurring. It is worth mentioning that the three failures are still moving at present in spite of conducting countermeasure works.

To prevent erosion and scouring against condition (1), river revetment should be installed in eroded portions of shoulder.

For adequate countermeasure against condition (2) installation of gabion wall at the toe of slope to act as counterweight and ideally cut the head of slope to decrease the driving moment. In addition, drainage work is basically required for decreasing the pore pressure.

Under condition (3), appropriate countermeasures should be considered following more precise investigation in situ and the analysis of sliding mechanism.

Sta 81+200 to Sta 91+000

The road runs through the River Terrace, which is ascending gently toward the end point of this project and is composed of very condensed gravel and sand sequences. Hence, it is straight forward to design and work for this section.

Sta 91+000 to Sta 99+500

The road enters on high mountain area underlain by Aitutu Formation and talus deposits. Three (3) kinds of issues are pointed out as follows:

(4) The slope failures have occurred by daylight joints in hard rocks, which consist of alternating beds of calcilutie and shale.
(5) Debris flows have taken place in the Mountain Rivers (torrent).
(6) The large landslide, which is located around Sta 99+500, has been under the large displacement therefore it is possible for the landslide mass to be stable and dormant for some time. If we can confirm its stable/dormant condition with the precisely investigation including the observation of GPS, the road might be restored like the former road.

Sta 99+500 to Sta117+000

The road runs through flat plane on the left, which is the river terrace of River Sahen and is underlain by Bobonaro "Scaly Clay" and talus deposits, at the foot of mountain slope, which is composed of hard rocks of Aitutu Formation.
Because the longitudinal slope of this road is very rugged but the grade of cross section is gentle, the height of cut slope is not high at all. On the other hand, the Mountain Rivers crossing the road have a large catchment area and steep inclination therefore the potential of debris flow is high.
Two (2) large landslides have menaced the existing road with prohibition of traffic.

Sta 117+000 to Sta 127+500

For most part of this section, the road goes through on the narrow ridge, which is underlain by weathered black shale, philite and fresh alternating beds of calcilutite and shale. This road is so-called "Skyline".
Because the slope of both sides facing valley are very steep, for widening road the high reclamation in the part of shoulder should be avoided and rather the surface of road should be lowered as much as possible.

Sta 127+500 to Sta 134+000

The road descends from the Skyline of 720m above sea level to 320m above sea level toward south coastline.
This area is formed in gentle slope, which extends around the right and left side of River Sahen and also is underlain by black shale etc. thought to be Wailuli Formation.
A large landslide associated with strongly weathered black shale has destroyed several times in spite of conducting countermeasures. The precise investigations and analysis on this landslide should be carried out sequentially.

Sta 134+000 to Sta 139+500

The road of East-West directions crosses the path of 420m above sea level and descends to River Lamara. This area is underlain by the alternating beds of calcilutite and shale. Though the rockslide and/or landslide failed by shearing along a daylight bedding plane, most of which dips 49°, the countermeasures using gabion is under construction now.

Sta 139+500 to Sta 144+800

The road runs through the fluvial fan of River Lamara up to the end point of this project. The fluvial fan is mainly composed of coarse (gravel and sand) granular deposits according to the current river situation therefore there is no problem for construction of road.

(Laclubar Jct) Sta 0+000 to (Laclubar) Sta10+500

The road goes through the ridge, which extends to east and west and is underlain by weathered philitic rocks and pre-Permian basic rocks near the Laclubar. It is not difficult to conducts design and earth works for improving the road. But, the rolling stone and basic rocks, which are very hard rocks (B, CH), are sporadically distributed in places therefore these destruction become critical issues in the case widening the road.

4.5 Bio-Engineering Measures

Based on field assessments of environmental and geotechnical aspects, priority areas for application of bio-engineering solutions have been initially identified. The specific locations, area sizes for treatment, and proposed type of bio-engineering application will be re-identified and confirmed during the detailed design phase of the project.

Soil bio-engineering measures are not simply "greening" techniques. They involve far more than simple application of a green vegetative cover to the degraded slopes. They integrate proven engineering practices with ecological principles, to provide mechanical, hydrological and environmental benefits. Hence, effective application of these measures requires careful planning and design, taking into account the specific characteristics of each site. Factors such as the geology, soils, slope angle, hydrology, existing vegetation cover, etc., should be assessed before appropriate soil bioengineering measures can be prescribed.

Several potential environmental benefits can be achieved by using soil bio-engineering measures, compared to conventional engineering practices. Notably, they usually require only minimal access provisions for equipment, materials and workers; and typically, create only minor disturbance to the site and the environs during installation. In environmentally sensitive locations, where preservation of scenery or wildlife habitats may be critical, soil bio-engineering measures can usually offer more environmentally compatible solutions. For sensitive or remote sites, these do not require long-term maintenance, thereby creating fewer disturbances.

Bio-engineering for slope protection and erosion prevention is comparatively cheaper than conventional systems, such as concrete or masonry protection works. In addition, it is a labor intensive approach, which benefits local residents, who are commonly familiar in the production of slope protection materials and plants, and whose skills in agriculture is of great advantage during installation.

The recommended techniques for use in the project are as follows:

- Live Stake – an appropriate means for repair of small earth slips and slumps that are frequently wet, through the use of local suitable species which creates a living root mat, that eventually stabilize the soil.
- Vegetation – serves as cut slope protection. Sodding or grass planting will protect the road slopes from erosion when the developed roots hold the slope soils together.
- Live Fascines – these are long bundles of branch cuttings bound together and installed with live and dead stout stakes.
- Brush Layering – consist of live branch cuttings of rooting plants installed almost perpendicular to the slope, to provide immediate earth support as a result of the overlapping layers.
- Coconet – made from coir fiber twine woven into high strength nets for extreme slope stabilization and protection for stream/river banks and channels.

The aforementioned bio-engineering proposals will be defined in details during the detailed design phase of the project roads.

Initial bio-engineering works are already included in the cost estimates for the economic analysis of this Feasibility Study.

4.6 Climate Change Adaptation

Projected Climate Change in Timor Leste is facing high degree of uncertainty. However, because the project roads are passing through rolling to mountainous terrain, and could potentially become an interior agricultural area, the expected change in rainfall regime is integrated into the design of pavement, slope protection works, and drainage structures.

Considerations, during the detailed design phase, to address climate change (increase in intensity of rainfall) are as follows:

- Pavement Structure – The proposed flexible pavement will be designed for wet condition of sub-grade, which is the worst strength scenario. The following considerations will be taken with respect to climate change: Sub-grade soaked Californian Bearing Ratio (CBR); loss of sub-grade support (arising from sub-base erosion or differential vertical soil movement); correcting the effective modulus of sub-grade reaction, (due to loss of foundation support); and the prevailing drainage condition.
- Drainage Structure – Rainfall data will be gathered from reliable records, and statistical inconsistencies will be corrected by acceptable regression analysis. Tributary catchment areas for the drainage structures will be demarcated, using suitable topographic maps. Watershed parameters will be measured from the delineated boundaries, cross-sectioning of the upstream/downstream reaches of the rivers, to determine design flood water level. This, in turns, will be compared against observed maximum flood level, through site inquiry and hydrologic modeling. This is to assure proper design of sub-structure depth, against scouring, superstructure free-board, and river training measures.
- Slope Protection Works – To address potential increase in landslides, general stability of slopes, and of cuts, which can increase impact of change in annual rainfall, detailed geotechnical investigation of existing and potential slope instability will be carried out. This is in order to assess the extent of proposed counter-measures including appropriate retaining structures, scour/erosion prevention, and bio-engineering slope stabilization measures.

The effect Sea Level Rise (SLR) is applicable mainly to low-lying areas. However, because the project roads which generally are located in high grounds this issue is not applicable to them.

Final note: initial cost estimates, associated with climate change adaptation, have been included in the options for the economic evaluation.

4.7 Proposed Road Upgrading Alternative Scenarios

The existing project roads were divided into seven (7) homogenous sections, taking into account varying terrain characteristics along the route, as well as conditions/features of the road. They are summarized in Table 4.2:

Table 4.2 Road Section Characteristics

Sect	Section Name	From To	Length (km)	Width (m)	Remarks
1	Manatuto-Cribas (A09-1a)	Km65.2 to km82	16.8	4.5	Flat/Rolling terrain
2	Manatuto-Cribas (A09-1b)	Km82-km88	6.0	4.5	Flat terrain, asphalt surface good
3	Cribas - Laclubar Jct (A09-2)	Km88 – km99.5	11.5	3.5-4.0	Rolling/Mountainous terrain, heavy deterioration
4	Laclubar Jct – Manehat (A09-3)	Km99.5-Km133	33.5	3.5-4.5	Rolling/Mountainous terrain, gravelly road
5	Manehat – Natarbora (A09-4a)	Km133 – Km140.5	7.5	4.5	Rolling, asphalt surfacing deteriorated
6	Manehat – Natarbora (A09-4b)	Km140.5 –Km144.7	4.2	4.5	Flat terrain, asphalt surface good
7	Laclubar Jct - Laclubar	Km0 – Km10.3	10.3	3 to 3.5	Rolling/Mountainous heavy deterioration, gravelly surface

These homogenous sections were used as a base to develop three upgrading alternative scenarios, as follows:

4.7.1 Scenario 1 - Repair/Rehab and Reconstruct, with 4.5m TST Surfacing

In Section A09-1b and A09-4b, Where the existing pavement is in reasonable order, the repair works include: repair of edge damage and potholes, and improving shoulders by reshaping or adding gravel to flush with the pavement. Edge damage and potholes will be squarely cut out up to sub-grade level, and the required pavement structures reconstructed to match the existing good surface. The shoulders which are predominantly covered with vegetation will be cleared and grubbed, and fresh aggregate materials added as required. Then, re-grade/re-shape and compact the new 1.0m shoulder on both sides. This treatment applies to sub-sections, built over flat and acceptable alignment, where the asphalt surface is in fair conditions.

In sub-sections A09-1a and A09-4a, as well as on all other sections, A09-2 A09-3, and C-15, where the existing pavement is highly deteriorated and bumpy, road roughness relatively high, and road furniture and feature are sub-standard; reconstruction is considered by upgrading the horizontal/vertical alignment to international standard. The road-works include: Removing existing asphalt surfacing, only if the below materials found adequate as pavement base. Otherwise, remove up to sub-grade level, and then prepare the succeeding layers to the required 4.5m Triple Surface Treatment (TST) pavement structures. Shoulder reconstruction will follow the same method in discussed above.

4.7.2 Scenario 2 - Reconstruct with 4.5m TST Surfacing

All the seven homogenous sections (A09, sections 1-4, and C-15) will be reconstructed to 4.5m TST surfacing, by improving the alignment to meet the required international design standards. This

includes: removal and replacement of inadequate structures, including bridges and other major drainage crossing, providing slope protection works (particularly in geologically unstable sections), and other miscellaneous works. Shoulders are improved to 1.0m on each side, with paved or unpaved surfacing, as required. Brick edging is installed on both edges of the 4.5m road-way, to deter edge damage, caused by opposing traffic.

4.7.3 Scenario 3 - Reconstruct with 6m Asphalt Concrete Surfacing

Scenario 3 is similar to Scenario 2 in that both of them consider complete reconstruction of all seven road links. However, Scenario 3 proposes significantly higher design standards. In Scenario 3 the road-way is widens to 6m (instead of 4.5m), and is surfaced with hot plant mix asphalt-concrete (instead of TST). Shoulders are improved to 0.5m - 1.0m wide on both sides, either with paved or unpaved surfacing, as required.
To save costs, in critical mountainous sub-sections, where widening necessitates excessive cut/fill, and massive slope protection works; and entails considerable cost in road-works and structures, it is proposed that the standard 6.0m width be adjusted to narrower width of about 4.5m. Likewise, existing 4.5m wide bridges, which are structurally adequate, should remain in place (at least in the short-medium term) to save on new construction. Nevertheless, the remaining 4.5m bridges need to be retrofit as required, and/or provide river training walls, to prevent further scouring/erosion of the river banks.

4.8 Cost Estimates and Contract Packaging

4.8.1 Civil Works Cost Estimates

The Consultant prepared civil works cost estimates for each of the seven homogenous sections (and sub-sections) listed above. The base for cost estimate was Scenario 3.
Scenario 3 includes the following characteristics as the base for cost estimates: A 6.0m wide road-way, with 50mm AC surfacing, 175mm crushed aggregate base course, and 150mm aggregate sub-base, over a sub-grade CBR>8. Shoulder is 0.5 to 1.0m wide, paved or unpaved.
Cost estimates for Scenario 1 and 2 were an adjustment to the estimates for Scenario 3.
Unit price method, per specific road-works item, was used to estimate the improvements and reconstruction cost of the two project roads (A-09 and C-15).
Bridges and special box culverts, as well as cross drainage concrete pipe culverts, were estimated by unit cost per structure.
The Consultant utilized the following assumptions for the cost estimates:

- The construction unit cost is composed of the direct cost, indirect cost, and tax.
- The civil work costs of the project roads are based on direct 2012 cost of previous projects, financed by ADB (RNUP/R-4B), and by the WB (TLRCRP).
- The indirect mark up of Overhead, Contingency & Overhead (OMC) is 10 %; Contractor's Profit is 10 %; and a 2 % Tax, is applied to both direct and indirect costs.
- Price escalation of 8 % per-annum in 2012, is derived from the IMF Consumers' Price Index (CPI) Report.
- Estimation does not include any import duties and taxes, which may be imposed by the Government on imported construction equipment and materials.

Details of civil works cost estimates are provided in **Appendix 4.6**.

4.8.2 Maintenance Cost Estimates

Maintenance cost estimates are based on data derived from the 2009 ADB TA-7100 Final Report: Table 4-6 "Normal Maintenance Unit Costs", and Table 4-7 "Essential Maintenance Unit Costs". These costs were adjusted to 2012 prices, using the IMF's CPI.

Summary of maintenance cost estimates is shown in Table 4.3.

Table 4.3 Estimated Maintenance Costs

MAINTENANCE COST									
Section	Sub-Section	Length (km)	Zone / Extg Surface	Alternate	Maintenance Cost Estimates ($ 000)				
					Base Cost 2009	2010 0.07%	2011 6.80%	2012 13.50%	**2013 8.00 %**
A09-1	A09-1a	16.8	1 & 3 Asphalt	0	9.60	9.67	10.32	11.72	12.66
				1	3.20	3.22	3.44	3.91	4.22
				2	3.20	3.22	3.44	3.91	4.22
				3	2.80	2.82	3.01	3.42	3.69
	A09-1b	6	3 Asphalt	0	6.30	6.34	6.78	7.69	8.31
				1	3.90	3.93	4.19	4.76	5.14
				2	3.20	3.22	3.44	3.91	4.22
				3	2.80	2.82	3.01	3.42	3.69
A09-2	-	11.5	2 & 3 Asphalt Gravel	0	10.75	10.83	11.56	13.12	14.17
				1	3.20	3.22	3.44	3.91	4.22
				2	3.20	3.22	3.44	3.91	4.22
				3	2.80	2.82	3.01	3.42	3.69
A09-3	-	33.5	3 &4 Asphalt Gravel	0	14.50	14.60	15.59	17.70	19.12
				1	3.90	3.93	4.19	4.76	5.14
				2	3.90	3.93	4.19	4.76	5.14
				3	3.40	3.42	3.66	4.15	4.48
A09-4	A09-4a	7.5	4 Asphalt Gravel	0	14.50	14.60	15.59	17.70	19.12
				1	3.20	3.22	3.44	3.91	4.22
				2	3.20	3.22	3.44	3.91	4.22
				3	2.80	2.82	3.01	3.42	3.69
	A09-4b	4.2	4 Asphalt	0	7.40	7.45	7.96	9.03	9.76
				1	3.90	3.93	4.19	4.76	5.14
				2	3.20	3.22	3.44	3.91	4.22
				3	2.80	2.82	3.01	3.42	3.69
C15	-	10.3	3 &4 Gravel	0	18.00	18.13	19.36	21.97	23.73
				1	3.90	3.93	4.19	4.76	5.14
				2	3.90	3.93	4.19	4.76	5.14
				3	3.40	3.42	3.66	4.15	4.48

Summary of engineering data, for input into the RED economic evaluation model, is shown in Table 4.4, below.

Table 4.4 Engineering Data for Economic Evaluation

Road Name			Manatuto - Natarbora						Jct Laclubar - Laclubar
Road ID No.			A09						C15
Road Section Name			Manatuto to Cribas		Cribas to Jct Laclubar	Jct Laclubar to Mane Hat	Mane Hat to Natarbora		Jct Laclubar to Laclubar
Road Section ID No			A09-1		A09-2	A09-3	A09-4		C15
Road Sub-Section			A09-1a	A09-1b	-	-	A09-4a	A09-4b	-
From (km)			65.2	82.0	88.0	99.5	133.0	140.5	0.0
To (km)			82.0	88.0	99.5	133.0	140.5	144.7	10.3
Length (km)			16.8	6.0	11.5	33.5	7.5	4.2	10.3
Road Width (m)	Existing		4.5	4.5	3.5 to 4	3 to 3.5	4.5	4.5	3 to3.5
	Proposed	Alt 0	4.5	4.5	3.5 to 4	3 to 3.5	4.5	4.5	3 to 3.5
		Alt 1	4.5	4.5	4.5	4.5	4.5	4.5	4.5
		Alt 2	4.5	4.5	4.5	4.5	4.5	4.5	4.5
		Alt 3	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Shoulder Width (m)	Existing		0.5 to1.0	1.0	0.5	0.5	0.5	0.5	0 to 0.5
	Proposed	Alt 0	0.5 to 1.0	1.0	0.5	0.5	0.5	0.5	0 to 0.5
		Alt 1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Alt 2	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Alt 3	1.0	1.0	0.5 to 1.0	0.5 to 1.0	1.0	1.0	0.5 to 1.0
Road Roughness (IRI Value)	Existing		11.0	10.0	27.4	31.4	29.0	10.4	34.0
	Post-work	Alt 0	9.4	8.5	23.3	25.0	24.7	8.8	25.0
		Alt 1	3.5	3.5	3.5	3.5	3.5	3.5	3.5
		Alt 2	3.5	3.5	3.5	3.5	3.5	3.5	3.5
		Alt 3	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total Works Cost (000$/km)	Alt 0		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Alt 1		528.80	199.06	714.01	677.67	515.37	208.41	633.91
	Alt 2		528.80	512.73	714.01	677.67	515.37	502.97	633.91
	Alt 3		719.13	705.17	982.89	931.20	716.66	701.78	876.29
Maintenance Cost (000$/km)	Alt 0 (Essential)		12.66	8.31	14.17	19.12	19.12	9.76	23.73
	Alt 1 (Normal)		4.22	5.14	4.22	5.14	4.22	5.14	5.14
	Alt 2 (Normal)		4.22	4.22	4.22	5.14	4.22	4.22	5.14
	Alt 3 (Normal)		3.69	3.69	3.69	4.48	3.69	3.69	4.48

4.8.3 Contract Packaging

The objective of determining the number and type of contract packages is to deliver value-for-money, by the most cost-effective means. The contract packaging should therefore promote competition amongst contractors with sufficient technical capacity to comply with the technical specifications.

The proposed contract packaging is shown in **Figure 4.1**.

Figure 4.1 Proposed Contract Packaging

APPENDIX 4.3

MANATUTO-LACLUBAR-NATARBORA ROAD (A09)

Start station 0+000 = Start of Project at km65.2

Station	From	To	Speed (kph)	Calibrated Roughness	Ave Rgh Per km (a)
0+000	0+000	0+000	0.0	0.00	
0+100	0+000	0+100	20.3	9.65	
0+200	0+100	0+200	24.8	16.15	
0+300	0+200	0+300	23.8	12.27	
0+400	0+300	0+400	23.4	11.42	
0+500	0+400	0+500	17.5	17.97	
0+600	0+500	0+600	28.5	4.51	
0+700	0+600	0+700	32.6	6.54	
0+800	0+700	0+800	32.2	5.50	
0+900	0+800	0+900	33.1	3.74	
1+000	0+900	1+000	280.	8.42	**9.62**
1+100	1+000	1+100	28.5	3.78	
1+200	1+100	1+200	24.1	8.67	
1+300	1+200	1+300	25.1	5.00	
1+400	1+300	1+400	17.4	18.36	
1+500	1+400	1+500	32.2	6.49	
1+600	1+500	1+600	30.7	6.93	
1+700	1+600	1+700	26.4	11.08	
1+800	1+700	1+800	33.3	7.29	
1+900	1+800	1+900	33.1	6.30	
2+000	1+900	2+000	32.1	6.24	**8.01**
2+100	2+000	2+100	30.9	4.78	
2+200	2+100	2+200	24.3	9.00	
2+300	2+200	2+300	26.0	7.21	
2+400	2+300	2+400	29.1	6.56	
2+500	2+400	2+500	28.5	12.36	
2+600	2+500	2+600	31.0	5.37	
2+700	2+600	2+700	23.4	11.94	
2+800	2+700	2+800	20.3	14.25	
2+900	2+800	2+900	26.9	11.86	
3+000	2+900	3+000	32.4	5.50	**8.88**
3+100	3+000	3+100	28.8	8.24	
3+200	3+100	3+200	25.1	9.04	
3+300	3+200	3+300	24.9	12.42	
3+400	3+300	3+400	30.6	5.97	
3+500	3+400	3+500	31.8	4.18	
3+600	3+500	3+600	32.4	5.17	
3+700	3+600	3+700	29.9	4.85	
3+800	3+700	3+800	31.0	4.11	
3+900	3+800	3+900	34.1	4.45	
4+000	3+900	4+000	34.7	4.20	**6.26**
4+100	4+000	4+100	32.3	4.25	
4+200	4+100	4+200	32.7	4.06	
4+300	4+200	4+300	28.8	4.38	
4+400	4+300	4+400	27.5	7.11	
4+500	4+400	4+500	26.9	6.19	
4+600	4+500	4+600	31.0	6.39	
4+700	4+600	4+700	10.3	4.07	
4+800	4+700	4+800	26.2	4.48	

4+900	4+800	4+900	28.4	4.50	
5+000	4+900	5+000	30.6	4.81	**5.02**
5+100	5+000	5+100	31.8	5.27	
5+200	5+100	5+200	29.4	4.86	
5+300	5+200	5+300	33.1	4.85	
5+400	5+300	5+400	32.6	5.30	
5+500	5+400	5+500	31.7	5.01	
5+600	5+500	5+600	29.1	9.12	
5+700	5+600	5+700	24.1	12.98	
5+800	5+700	5+800	26.0	8.21	
5+900	5+800	5+900	22.6	16.09	
6+000	5+900	6+000	26.4	12.63	**8.43**
6+100	6+000	6+100	30.4	5.42	
6+200	6+100	6+200	32.4	4.51	
6+300	6+200	6+300	32.0	6.67	
6+400	6+300	6+400	34.2	5.59	
6+500	6+400	6+500	31.3	7.94	
6+600	6+500	6+600	32.2	6.03	
6+700	6+600	6+700	30.4	6.31	
6+800	6+700	6+800	25.9	14.58	
6+900	6+800	6+900	16.0	28.77	
7+000	6+900	7+000	28.9	4.38	**9.02**
7+100	7+000	7+100	27.1	4.57	
7+200	7+100	7+200	29.0	6.84	
7+300	7+200	7+300	17.4	17.22	
7+400	7+300	7+400	23.9	12.08	
7+500	7+400	7+500	25.2	7.57	
7+600	7+500	7+600	18.8	12.49	
7+700	7+600	7+700	22.2	6.35	
7+800	7+700	7+800	28.4	6.57	
7+900	7+800	7+900	29.7	6.21	
8+000	7+900	8+000	30.6	6.18	**8.61**
8+100	8+000	8+100	25.6	9.21	
8+200	8+100	8+200	21.5	10.68	
8+300	8+200	8+300	25.6	7.02	
8+400	8+300	8+400	28.8	6.98	
8+500	8+400	8+500	19.8	18.74	
8+600	8+500	8+600	20.3	7.53	
8+700	8+600	8+700	28.9	6.46	
8+800	8+700	8+800	32.5	5.08	
8+900	8+800	8+900	29.6	4.59	
9+000	8+900	9+000	26.2	5.74	**8.20**
9+100	9+000	9+100	23.4	8.63	
9+200	9+100	9+200	21.3	9.24	
9+300	9+200	9+300	25.3	6.53	
9+400	9+300	9+400	25.3	7.19	
9+500	9+400	9+500	26.2	7.21	
9+600	9+500	9+600	24.7	6.64	
9+700	9+600	9+700	14.4	46.99	
9+800	9+700	9+800	17.5	19.37	
9+900	9+800	9+900	24.5	8.48	
10+000	9+900	10+000	20.8	7.20	**12.75**
10+100	10+000	10+100	31.6	8.29	

10+200	10+100	10+200	29.0	6.30	
10+300	10+200	10+300	24.4	8.50	
10+400	10+300	10+400	30.1	7.21	
10+500	10+400	10+500	29.7	8.06	
10+600	10+500	10+600	25.8	11.07	
10+700	10+600	10+700	22.3	15.90	
10+800	10+700	10+800	22.0	11.70	
10+900	10+800	10+900	21.4	12.33	
11+000	10+900	11+000	30.6	8.90	**9.83**
11+100	11+000	11+100	23.0	9.08	
11+200	11+100	11+200	28.5	7.70	
11+300	11+200	11+300	26.3	7.45	
11+400	11+300	11+400	27.1	8.32	
11+500	11+400	11+500	19.0	10.43	
11+600	11+500	11+600	21.6	12.87	
11+700	11+600	11+700	17.2	22.07	
11+800	11+700	11+800	25.1	9.57	
11+900	11+800	11+900	27.8	6.80	
12+000	11+900	12+000	27.2	10.00	**10.43**
12+100	12+000	12+100	27.9	9.88	
12+200	12+100	12+200	27.0	8.17	
12+300	12+200	12+300	30.3	8.74	
12+400	12+300	12+400	31.4	7.96	
12+500	12+400	12+500	26.4	13.33	
12+600	12+500	12+600	23.4	14.60	
12+700	12+600	12+700	25.4	8.09	
12+800	12+700	12+800	27.2	9.15	
12+900	12+800	12+900	22.0	14.75	
13+000	12+900	13+000	13.3	19.94	**11.46**
13+100	13+000	13+100	16.1	27.67	
13+200	13+100	13+200	20.1	15.13	
13+300	13+200	13+300	19.9	21.78	
13+400	13+300	13+400	18.1	21.80	
13+500	13+400	13+500	15.9	38.92	
13+600	13+500	13+600	16.4	32.07	
13+700	13+600	13+700	26.6	13.66	
13+800	13+700	13+800	19.9	15.82	
13+900	13+800	13+900	21.2	13.31	
14+000	13+900	14+000	19.7	15.17	**21.53**
14+100	14+000	14+100	25.1	8.45	
14+200	14+100	14+200	21.8	13.74	
14+300	14+200	14+300	20.5	25.73	
14+400	14+300	14+400	23.4	12.81	
14+500	14+400	14+500	23.6	10.13	
14+600	14+500	14+600	18.9	23.86	
14+700	14+600	14+700	21.7	19.55	
14+800	14+700	14+800	22.0	14.57	
14+900	14+800	14+900	20.1	15.93	
15+000	14+900	15+000	21.8	17.33	**16.21**
15+100	15+000	15+100	19.2	12.93	
15+200	15+100	15+200	19.5	14.91	
15+300	15+200	15+300	21.5	20.32	
15+400	15+300	15+400	16.7	29.13	

15+500	15+400	15+500	21.7	16.42	
15+600	15+500	15+600	19.6	15.22	
15+700	15+600	15+700	18.4	17.38	
15+800	15+700	15+800	21.6	22.16	
15+900	15+800	15+900	15.3	42.51	
16+000	15+900	16+000	19.9	31.66	**22.26**
16+100	16+000	16+100	24.5	22.40	
16+200	16+100	16+200	22.9	20.45	
16+300	16+200	16+300	22.7	13.78	
16+400	16+300	16+400	30.0	8.97	
16+500	16+400	16+500	29.0	9.21	
16+600	16+500	16+600	25.5	10.27	
16+700	16+600	16+700	27.7	7.80	
16+800	16+700	16+800	24.8	6.90	
16+900	16+800	16+900	29.9	5.09	
17+000	16+900	17+000	15.8	6.77	**11.16**
17+100	17+000	17+100	29.1	6.81	
17+200	17+100	17+200	33.0	7.24	
17+300	17+200	17+300	30.4	7.84	
17+400	17+300	17+400	29.2	7.19	
17+500	17+400	17+500	28.0	6.04	
17+600	17+500	17+600	30.2	7.42	
17+700	17+600	17+700	30.5	6.75	
17+800	17+700	17+800	25.4	7.84	
17+900	17+800	17+900	29.5	6.88	
18+000	17+900	18+000	33.3	6.01	**7.00**
18+100	18+000	18+100	33.7	5.53	
18+200	18+100	18+200	34.5	8.38	
18+300	18+200	18+300	32.6	7.77	
18+400	18+300	18+400	32.9	6.78	
18+500	18+400	18+500	34.0	7.27	
18+600	18+500	18+600	33.7	6.88	
18+700	18+600	18+700	32.2	4.86	
18+800	18+700	18+800	31.7	5.23	
18+900	18+800	18+900	33.0	5.27	
19+000	18+900	19+000	31.4	6.26	**6.42**
19+100	19+000	19+100	33.1	6.76	
19+200	19+100	19+200	33.9	6.27	
19+300	19+200	19+300	32.1	7.38	
19+400	19+300	19+400	31.8	6.01	
19+500	19+400	19+500	28.1	6.39	
19+600	19+500	19+600	32.6	5.67	
19+700	19+600	19+700	32.1	5.87	
19+800	19+700	19+800	31.5	6.19	
19+900	19+800	19+900	30.3	7.32	
20+000	19+900	20+000	27.8	6.89	**6.48**
20+100	20+000	20+100	25.7	6.52	
20+200	20+100	20+200	28.9	5.81	
20+300	20+200	20+300	29.4	6.08	
20+400	20+300	20+400	30.0	10.96	
20+500	20+400	20+500	30.0	11.90	
20+600	20+500	20+600	30.0	10.77	
20+700	20+600	20+700	30.6	12.68	

20+800	20+700	20+800	31.0	11.62	
20+900	20+800	20+900	30.9	8.13	
21+000	20+900	21+000	32.4	8.64	**9.31**
21+100	21+000	21+100	26.6	16.72	
21+200	21+100	21+200	21.5	26.76	
21+300	21+200	21+300	26.3	16.30	
21+400	21+300	21+400	27.0	19.26	
21+500	21+400	21+500	30.8	14.64	
21+600	21+500	21+600	30.4	11.61	
21+700	21+600	21+700	27.1	11.51	
21+800	21+700	21+800	25.8	9.55	
21+900	21+800	21+900	28.1	11.41	
22+000	21+900	22+000	24.3	12.77	**15.05**
22+100	22+000	22+100	27.3	9.09	
22+200	22+100	22+200	26.1	8.86	
22+300	22+200	22+300	29.1	9.41	
22+400	22+300	22+400	30.0	14.17	
22+500	22+400	22+500	24.8	23.36	
22+600	22+500	22+600	26.0	20.10	
22+700	22+600	22+700	24.8	18.64	
22+800	22+700	22+800	29.6	17.95	
22+900	22+800	22+900	31.8	19.37	
23+000	22+900	23+000	29.0	18.39	**15.93**
23+100	23+000	23+100	19.9	22.50	
23+200	23+100	23+200	23.1	25.38	
23+300	23+200	23+300	25.2	21.28	
23+400	23+300	23+400	24.3	22.37	
23+500	23+400	23+500	21.5	18.98	
23+600	23+500	23+600	10.9	20.46	
23+700	23+600	23+700	23.2	20.02	
23+800	23+700	23+800	24.8	24.13	
23+900	23+800	23+900	24.7	21.02	
24+000	23+900	24+000	23.4	22.00	**21.81**
24+100	24+000	24+100	21.9	25.41	
24+200	24+100	24+200	22.4	21.06	
24+300	24+200	24+300	23.8	20.59	
24+400	24+300	24+400	25.2	21.92	
24+500	24+400	24+500	20.8	31.55	
24+600	24+500	24+600	21.5	29.00	
24+700	24+600	24+700	23.5	18.42	
24+800	24+700	24+800	27.2	18.76	
24+900	24+800	24+900	26.9	22.48	
25+000	24+900	25+000	29.0	22.49	**23.17**
25+100	25+000	25+100	22.6	25.90	
25+200	25+100	25+200	25.5	27.41	
25+300	25+200	25+300	29.1	18.22	
25+400	25+300	25+400	25.4	25.90	
25+500	25+400	25+500	23.2	25.53	
25+600	25+500	25+600	29.3	17.72	
25+700	25+600	25+700	21.5	30.50	
25+800	25+700	25+800	18.6	46.93	
25+900	25+800	25+900	22.1	25.86	
26+000	25+900	26+000	35.6	5.15	**24.91**

26+100	26+000	26+100	32.0	8.87	
26+200	26+100	26+200	20.8	20.77	
26+300	26+200	26+300	21.2	21.96	
26+400	26+300	26+400	19.0	30.89	
26+500	26+400	26+500	19.1	26.15	
26+600	26+500	26+600	20.2	19.34	
26+700	26+600	26+700	18.8	21.60	
26+800	26+700	26+800	20.1	10.95	
26+900	26+800	26+900	17.8	29.75	
27+000	26+900	27+000	20.7	26.53	**21.68**
27+100	27+000	27+100	16.1	22.88	
27+200	27+100	27+200	18.0	29.32	
27+300	27+200	27+300	18.2	20.60	
27+400	27+300	27+400	10.5	26.73	
27+510	27+400	27+510	8.7	23.99	
27+600	0+000	0+090	8.7	36.84	
27+700	0+090	0+190	13.4	43.95	
27+800	0+190	0+290	18.6	23.59	
27+920	0+290	0+410	-522.3	12.79	
28+000		0+000	-522.3	0.90	**24.16**

MANATUTO-LACLUBAR-NATARBORA ROAD (A09)

Start Sta 0+000 = sta 28+000

Station	FROM	TO	SPEED (kph)	Calibrated Roughness	Ave Rgh per km (a)
0+000	0+000	0+000	0.0	0.00	
0+100	0+000	0+100	11.6	27.38	
0+200	0+100	0+200	14.6	41.01	
0+300	0+200	0+300	18.6	29.35	
0+400	0+300	0+400	25.9	15.24	
0+500	0+400	0+500	22.0	24.57	
0+600	0+500	0+600	22.2	31.70	
0+700	0+600	0+700	21.9	25.62	
0+800	0+700	0+800	16.4	19.17	
0+900	0+800	0+900	23.3	8.80	
1+000	0+900	1+000	13.6	37.39	26.02
1+100	1+000	1+100	13.6	44.82	
1+200	1+100	1+200	18.5	27.20	
1+300	1+200	1+300	20.5	30.85	
1+400	1+300	1+400	19.7	26.46	
1+500	1+400	1+500	19.0	26.69	
1+600	1+500	1+600	17.0	43.42	
1+700	1+600	1+700	16.1	49.19	
1+800	1+700	1+800	15.6	42.54	
1+900	1+800	1+900	18.3	42.94	
2+000	1+900	2+000	17.1	50.03	38.41
2+100	2+000	2+100	20.0	39.42	
2+200	2+100	2+200	19.8	39.25	
2+300	2+200	2+300	19.5	33.77	
2+400	2+300	2+400	15.2	55.76	
2+500	2+400	2+500	14.4	42.87	

2+600	2+500	2+600	14.7	35.99	
2+700	2+600	2+700	20.0	39.54	
2+800	2+700	2+800	18.5	49.75	
2+900	2+800	2+900	22.1	28.87	
3+000	2+900	3+000	22.1	28.00	39.32
3+100	3+000	3+100	17.4	54.19	
3+200	3+100	3+200	13.5	55.22	
3+300	3+200	3+300	14.1	33.69	
3+400	3+300	3+400	19.9	38.75	
3+500	3+400	3+500	19.0	42.95	
3+600	3+500	3+600	21.5	32.34	
3+700	3+600	3+700	19.3	39.50	
3+800	3+700	3+800	15.7	34.97	
3+900	3+800	3+900	20.8	39.24	
4+000	3+900	4+000	15.9	38.22	40.91
4+100	4+000	4+100	17.3	41.12	
4+200	4+100	4+200	19.4	38.10	
4+300	4+200	4+300	16.9	53.46	
4+400	4+300	4+400	12.5	62.21	
4+500	4+400	4+500	13.2	46.56	
4+600	4+500	4+600	19.1	18.84	
4+700	4+600	4+700	11.7	54.00	
4+800	4+700	4+800	11.8	52.56	
4+900	4+800	4+900	18.3	32.97	
5+000	4+900	5+000	15.1	30.56	43.04
5+100	5+000	5+100	14.7	25.14	
5+200	5+100	5+200	11.6	34.04	
5+300	5+200	5+300	14.8	31.80	
5+400	5+300	5+400	13.0	27.95	
5+500	5+400	5+500	15.6	7.93	
5+600	5+500	5+600	12.7	24.51	
5+700	5+600	5+700	17.2	34.53	
5+800	5+700	5+800	13.2	31.30	
5+900	5+800	5+900	11.9	32.25	
6+000	5+900	6+000	13.3	26.99	27.64
6+100	6+000	6+100	16.9	15.94	
6+200	6+100	6+200	16.5	37.91	
6+300	6+200	6+300	16.3	49.32	
6+400	6+300	6+400	20.2	36.01	
6+500	6+400	6+500	9.3	31.49	
6+600	6+500	6+600	11.7	95.45	
6+700	6+600	6+700	12.5	101.40	
6+800	6+700	6+800	12.1	70.35	
6+900	6+800	6+900	13.3	69.05	
7+000	6+900	7+000	17.1	28.44	53.54
7+100	7+000	7+100	24.9	23.22	
7+200	7+100	7+200	20.9	22.84	
7+300	7+200	7+300	16.0	48.44	
7+400	7+300	7+400	19.6	54.77	
7+500	7+400	7+500	19.9	61.50	
7+600	7+500	7+600	17.0	59.05	
7+700	7+600	7+700	15.9	73.20	
7+800	7+700	7+800	23.6	25.78	

7+900	7+800	7+900	19.6	26.99	
8+000	7+900	8+000	14.9	28.22	42.40
8+100	8+000	8+100	10.2	34.92	
8+200	8+100	8+200	16.2	43.61	
8+300	8+200	8+300	18.3	31.47	
8+400	8+300	8+400	12.5	43.45	
8+500	8+400	8+500	14.9	44.56	
8+600	8+500	8+600	21.3	33.31	
8+700	8+600	8+700	18.1	44.06	
8+800	8+700	8+800	25.8	24.51	
8+900	8+800	8+900	22.7	26.18	
9+000	8+900	9+000	18.7	29.55	35.56
9+100	9+000	9+100	17.5	28.90	
9+200	9+100	9+200	17.2	25.64	
9+300	9+200	9+300	11.5	31.22	
9+400	9+300	9+400	19.0	24.59	
9+500	9+400	9+500	23.1	30.47	
9+600	9+500	9+600	22.5	27.62	
9+700	9+600	9+700	20.9	31.73	
9+800	9+700	9+800	15.8	40.53	
9+900	9+800	9+900	18.9	31.60	
10+000	9+900	10+000	12.9	28.45	30.08
10+100	10+000	10+100	12.5	25.62	
10+200	10+100	10+200	14.0	36.20	
10+300	10+200	10+300	17.7	33.37	
10+400	10+300	10+400	19.3	27.02	
10+500	10+400	10+500	16.8	30.53	
10+600	10+500	10+600	18.9	35.52	
10+700	10+600	10+700	22.1	29.44	
10+800	10+700	10+800	10.0	28.77	
10+900	10+800	10+900	15.5	31.14	
11+000	10+900	11+000	16.3	37.87	31.55
11+100	11+000	11+100	21.7	25.12	
11+200	11+100	11+200	17.6	26.11	
11+300	11+200	11+300	15.2	29.11	
11+400	11+300	11+400	19.8	27.98	
11+500	11+400	11+500	11.9	23.00	
11+600	11+500	11+600	13.7	29.10	
11+700	11+600	11+700	10.9	35.83	
11+800	11+700	11+800	19.7	34.66	
11+900	11+800	11+900	17.1	34.86	
12+000	11+900	12+000	14.9	35.45	30.12
12+100	12+000	12+100	14.8	40.31	
12+200	12+100	12+200	19.4	36.57	
12+300	12+200	12+300	10.5	16.61	
12+400	12+300	12+400	17.3	46.61	
12+500	12+400	12+500	17.8	20.91	
12+600	12+500	12+600	23.8	24.03	
12+700	12+600	12+700	24.7	25.25	
12+800	12+700	12+800	23.0	27.68	
12+900	12+800	12+900	14.6	23.50	
13+000	12+900	13+000	16.5	23.21	28.47
13+100	13+000	13+100	16.5	30.43	

13+200	13+100	13+200	27.7	22.05	
13+300	13+200	13+300	23.3	29.66	
13+400	13+300	13+400	21.2	28.62	
13+500	13+400	13+500	25.3	26.48	
13+600	13+500	13+600	18.4	31.94	
13+700	13+600	13+700	16.3	35.98	
13+800	13+700	13+800	23.2	13.43	
13+900	13+800	13+900	21.9	20.79	
14+000	13+900	14+000	18.2	29.13	26.85
14+100	14+000	14+100	10.2	27.26	
14+200	14+100	14+200	11.2	25.31	
14+300	14+200	14+300	21.5	26.65	
14+400	14+300	14+400	14.1	28.00	
14+500	14+400	14+500	13.8	22.44	
14+600	14+500	14+600	20.5	22.63	
14+700	14+600	14+700	22.6	19.73	
14+800	14+700	14+800	14.7	23.51	
14+900	14+800	14+900	22.3	25.46	
15+000	14+900	15+000	23.6	26.65	24.76
15+100	15+000	15+100	27.8	22.47	
15+200	15+100	15+200	23.9	25.51	
15+300	15+200	15+300	22.9	31.02	
15+400	15+300	15+400	27.5	22.54	
15+500	15+400	15+500	22.2	25.13	
15+600	15+500	15+600	21.2	26.35	
15+700	15+600	15+700	23.9	21.65	
15+800	15+700	15+800	22.5	28.56	
15+900	15+800	15+900	22.6	30.79	
16+000	15+900	16+000	24.9	25.12	25.91
16+100	16+000	16+100	17.3	38.07	
16+200	16+100	16+200	18.3	33.05	
16+300	16+200	16+300	14.1	70.55	
16+400	16+300	16+400	16.0	66.28	
16+500	16+400	16+500	14.2	46.15	
16+600	16+500	16+600	12.0	41.53	
16+700	16+600	16+700	13.3	29.33	
16+800	16+700	16+800	16.4	47.19	
16+900	16+800	16+900	14.0	42.79	
17+000	16+900	17+000	10.8	29.23	44.42
17+100	17+000	17+100	17.4	33.15	
17+200	17+100	17+200	21.2	23.52	
17+300	17+200	17+300	23.8	21.53	
17+400	17+300	17+400	16.1	16.45	
17+500	17+400	17+500	19.9	28.28	
17+600	17+500	17+600	15.7	42.77	
17+700	17+600	17+700	12.8	26.41	
17+800	17+700	17+800	15.7	26.46	
17+900	17+800	17+900	24.3	21.89	
18+000	17+900	18+000	17.6	36.82	27.73
18+100	18+000	18+100	23.4	22.34	
18+200	18+100	18+200	24.8	21.98	
18+300	18+200	18+300	18.5	28.92	
18+400	18+300	18+400	17.7	30.22	

18+500	18+400	18+500	9.8	7.70	
18+600	18+500	18+600	18.0	17.69	
18+700	18+600	18+700	23.7	16.35	
18+800	18+700	18+800	16.8	36.69	
18+900	18+800	18+900	21.0	32.18	
19+000	18+900	19+000	20.8	37.65	25.17
19+100	19+000	19+100	21.3	33.62	
19+200	19+100	19+200	15.7	22.90	
19+300	19+200	19+300	24.3	25.44	
19+400	19+300	19+400	15.3	32.88	
19+500	19+400	19+500	13.5	42.08	
19+600	19+500	19+600	15.9	28.97	
19+700	19+600	19+700	19.2	25.55	
19+800	19+700	19+800	16.0	32.09	
19+900	19+800	19+900	20.8	25.27	
20+000	19+900	20+000	16.7	43.70	31.25
20+100	20+000	20+100	14.7	57.33	
20+200	20+100	20+200	20.8	21.96	
20+300	20+200	20+300	18.3	36.18	
20+400	20+300	20+400	21.9	29.65	
20+500	20+400	20+500	20.6	38.90	
20+600	20+500	20+600	14.4	36.97	
20+700	20+600	20+700	14.4	45.82	
20+800	20+700	20+800	14.8	32.56	
20+900	20+800	20+900	17.2	47.12	
21+000	20+900	21+000	19.7	37.87	38.44
21+100	21+000	21+100	23.2	32.68	
21+200	21+100	21+200	19.1	37.42	
21+300	21+200	21+300	16.4	35.14	
21+400	21+300	21+400	20.7	32.28	
21+500	21+400	21+500	18.6	38.31	
21+600	21+500	21+600	17.8	34.37	
21+700	21+600	21+700	19.0	24.56	
21+800	21+700	21+800	12.0	27.64	
21+900	21+800	21+900	12.1	60.58	
22+000	21+900	22+000	16.9	34.97	35.80
22+100	22+000	22+100	23.7	31.84	
22+200	22+100	22+200	13.2	60.20	
22+300	22+200	22+300	15.1	52.15	
22+400	22+300	22+400	14.9	56.68	
22+500	22+400	22+500	14.8	53.15	
22+600	22+500	22+600	17.8	38.51	
22+700	22+600	22+700	20.5	43.33	
22+800	22+700	22+800	14.0	43.13	
22+900	22+800	22+900	13.8	66.17	
23+000	22+900	23+000	22.3	37.01	48.22
23+100	23+000	23+100	20.7	39.84	
23+200	23+100	23+200	22.1	32.11	
23+300	23+200	23+300	16.9	48.88	
23+400	23+300	23+400	22.3	40.06	
23+500	23+400	23+500	25.0	43.10	
23+600	23+500	23+600	17.6	28.36	
23+700	23+600	23+700	15.1	62.57	

23+800	23+700	23+800	24.3	23.76	
23+900	23+800	23+900	24.9	43.11	
24+000	23+900	24+000	26.0	38.06	39.99
24+100	24+000	24+100	23.7	42.56	
24+200	24+100	24+200	13.7	60.62	
24+300	24+200	24+300	21.2	44.11	
24+400	24+300	24+400	27.6	32.49	
24+500	24+400	24+500	18.9	60.80	
24+600	24+500	24+600	22.3	47.97	
24+700	24+600	24+700	23.4	39.55	
24+800	24+700	24+800	21.0	42.69	
24+900	24+800	24+900	26.1	24.40	
25+000	24+900	25+000	30.0	19.42	41.46
25+100	25+000	25+100	29.1	25.77	
25+200	25+100	25+200	30.1	24.58	
25+300	25+200	25+300	15.0	66.50	
25+400	25+300	25+400	19.8	43.58	
25+500	25+400	25+500	20.2	51.68	
25+600	25+500	25+600	22.9	45.82	
25+700	25+600	25+700	24.9	42.02	
25+800	25+700	25+800	27.3	36.31	
25+900	25+800	25+900	24.4	50.72	
26+000	25+900	26+000	29.7	25.48	41.25
26+100	26+000	26+100	19.3	49.69	
26+200	26+100	26+200	21.2	47.12	
26+300	26+200	26+300	22.6	35.17	
26+400	26+300	26+400	32.8	18.58	
26+500	26+400	26+500	28.8	26.83	
26+600	26+500	26+600	27.9	25.72	
26+700	26+600	26+700	17.2	35.40	
26+800	26+700	26+800	23.6	40.87	
26+900	26+800	26+900	21.5	31.11	
27+000	26+900	27+000	25.4	25.98	33.65
27+100	27+000	27+100	20.2	35.80	
27+200	27+100	27+200	16.3	41.32	
27+300	27+200	27+300	17.0	57.29	
27+400	27+300	27+400	23.0	36.60	
27+500	27+400	27+500	24.0	38.92	
27+600	27+500	27+600	25.6	30.33	
27+700	27+600	27+700	19.3	24.08	
27+800	27+700	27+800	17.5	39.90	
27+900	27+800	27+900	14.9	47.51	
28+000	27+900	28+000	22.5	28.24	38.00
28+100	28+000	28+100	23.9	24.85	
28+200	28+100	28+200	26.7	18.49	
28+300	28+200	28+300	28.2	17.27	
28+400	28+300	28+400	19.9	25.77	
28+500	28+400	28+500	18.1	27.7	
28+600	28+500	28+600	20.8	32.11	
28+700	28+600	28+700	21.1	22.65	
28+800	28+700	28+800	19.6	18.95	
28+900	28+800	28+900	23.8	24.91	
29+000	28+900	29+000	20.5	34.64	24.73

29+100	29+000	29+100	23.9	20.71	
29+200	29+100	29+200	21.5	29.93	
29+300	29+200	29+300	26.6	13.81	
29+400	29+300	29+400	26.9	15.32	
29+500	29+400	29+500	28.6	11.36	
29+600	29+500	29+600	19.9	20.48	
29+700	29+600	29+700	16.1	25.88	
29+800	29+700	29+800	23.1	14.15	
29+900	29+800	29+900	18.5	22.87	
30+000	29+900	30+000	33.0	13.43	18.79
30+100	30+000	30+100	32.0	15.15	
30+200	30+100	30+200	18.1	18.26	
30+300	30+200	30+300	26.5	16.24	
30+400	30+300	30+400	33.8	11.86	
30+500	30+400	30+500	23.1	24.60	
30+600	30+500	30+600	31.1	16.32	
30+700	30+600	30+700	21.4	36.48	
30+800	30+700	30+800	20.5	31.58	
30+900	30+800	30+900	26.5	16.27	
31+000	30+900	31+000	24.4	29.33	21.61
31+100	31+000	31+100	26.2	27.51	
31+200	31+100	31+200	27.4	19.68	
31+300	31+200	31+300	28.9	13.21	
31+400	31+300	31+400	27.4	21.10	
31+500	31+400	31+500	24.8	21.63	
31+600	31+500	31+600	23.0	24.74	
31+700	31+600	31+700	19.6	32.42	
31+800	31+700	31+800	20.6	19.62	
31+900	31+800	31+900	23.3	28.84	
32+000	31+900	32+000	21.6	45.92	25.47
32+100	32+000	32+100	26.3	32.38	
32+200	32+100	32+200	24.3	37.06	
32+300	32+200	32+300	23.9	24.46	
32+400	32+300	32+400	27.5	20.94	
32+500	32+400	32+500	28.6	15.40	
32+600	32+500	32+600	17.3	23.24	
32+700	32+600	32+700	24.4	17.52	
32+800	32+700	32+800	24.6	20.74	
32+900	32+800	32+900	30.8	13.15	
33+000	32+900	33+000	33.1	16.90	22.18
33+100	33+000	33+100	24.3	20.37	
33+200	33+100	33+200	26.0	18.04	
33+300	33+200	33+300	30.1	14.74	
33+400	33+300	33+400	31.4	13.34	
33+500	33+400	33+500	24.8	18.11	
33+600	33+500	33+600	29.3	18.25	
33+700	33+600	33+700	14.0	13.89	
33+800	33+700	33+800	16.8	30.58	
33+900	33+800	33+900	21.3	23.85	
34+000	33+900	34+000	30.1	18.04	18.92
34+100	34+000	34+100	27.9	24.96	
34+200	34+100	34+200	28.6	16.48	
34+300	34+200	34+300	29.0	25.60	

34+400	34+300	34+400	22.3	33.18	
34+500	34+400	34+500	22.2	26.98	
34+600	34+500	34+600	18.3	27.41	
34+700	34+600	34+700	21.9	20.87	
34+800	34+700	34+800	22.6	25.54	
34+900	34+800	34+900	18.8	35.32	
35+000	34+900	35+000	23.5	38.77	27.51
35+100	35+000	35+100	20.4	35.33	
35+200	35+100	35+200	27.2	28.40	
35+300	35+200	35+300	23.5	28.72	
35+400	35+300	35+400	20.8	25.63	
35+500	35+400	35+500	22.5	22.93	
35+600	35+500	35+600	25.2	22.99	
35+700	35+600	35+700	22.5	23.29	
35+800	35+700	35+800	19.0	35.96	
35+900	35+800	35+900	17.2	33.75	
36+000	35+900	36+000	23.3	22.78	27.98
36+100	36+000	36+100	23.6	26.90	
36+200	36+100	36+200	15.3	30.94	
36+300	36+200	36+300	13.4	35.33	
36+400	36+300	36+400	23.3	30.74	
36+500	36+400	36+500	23.3	24.50	
36+600	36+500	36+600	25.1	27.68	
36+700	36+600	36+700	24.0	22.73	
36+800	36+700	36+800	22.0	24.09	
36+900	36+800	36+900	30.0	19.74	
37+000	36+900	37+000	27.6	18.81	26.15
37+100	37+000	37+100	24.0	27.17	
37+200	37+100	37+200	31.0	11.89	
37+300	37+200	37+300	29.8	16.69	
37+400	37+300	37+400	27.2	17.93	
37+500	37+400	37+500	24.3	22.26	
37+600	37+500	37+600	13.0	29.48	
37+700	37+600	37+700	11.4	24.29	
37+800	37+700	37+800	17.4	29.20	
37+900	37+800	37+900	20.6	27.79	
38+000	37+900	38+000	20.9	30.75	23.75
38+100	38+000	38+100	21.4	29.54	
38+200	38+100	38+200	22.4	19.60	
38+300	38+200	38+300	22.7	24.23	
38+400	38+300	38+400	19.9	12.23	
38+500	38+400	38+500	22.9	23.71	
38+600	38+500	38+600	23.5	24.37	
38+700	38+600	38+700	17.7	24.52	
38+800	38+700	38+800	17.3	39.38	
38+900	38+800	38+900	21.3	28.03	
39+000	38+900	39+000	21.4	20.03	24.56
39+100	39+000	39+100	17.7	33.70	
39+200	39+100	39+200	21.1	32.54	
39+300	39+200	39+300	18.1	30.42	
39+400	39+300	39+400	19.0	34.78	
39+500	39+400	39+500	22.4	26.92	
39+600	39+500	39+600	21.2	38.62	

39+700	39+600	39+700	20.7	36.28	
39+800	39+700	39+800	23.3	32.33	
39+900	39+800	39+900	23.5	31.68	
40+000	39+900	40+000	22.1	30.46	32.77
40+100	40+000	40+100	16.7	47.74	
40+200	40+100	40+200	20.0	31.44	
40+300	40+200	40+300	23.6	32.16	
40+400	40+300	40+400	25.5	27.39	
40+500	40+400	40+500	25.9	26.39	
40+600	40+500	40+600	30.1	23.90	
40+700	40+600	40+700	24.5	31.09	
40+800	40+700	40+800	24.9	31.70	
40+900	40+800	40+900	24.2	27.93	
41+000	40+900	41+000	18.6	37.36	31.71
41+100	41+000	41+100	20.0	47.26	
41+200	41+100	41+200	21.2	40.41	
41+300	41+200	41+300	17.4	56.14	
41+400	41+300	41+400	19.0	53.22	
41+500	41+400	41+500	21.5	38.87	
41+600	41+500	41+600	16.3	55.98	
41+700	41+600	41+700	20.0	41.65	
41+800	41+700	41+800	17.8	48.32	
41+900	41+800	41+900	17.4	54.57	
42+000	41+900	42+000	21.4	33.17	46.96
42+100	42+000	42+100	23.0	31.50	
42+200	42+100	42+200	30.9	25.42	
42+300	42+200	42+300	28.5	23.86	
42+400	42+300	42+400	30.4	28.84	
42+500	42+400	42+500	29.1	28.98	
42+600	42+500	42+600	31.4	26.39	
42+700	42+600	42+700	24.7	21.27	
42+800	42+700	42+800	13.1	26.68	
42+900	42+800	42+900	22.6	25.59	
43+000	42+900	43+000	21.3	30.31	26.88
43+100	43+000	43+100	20.5	39.62	
43+200	43+100	43+200	24.8	30.84	
43+300	43+200	43+300	31.0	20.99	
43+400	43+300	43+400	26.9	21.27	
43+500	43+400	43+500	27.7	24.17	
43+600	43+500	43+600	25.4	23.30	
43+700	43+600	43+700	28.1	14.61	
43+800	43+700	43+800	31.7	13.38	
43+900	43+800	43+900	35.3	17.33	
44+000	43+900	44+000	25.1	21.91	22.74
44+100	44+000	44+100	19.8	28.12	
44+200	44+100	44+200	26.5	21.49	
44+300	44+200	44+300	24.0	26.47	
44+400	44+300	44+400	22.1	34.00	
44+500	44+400	44+500	22.2	31.77	
44+600	44+500	44+600	29.3	26.99	
44+700	44+600	44+700	23.5	30.76	
44+800	44+700	44+800	20.3	45.17	
44+900	44+800	44+900	18.3	61.97	

45+000	44+900	45+000	21.7	36.51	34.33
45+100	45+000	45+100	19.2	33.70	
45+200	45+100	45+200	21.2	38.06	
45+300	45+200	45+300	27.3	29.09	
45+400	45+300	45+400	20.5	35.11	
45+500	45+400	45+500	22.6	33.70	
45+600	45+500	45+600	24.1	30.93	
45+700	45+600	45+700	20.7	29.72	
45+800	45+700	45+800	24.9	29.03	
45+900	45+800	45+900	24.8	27.06	
46+000	45+900	46+000	32.4	20.82	30.72
46+100	46+000	46+100	24.8	27.66	
46+200	46+100	46+200	28.6	15.75	
46+300	46+200	46+300	21.4	36.06	
46+400	46+300	46+400	22.7	20.54	
46+500	46+400	46+500	22.6	18.90	
46+600	46+500	46+600	20.5	29.77	
46+700	46+600	46+700	19.2	35.62	
46+800	46+700	46+800	21.2	24.04	
46+900	46+800	46+900	23.6	27.58	
47+000	46+900	47+000	21.0	24.77	26.07
47+100	47+000	47+100	31.1	20.26	
47+200	47+100	47+200	32.2	21.08	
47+300	47+200	47+300	31.6	21.70	
47+400	47+300	47+400	33.1	20.73	
47+500	47+400	47+500	30.8	14.46	
47+600	47+500	47+600	32.1	11.24	
47+700	47+600	47+700	30.9	11.06	
47+800	47+700	47+800	35.8	12.08	
47+900	47+800	47+900	28.9	23.83	
48+000	47+900	48+000	19.5	27.06	18.35
48+100	48+000	48+100	24.1	31.65	
48+200	48+100	48+200	24.5	40.22	
48+300	48+200	48+300	26.1	21.99	
48+400	48+300	48+400	24.6	25.23	
48+500	48+400	48+500	23.2	30.34	
48+600	48+500	48+600	21.1	34.93	
48+700	48+600	48+700	23.9	32.94	
48+800	48+700	48+800	28.1	15.48	
48+900	48+800	48+900	31.7	14.09	
49+000	48+900	49+000	35.6	11.50	25.84
49+100	49+000	49+100	35.6	12.20	
49+200	49+100	49+200	35.6	11.33	
49+300	49+200	49+300	38.9	9.77	
49+400	49+300	49+400	40.1	9.39	
49+500	49+400	49+500	40.0	12.12	
49+600	49+500	49+600	39.6	10.12	
49+700	49+600	49+700	37.6	10.92	
49+800	49+700	49+800	36.3	12.21	
49+900	49+800	49+900	36.3	14.03	
50+000	49+900	50+000	35.9	10.84	11.29
50+100	50+000	50+100	37.6	9.81	
50+200	50+100	50+200	39.2	11.62	

50+300	50+200	50+300	37.2	8.62	
50+400	50+300	50+400	28.5	17.39	
50+500	50+400	50+500	27.8	13.92	
50+600	50+500	50+600	36.9	10.02	
50+700	50+600	50+700	36.1	9.79	
50+800	50+700	50+800	34.2	9.63	
50+900	50+800	50+900	31.7	10.98	
51+000	50+900	51+000	22.2	11.95	11.37
51+100	51+000	51+100	32.2	11.30	
51+200	51+100	51+200	36.4	10.36	
51+300	51+200	51+300	34.4	12.60	
51+400	51+300	51+400	30.8	13.52	
51+500	51+400	51+500	35.1	10.44	
51+600	51+500	51+600	38.5	10.39	
51+700	51+600	51+700	42.2	10.44	
51+800	51+700	51+800	37.6	10.63	
51+900	51+800	51+900	35.7	10.43	
52+000	51+900	52+000	33.9	12.25	11.24
52+100	52+000	52+100	31.1	10.89	
52+200	52+100	52+200	35.4	10.33	
52+300	52+200	52+300	32.8	11.89	
52+400	52+300	52+400	30.2	9.18	
52+500	52+400	52+500	26.6	11.05	
52+600	52+500	52+600	31.6	9.58	
52+700	52+600	52+700	28.7	10.09	
52+800	52+700	52+800	18.7	16.11	
52+900	52+800	52+900	20.2	16.88	
53+000	52+900	53+000	18.2	12.02	
53+073	53+000	53+073	11.4	15.31	12.12

LACLUBAR JUNCTION- LACLUBAR ROAD (C15)

Station	From	To	Speed (kph)	Calibrated Roughness	Ave Rgh Per km (a)
0+000	0+000	0+000	0	0	
0+100	0+000	0+100	13.3	32.34	
0+200	0+100	0+200	15.8	39.37	
0+300	0+200	0+300	16.8	31.48	
0+400	0+300	0+400	16.1	39.67	
0+500	0+400	0+500	17.2	40.76	
0+600	0+500	0+600	16.5	42.7	
0+700	0+600	0+700	14	35.06	
0+800	0+700	0+800	18.1	34.91	
0+900	0+800	0+900	20.6	47.3	
1+000	0+900	1+000	22.3	47.25	39.08
1+100	1+000	1+100	21.8	39.12	
1+200	1+100	1+200	18.3	39.46	
1+300	1+200	1+300	28.7	20.26	
1+400	1+300	1+400	27.7	34.53	
1+500	1+400	1+500	32.9	18.09	
1+600	1+500	1+600	23.8	24.87	
1+700	1+600	1+700	20.1	33.99	

1+800	1+700	1+800	17.3	27.64	
1+900	1+800	1+900	19	36.65	
2+000	1+900	2+000	24	26.71	30.13
2+100	2+000	2+100	25.3	31.12	
2+200	2+100	2+200	21.9	35.46	
2+300	2+200	2+300	28.6	26.82	
2+400	2+300	2+400	25.9	23.9	
2+500	2+400	2+500	22.6	35.28	
2+600	2+500	2+600	17.9	36.5	
2+700	2+600	2+700	21.3	34.24	
2+800	2+700	2+800	19.6	35.96	
2+900	2+800	2+900	19.9	44.16	
3+000	2+900	3+000	22.2	34.35	33.78
3+100	3+000	3+100	22.6	31.47	
3+200	3+100	3+200	24.2	41.52	
3+300	3+200	3+300	21.6	45.04	
3+400	3+300	3+400	25.8	23.57	
3+500	3+400	3+500	22.1	31.24	
3+600	3+500	3+600	20.9	34.29	
3+700	3+600	3+700	20.6	37.14	
3+800	3+700	3+800	19.4	43.81	
3+900	3+800	3+900	21.4	41	
4+000	3+900	4+000	20.9	36.19	36.53
4+100	4+000	4+100	21.8	33.79	
4+200	4+100	4+200	19.6	39.31	
4+300	4+200	4+300	20.4	42.27	
4+400	4+300	4+400	23	39.08	
4+500	4+400	4+500	14.8	38.53	
4+600	4+500	4+600	14.7	62.21	
4+700	4+600	4+700	19.8	51.39	
4+800	4+700	4+800	19	56.12	
4+900	4+800	4+900	19.8	41.07	
5+000	4+900	5+000	12.4	58.57	46.23
5+100	5+000	5+100	15.7	49.07	
5+200	5+100	5+200	23.1	33.54	
5+300	5+200	5+300	19.5	38.94	
5+400	5+300	5+400	30.5	20.57	
5+500	5+400	5+500	23.8	35.05	
5+600	5+500	5+600	24.8	33.48	
5+700	5+600	5+700	21.4	42.59	
5+800	5+700	5+800	26.2	26.26	
5+900	5+800	5+900	17.9	37.03	
6+000	5+900	6+000	21	37.69	35.42
6+100	6+000	6+100	17.5	29.77	
6+200	6+100	6+200	16.6	41.69	
6+300	6+200	6+300	16.6	37.03	
6+400	6+300	6+400	20.6	27.99	
6+500	6+400	6+500	20.4	30.81	
6+600	6+500	6+600	21.3	33.73	
6+700	6+600	6+700	26.9	25.79	
6+800	6+700	6+800	19.4	27.82	
6+900	6+800	6+900	21.8	34.8	
7+000	6+900	7+000	23.2	29.27	31.87

7+100	7+000	7+100	14.7	39.47	
7+200	7+100	7+200	14.6	37.97	
7+300	7+200	7+300	16.2	46.87	
7+400	7+300	7+400	21.5	35.8	
7+500	7+400	7+500	21.6	30.89	
7+600	7+500	7+600	24.5	29.86	
7+700	7+600	7+700	28	26.59	
7+800	7+700	7+800	22	35.22	
7+900	7+800	7+900	20.5	43.38	
8+000	7+900	8+000	17.1	43.83	36.99
8+100	8+000	8+100	19.5	34.85	
8+200	8+100	8+200	23	29	
8+300	8+200	8+300	22.8	37	
8+400	8+300	8+400	24.5	39.61	
8+500	8+400	8+500	21.1	36.95	
8+600	8+500	8+600	25.2	46.84	
8+700	8+600	8+700	20.1	59.71	
8+800	8+700	8+800	30.8	31.37	
8+900	8+800	8+900	32.5	26.33	
9+000	8+900	9+000	16	33.83	37.55
9+100	9+000	9+100	21.9	44.67	
9+200	9+100	9+200	27	18.69	
9+300	9+200	9+300	16.9	35.94	
9+400	9+300	9+400	20.3	34.75	
9+500	9+400	9+500	24.9	40.36	
9+600	9+500	9+600	25.8	39.99	
9+700	9+600	9+700	25.6	34.14	
9+800	9+700	9+800	24.1	36.43	
9+900	9+800	9+900	24.9	31.63	
10+000	9+900	10+000	27.1	24.33	34.09
10+100	10+000	10+100	23.1	38.95	
10+168	10+100	10+168	13.2	39.74	

Roughness Index

Manatuto - Natarbora

Equivalent Km Rdg	Ave Roughness per km	Ave Speed (kph)
65.2-66	9.62	26.42
66-67	8.01	28.29
67-68	8.88	27.28
68-69	6.26	30.33
69-70	5.02	27.47
70-71	8.43	28.68
71-72	9.02	29.37
72-73	8.61	25.23
73-74	8.20	25.88
74-75	12.75	22.34
75-76	9.83	26.69
76-77	10.43	24.28
77-78	11.46	25.43
78-79	21.53	19.39
79-80	16.21	21.89
80-81	22.26	19.34
81-82	11.16	25.28
82-83	7.00	29.86
83-84	6.42	32.97
84-85	6.48	31.33
85-86	9.31	29.89
86-87	15.05	26.79
87-88	15.93	27.85
88-89	21.81	22.10
89-90	23.17	24.22
90-91	24.91	25.29
91-92	21.68	20.97
92-93	24.16	14.03
93-94	26.02	19.01
94-95	38.41	17.54
95-96	39.32	18.63
96-97	40.91	17.71
97-98	43.04	15.53
98-99	27.64	13.80
99-100	53.54	14.59
100-101	42.40	19.23
101-102	35.56	17.87
102-103	30.08	17.93
103-104	31.55	16.31
104-105	30.12	16.25

Equivalent Km Rdg	Ave Roughness per km	Ave Speed (kph)
105-106	28.47	18.24
106-107	26.85	21.20
107-108	24.76	17.45
108-109	25.91	23.94
109-110	44.42	14.64
110-111	27.73	18.45
111-112	25.17	19.45
112-113	31.25	17.87
112-113	38.44	17.68
113-114	35.80	17.58
114-115	48.22	17.01
115-116	39.99	21.49
116-117	41.46	22.79
117-118	41.25	24.34
118-119	33.65	24.03
119-120	38.00	20.03
120-121	24.73	22.26
121-122	18.79	23.81
122-123	21.61	25.74
123-124	25.47	24.28
124-125	22.18	26.08
125-126	18.92	24.81
126-127	27.51	23.51
127-128	27.98	22.16
128-129	26.15	22.76
129-130	23.75	21.96
130-131	24.56	21.05
131-132	32.77	20.91
132-133	31.71	23.40
133-134	46.96	19.20
134-135	26.88	25.50
135-136	22.74	27.65
136-137	34.33	22.77
137-138	30.72	23.77
138-139	26.07	22.56
139-140	18.35	30.60
140-141	25.84	26.29
141-142	11.29	37.59
142-143	7.00	33.14
143-144	11.24	35.68
144-144.7	12.12	25.90

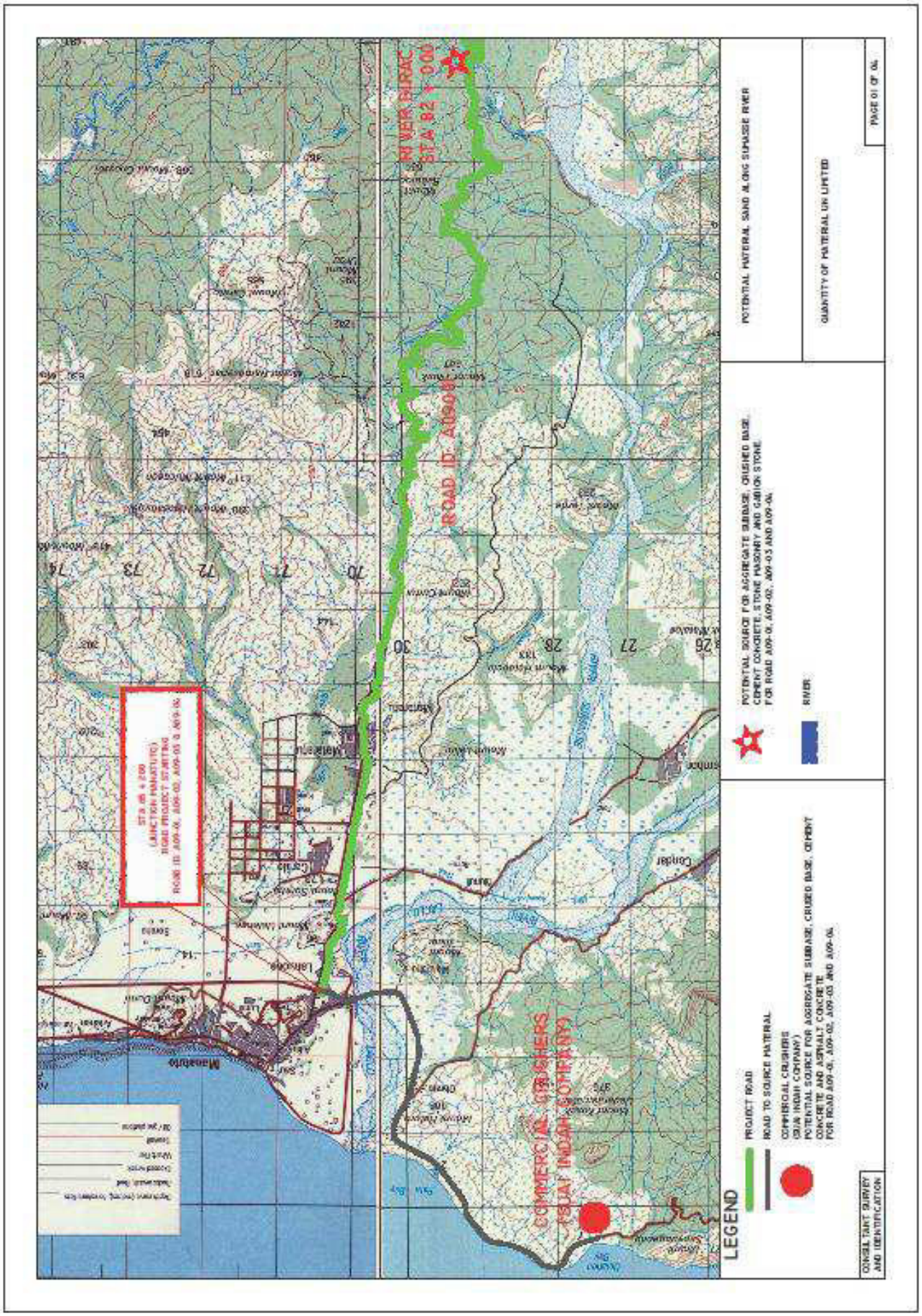
Jct Laclubar-Laclubar

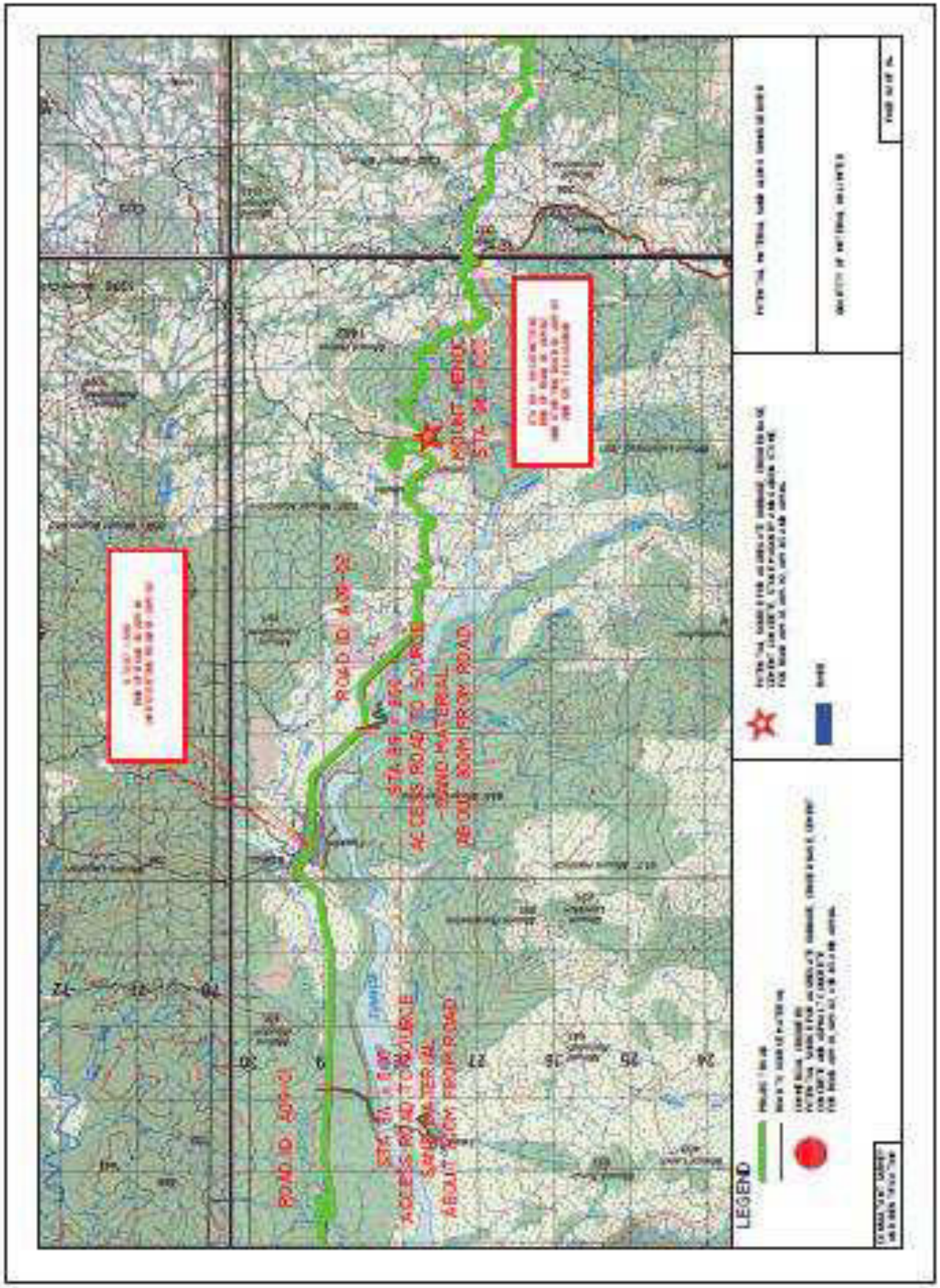
0-1	39.08	17.07	5-6	35.42	22.39
1-2	30.13	23.36	6-7	31.87	20.43
2-3	33.78	22.52	7-8	36.99	20.07
3-4	36.53	21.95	8-9	37.55	23.55
4-5	46.23	18.53	9-10.3	12.75	22.34

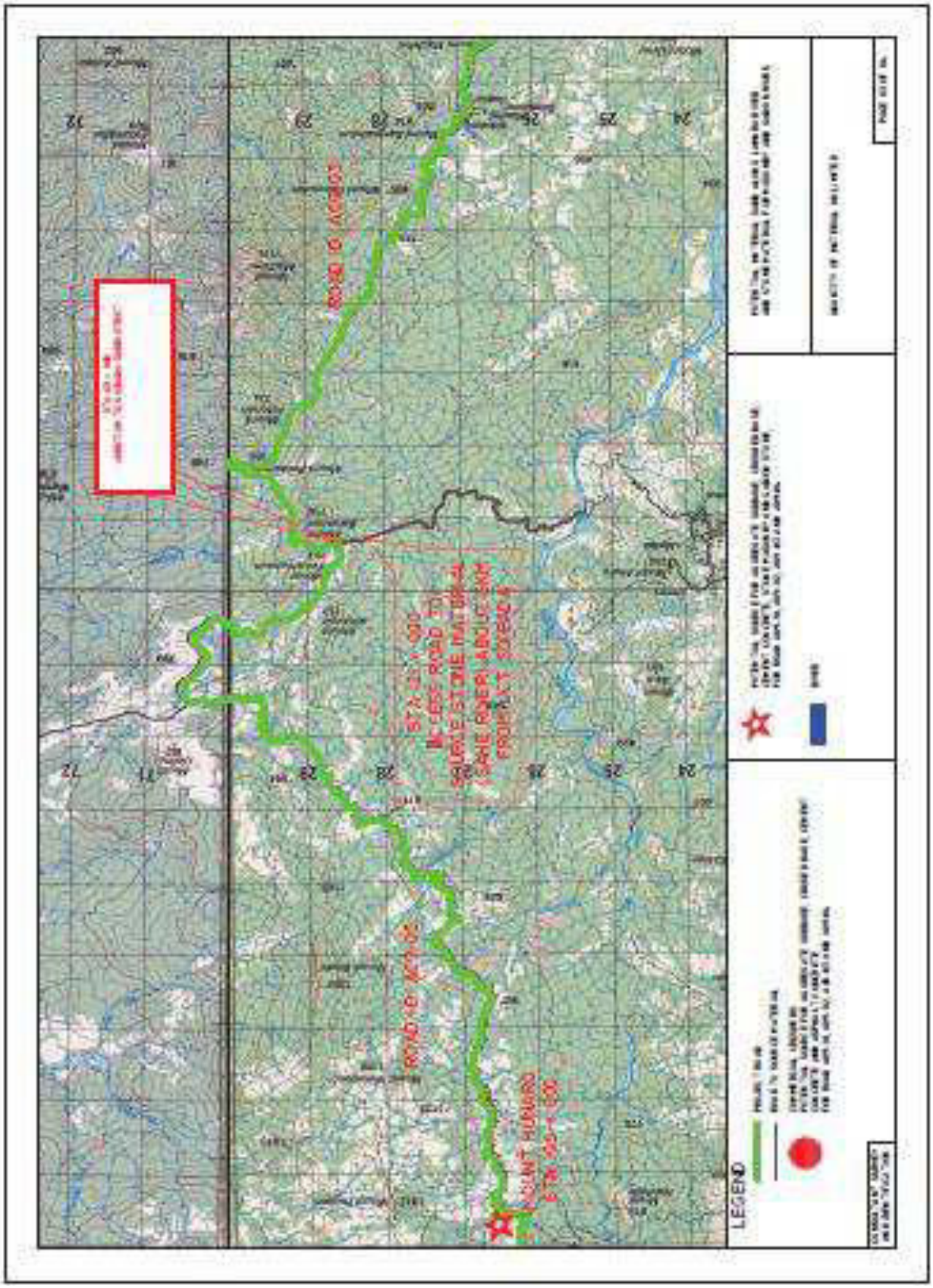
SUMMARY OF ROUGHNESS INDEX

SECTION	FROM -TO	IRI AVERAGE	SECTION	FROM -TO	IRI AVERAGE
A09-1a	km65.2-km82	11.0	A09-4a	km133-km140.5	29.0
A09-1b	km82-km88	10.0	A09-4b	km140.5-km144.7	10.4
A09-2	km88 - km99.5	27.4	C15	km0 -km10.3	34.0
A09-3	km99.5 - km133	31.4			

APPENDIX 4.4


ROAD ID: A09-01
STA 82 + 000
COMMERCIAL CRUSHERS
(SUAI INDAH COMPANY)
LEGEND
PROJECT ROAD
ROAD TO SOURCE MATERIAL
COMMERCIAL CRUSHERS
(SUAI INDAH COMPANY)
POTENTIAL SOURCE FOR AGGREGATE SUBBASE, CRUSHED BASE, CEMENT CONCRETE AND ASPHALT CONCRETE
FOR ROAD A09-01, A09-02, A09-03 AND A09-04
CONSULTANT SURVEY AND IDENTIFICATION
POTENTIAL SOURCE FOR AGGREGATE SUBBASE, CRUSHED BASE, CEMENT CONCRETE, STONE PASONRY AND GABION STONE
FOR ROAD A09-01, A09-02, A09-03 AND A09-04
RIVER
POTENTIAL MATERIAL SAND ALONG SUPASSE RIVER
QUANTITY OF MATERIAL UN LIMITED
PAGE 01 OF 04


LEGEND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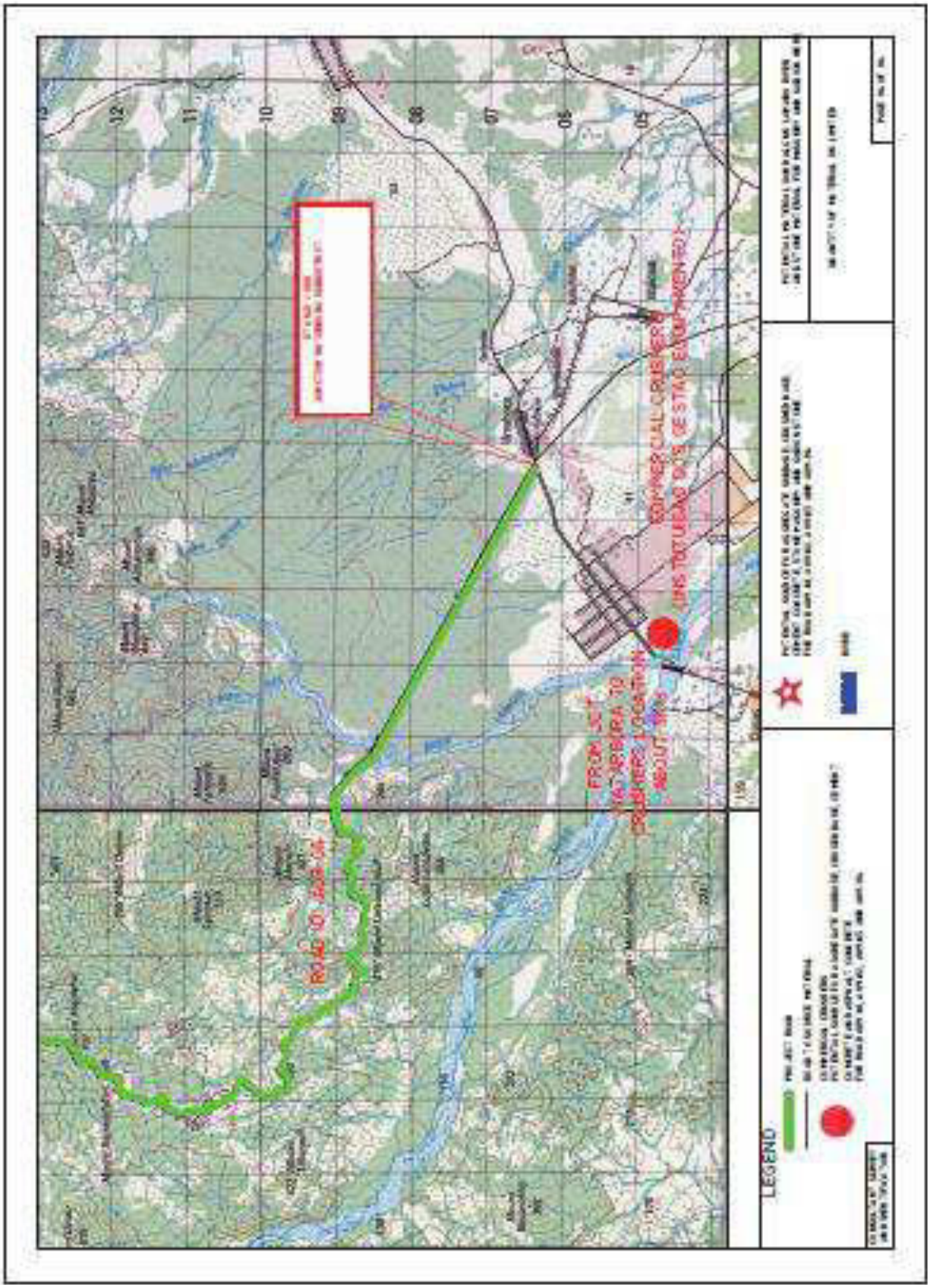
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APPENDIX 4.5

Summary of Proposed Geometric Design Standard
(Design Vehicle - SU and Average Daily Traffic on Opening Date assumed below 400)

1. Terrain		Mountainous			Rolling	Flat	Remarks
2. Design Speed (Km/h)		**20**	**30**	**40**	**50**	**60**	Consultant's Recommendation
3. Stopping Sight Distance (m) (Wet Pavement) For level roadway	AASHTO 2011	20	35	50	65	85	AASHTO 2011, Page 3-4
	MPW (R6)		35	50	65	85	
	Consultant's Recommendation	**20**	**35**	**50**	**65**	**85**	
4. Minimum Passing Sight Distance(m)	AASHTO 2011		120	140	160	180	AASHTO 2011, Page 3-9
	MPW (R6)		200	270	345	410	
	Consultant's Recommendation		**120**	**140**	**160**	**180**	
5. Type of Pavement		**Asphalt Cement, Agg Base Course & Agg Subbase Course , Subgrade Design CBR >6**					PCCP will be adopted as required in extreme case such as steep slope, flooded areas, etc
6. Travelled way/Pavement Width (m)		**2 lanes, 3m width = 6.0**					
7. Minimum Radius of Curvature (m)	AASHTO 2011	7	20	41	73	113	AASHTO 2011, Page 3-46
	MPW (R6)	15	20	41	73	113	
	Consultant's Recommendation	**10 (7)**	**20**	**41**	**73**	**113**	
8. Maximum Superelevation e (%)		8.0					For traffic safety, adopt 4% maximum superelevation on sharp curve less than 20m radius
9. Maximum Relative Gradient (%)	AASHTO 2011	0.80	0.75	0.70	0.65	0.60	AASHTO 2011, Page 3-61
	MPW (R6)	0.80	0.75	0.70	0.65	0.60	
	Consultant's Recommendation	**0.80**	**0.75**	**0.70**	**0.65**	**0.60**	
10. Minimum Length of Runoff (m)		**30**	**32**	**34**	**37**	**40**	AASHTO 2011, Page 3-64 was recomputed from 3.0m lane width and 8% maximum lane cross slope
10. Maximum Grade (%)	AASHTO 2004	17	16	15	10	7	AASHTO 2011, Page 5-3
	MPW (R6)	15	12	10	7	7	
	Consultant's Recommendation	**17**	**16**	**15**	**10**	**7**	
12. Minimum Grade (%)		0.5 (.35)					AASHTO 2011, Page 3-119
13. Minimum Rate of Vertical Curvature (K), Stopping Condition							
K value at crest:		1	2	4	7	11	AASHTO 2011, Page 3-155, MPW same as AASHTO
K value at sag:		3	6	9	13	18	AASHTO 2011, Page 3-161, MPW same as AASHTO
14. Lane Cross-Slope (%) Normal Crown		(-) 2.50					Adopted
15. Widening on Curves	Curve Radius (m)	<20	20-40	40-60	60-120	120-250	Adopt the MPW standard, with a minimum widening of 0.60m. Radius >250, no more widening
	Widening @ Inner Lane	2.00	1.50	1.20	0.90	0.60	
16. Shoulder Width (m)		1.00					Shoulder width may be reduced not lower than 0.50m to suit actual condition and to avoid excessive cut/fill in mountainous terrain
17. Slope of Shoulder (%)		Unpaved Shoulder - (-) 4.00 % normal crown Paved Shoulder - to follow travel way slope					AASHTO and MPW with the same specs. Shoulder shall be paved with AC in mountainous section with 0.50m width, at superelevated section of more than 6% as needed, at steep gradient >8% and at section deemed needed to avoid erosion.

( ) - Absolute minimum

Note: Deviation to the Geometric Design may arise to suit actual requirement and the Consultant will inform MWP-PMU for their approval prior to implementation.

Pavement Design Guidelines

1.0 Introduction

Government of Timor Leste wishes to upgrade the road to an all weathered asphalt surfaced standard which enable to carry a 20-foot container trucks as minimum. Competent design of hot-mix asphalt, flexible pavements, provides a system that is stable, durable and cost effective. The project road is assumed to be rural national arterial road though considered low traffic road.

The primary principle that forms the basis for flexible pavements is that the vehicular loads can be dissipated through successive layers of properly engineered materials. The success of such design is based on; 1) an evaluations of the subgrade soil, 2) the relative load support value of pavement components, and 3) the magnitude and repetitions of traffic loads.

2.0 Design Considerations

2.1 Roadbed soil or the Subgrade

The roadbed soil or the subgrade is the prepared and compacted soil forming the foundation of the pavement system including the soil under the pavement within a depth of approximately one (1) meter below the subgrade level. The bearing capacity of the subgrade is the basic factor to determine the thickness of the pavement and is evaluated by means of California Bearing Ration (CBR) Test.
The representative or design CBR of subgrade on section of road have been determined by calculating the mean (x) and the standard deviation (s) of the CBR results by using the formula.

$$\text{Design CBR} = \bar{x} - {}^{2}/_{3}\, S$$

$$\text{Standard Deviation (S)} = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

Where:

n	=	number of CBR samples
x_i	=	individual CBR value
$\bar{x}$	=	average CBR value
S	=	standard deviation

In determining the representative value of design CBR, it is desirable to determine the actual distribution or number of CBR values required to have a 90% probability that the difference between the true mean and the sample mean is not more than 20% of the sample mean for a range of standard deviations (expressed as percentage of sample mean) as indicated in **Table 1**.

Table 1 - Minimum Number of CBR Samples

Standard Deviation mean of CBR Values	Minimum No. of CBR Samples For Error <±20%
5	3
10	3
15	4
20	5
25	7
30	8
35	11
40	13
45	16
50	19
55	22
60	26
65	30
70	40

The support value of approved subgrade soil is classified based on the resilient modulus or on the average CBR for the subgrade soil is shown in **Table 2**

Table 2 – Support Value for Subgrade Soils

Effective Resilient Modulus (psi)	CBR	Relative Quality of Roadbed Soil
8,000	>5.3	Very Good
7,000	4.7	Good
6,000	4.0	Good
5,000	3.3	Fair
4,000	2.7	Fair
3,000	2.0	Poor
2,000	1.3	Very Poor

This correlation (Resilient Modulus = 1,500 x CBR) is based on subgrade soils tested in accordance with either AASHTO Test Method T-307 (Resilient Modulus) or AASHTO Test Method T-193 (soaked CBR)

2.2 Pavement Components

Each of the pavement components above the subgrade adds to the overall support provided by the pavement system. By quantifying the relative values of pavement components, various design alternatives may be examined and compared. Common components of the flexible pavement system include HMA surface course (AC) graded aggregate base course and aggregate subbase.

2.3 Traffic Volume

A critical factor to be considered in the design of flexible pavements is the anticipated traffic volume and the magnitude of the loads it will impose on the pavement system. In accordance with Consultant's scope of work, a 20-year design life is to be considered. Therefore, traffic levels used in the design process should be the total anticipated traffic for the following 20-year period from the date of opening traffic assumed in 2016.

2.4 Design Parameters

The AASHTO flexible pavement design process relies on a variety of design inputs to produce the required structural number sufficient to carry the design traffic. These parameters are described in the following paragraphs:
Reliability Level (R) – The reliability level for a rural national arterial road is assumed to be 85 %, based on recommendation in the AASHTO guide.
Standard Normal Deviate (ZR) - The corresponding standard normal deviate for a reliability level of 85% per ASSHTO is -1.037.
Overall Standard Deviation (So) – A recommended overall standard deviation for flexible pavement is0.49 considering error in traffic projections or 0.44 if error in traffic projection is not considered (adopted in this project).
Drainage Coefficient (m) – Therecommended drainage coefficient of 1.00applied to granular base and subbase will ensure a degree of conservatism in the pavement structure thicknesses.
Initial and Terminal Serviceability Levels – The initial serviceability level of 4.20 for flexible design and terminal serviceability level of 2.00for roadway with lesser traffic volume will be adopted as per AASHTO.
Layer Coefficient – The layer coefficient to be used in this project road will be; 0.44 for HMA surface mix, 0.14 and 0.11 for granular base & granular subbase respectively.

Summary of Design Parameters

Design Traffic Load, W18 (CESAL)	Based on Traffic survey Data
Resilient Modulus of Subgrade (Mr)	Based on Designed Subgrade CBR from Geotech Investigation
Reliability (R)	85 %
Standard Normal Deviate (Z_R)	-1.037
Overall Standard Deviation (S_O)	0.44
Drainage Coefficient (m)	1.00
Initial Serviceability (P_O)	4.20
Terminal Serviceability (P_T)	2.00
Design Serviceability Loss, (ΔS)	2.20
Layer Coefficient;	
Asphalt Cement (HMA), a_1	0.44
Aggregate Base Course (ABC), a_2	0.14
Aggregate Subbase Course (ASC), a_3	0.11

3.0 Structural Number (SN) Calculation

The Structural Number (SN) for Flexible Pavement can be determined by theregressionequation developed by ASSHTO:

$$\text{Log}_{10}(W18) = Z_R \times S_O + 9.36 \times \text{Log}_{10}(SN+1) - 0.2 + \frac{\text{Log}_{10}\,\Delta S/3}{0.40 + \left[\frac{1094}{(SN+1)^{5.19}}\right]}$$

$$+ 2.32 \times \text{Log}_{10}(Mr) - 8.07$$

From the above equation and given data, the SN is computed by iteration process in Microsoft Excel format

4.0 Selection of Pavement Layer Thicknesses

The pavement thicknesses are determined from the value of SN which is a function of layer thicknesses, i.e.,

$SN = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$

Where: SN = structural number of pavement

a_1, a_2 & a_3 = layer coefficient

D_1, D_2&D_3 = thickness of surface, base &subbase

m_2 & m_3 = drainage coefficient considered as 1

Hydrology and Drainage Design Criteria

Hydrological Analysis

Hydrological analysis will be conducted mainly to derive design or peak flood discharges at the various points of interest produce in several drainage basins or catchments areas traversed by the road alignment. Preliminary considerations and input parameters used are as follows:

a) Watershed Parameters

Watershed parameters such as areas, stream length, streambed elevation and riverbed slope will be measured from each of the delineated boundaries on the 1:50,000 topographic map of Timor Leste and from the detailed topographic survey.

b) Design Flood Frequency

The design flood frequency adopted for the different types of drainage structures and facilities for this project are shown below.

Structures Type	Design Storm Frequency
Bridge	1 in 50 years
Reinforced Concrete Box Culvert (RCBC)	1 in 25 years
Reinforced Concrete Pipe (RCP) Culvert	1 in 15 years
Embankments	1 in 10 years
Road Surface Drainage &Roadside Drainage	1 in 5 years

c) Rainfall Intensity

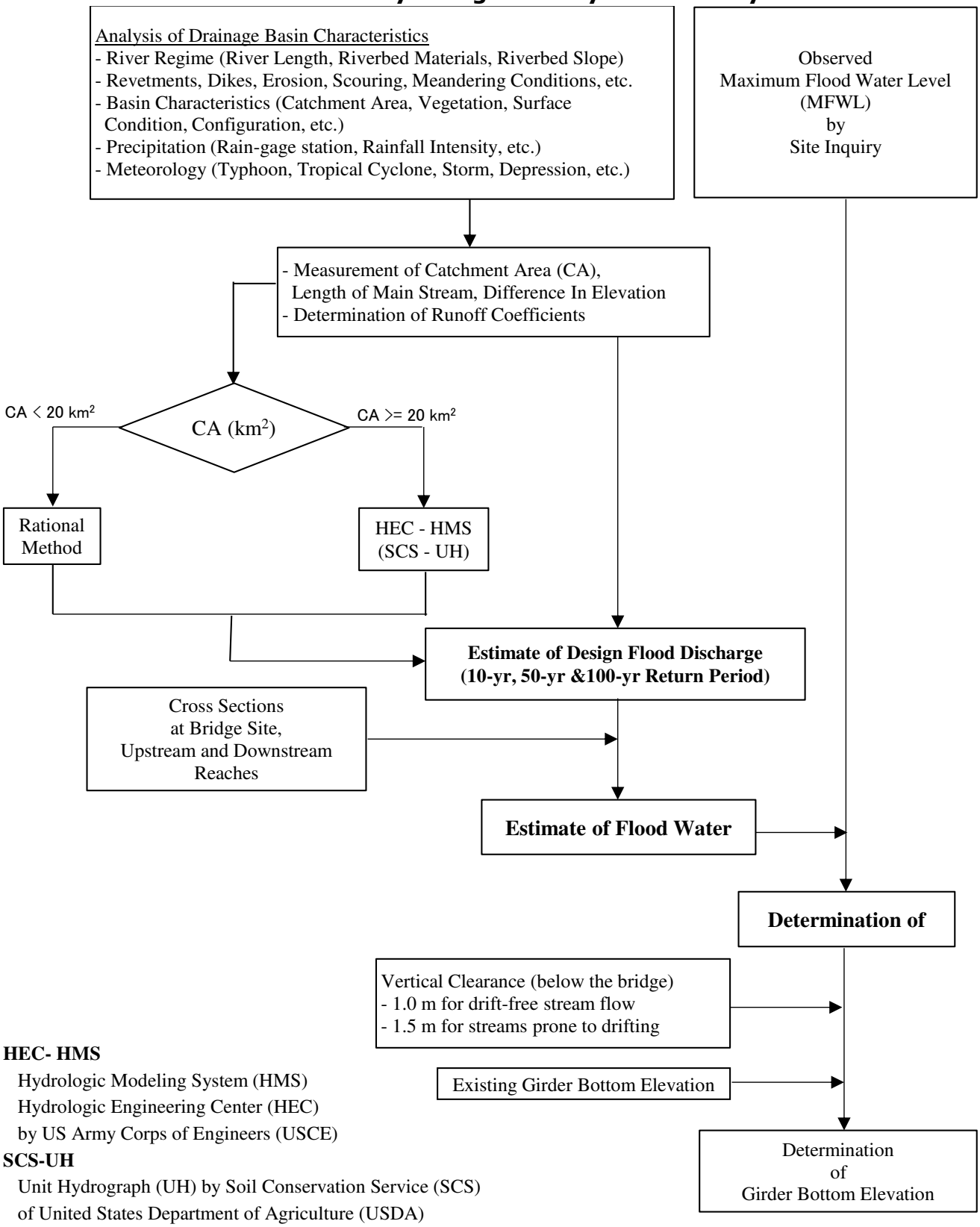
Rainfall intensity is the rate at which rain falls, typically expressed in millimeters per hour. In view of the probabilistic nature of weather, the intensity of rainfall is presented in the context of its frequency and duration.A direct individual plotting of the short duration values against time for different return periods, however, will show that the curves tend to intersect at the higher duration.This statistical inconsistency will be corrected by Regression Analysis for each RIDF Curves using a general equation of the form shown below which generally preserves the integrity of the data and lends itself handily for practical computer applications.

$$I = \frac{A}{(Tc + D)^B}$$

Where:

I = Rainfall Intensity (mm/hr)
Tc = Time of concentration (minutes)
A = Regression intercept
B = Slope
D = Adjustment factor for best curve fit

Flow Chart – Hydrologic and Hydraulic Analysis



HEC- HMS
Hydrologic Modeling System (HMS)
Hydrologic Engineering Center (HEC)
by US Army Corps of Engineers (USCE)

SCS-UH
Unit Hydrograph (UH) by Soil Conservation Service (SCS)
of United States Department of Agriculture (USDA)

Bridge Design Guidelines

1. Design Specification

AASHTO LRFD Bridge Design Specifications SI Units 4th Edition 2007

2. Materials Specification

Refer to 5.4 **AASHTO LRFD** 2007 SI Ed**.**

Structural Member	f'c (MPa)	Max size of Coarse Aggregate (mm)
Cast-in-place Girders, Slabs, Diaphragms, Back walls, Copings, Column	21	25
Footings	21	50
Precast R.C. Piles	28	20
Thin reinforced sections, railings and rail post	21	12
Prestressed concrete members	35	20
Lean concrete	18	20

1) Concrete: Refer Table C 5.4.2.1.1 AASHTOLRFD 2007 SIEd.
2) Reinforcing Steel: Refer to 5.4.3 AASHTO LRFD2007 SI Ed.
3) Prestressing Steel Bar: Refer 5.4.4 AASHTO LRFD2007 SI Ed.
4) Post-Tensioning Anchorage and Couplers: Refer to 5.4.5 AASHTO LRFD2007 SI Ed.
5) SteelStructures

Structural Steels	Refer 6.4.1 AASTHO LRFD 2007 SI Ed.
Pin, Rollers and Rockers	Refer 6.4.2AASTHO LRFD 2007 SI Ed.
Bolts, Nuts and Washers	Refer 6.4.3 AASTHO LRFD 2007 SI Ed.
Stud Shear Connectors	Refer 6.4.4 AASTHO LRFD 2007 SI Ed.
Weld Metal	Refer 6.4.5 AASTHO LRFD 2007 SI Ed.

3. Design Loads

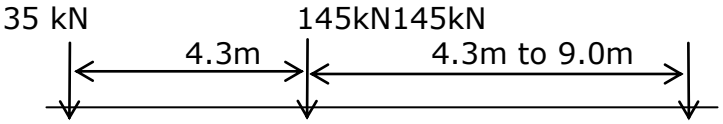
1) Dead Load

Self-weight plus allowance for future superimposed dead loads such as wearing surface and weight of public utilities.

	Dead Load	Weight
a)	Concrete	23.56 kN/m^3
b)	Steel	77.00 kN/m^3
c)	Prestressed Concrete	24.00 kN/m^3
d)	Earth	19.00 kN/m^3
e)	Wearing Surface	1.05 N/m^3

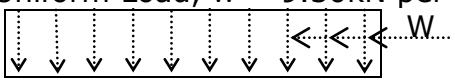
2) Design Vehicular Live Load: Refer 3.6.1.10 AASTHO LRFD 2007 SI Ed.

a) Design Truck Load



b) Lane Loading

Uniform Load, w = 9.30kN per meter of load lane (1 Design Lane)



c) *Pedestrian Loads*: Refer to 3.6.1.6AASTHO LRFD 2007 SI Ed.
For all sidewalks wider than 600 mm 3.6 X 10^{-3}MPa or 3.6kN/m^2 of pedestrian loads shall be applied simultaneously with the vehicular design live loads.

a) Dynamic Load Allowance : IM	Refer 3.6.2 AASTHO LRFD 2007 SI Ed.
b) Centrifugal Forces : CE	Refer 3.6.3 AASTHO LRFD 2007 SI Ed.
c) Braking Force : BR	Refer 3.6.4AASTHO LRFD 2007 SI Ed.
d) Wind Load	Refer Table 3.8.1.2.7 AASTHO LRFD 2007 SI Ed.
e) Buoyancy	Refer 3.7.2AASTHO LRFD 2007 SI Ed.
f) Earthquake Effect	Refer 3.10 AASTHO LRFD 2007 SI Ed.
g) Earth Pressure : EH	Refer 3.11AASTHO LRFD 2007 SI Ed.

4. Analysis Procedure:

Procedure 1:

Single Mode Spectral Method (Equivalent Static Lateral Force Method)

* For "regular" bridges only.

The method assumes single mode shape so that a single degree of freedom "generalized parameter" model can be formulated.

Procedure 2: Multi-mode Spectral Method (Dynamic Analysis)

Required for bridges with irregular geometry.
Performed using a computer program with space frame linear dynamic analysis capabilities.

Ex. SAP 2000, STAAD III & STRUDL

A regular bridge has no abrupt or unusual changes in mass, stiffness or geometry along its span and has no large difference in these parameters between adjacent supports (abutments excluded). For example a bridge may be considered regular if it is straight or describes the sector of an arc not exceeding 90^0 and has adjacent columns or piers that do not differ in stiffness by more than 25%.An irregular bridge is any bridge that does not satisfy the above definition.
In modern seismic design of bridges, the basic design philosophy is for the bridge to resist small to moderate earthquakes in the elastic range without significant damage. In case of large earthquakes, a bridge may suffer damage but this should not cause collapse of all or any of its parts and such damage should readily be detectable and accessible for inspection and repair.

5. Design Procedure

1) Preliminary layout of the proposed bridge

General Plan and Elevation

- Review hydraulic/ hydrologic analyses to determine the required waterway, water elevations.
- Survey data (topographic map of bridge site, profiles, river cross sections, water elevations)
- Bridge geometric requirements such as vertical and horizontal alignments, roadway width, and sidewalk.
- Preliminary selection of the types of superstructures, substructures and foundation.

2) Establish the design criteria and specification.

3) Final selection of the type of structures.

- Superstructures, substructures and foundation

4) Design of superstructures

- Deck slab
  Slab thickness
  Steel reinforcement

- Design of main girders
  (RCDG, PSDG)

- Design of steel trusses
  Main members (top & bottom chords, vertical and diagonal) Floor system

- Miscellaneous designs
  Bearings, railings, lightings etc.
- Detailing

5) Design of Substructures

- Check for depth of scour
- Analysed for various combination of loads
- Design pier coping and columns.
- Design pier footing and abutment footing
- Detailing

Other Design Considerations

- Geological Mapping

  - Collecting the geological and topographic data/materials/reference books.
  - Reconnaissance around existing road for gathering the following data.

  1. Topographic data
     - 1.1 micro topography
     - 1.2 slope failure and landslide features
     - 1.3 mountain river features
     - 1.4 cutting and fill slope features
     - 1.5 subsurface features

  2. Geological data
     - 2.1 classification and nomenclature of rocks
     - 2.2 dip and strike of bedding
     - 2.3 dip and strike of cleavages/joints/cracks
     - 2.4 rigidity/weathering degree of rock mass
     - 2.5 rock mass classification
     - 2.6 thickness of each stratum according to geological formation and weathering degree.
     - 2.7 geological mapping for statistical analysis of joint system and point load test.

  - Adjusting reconnaissance data

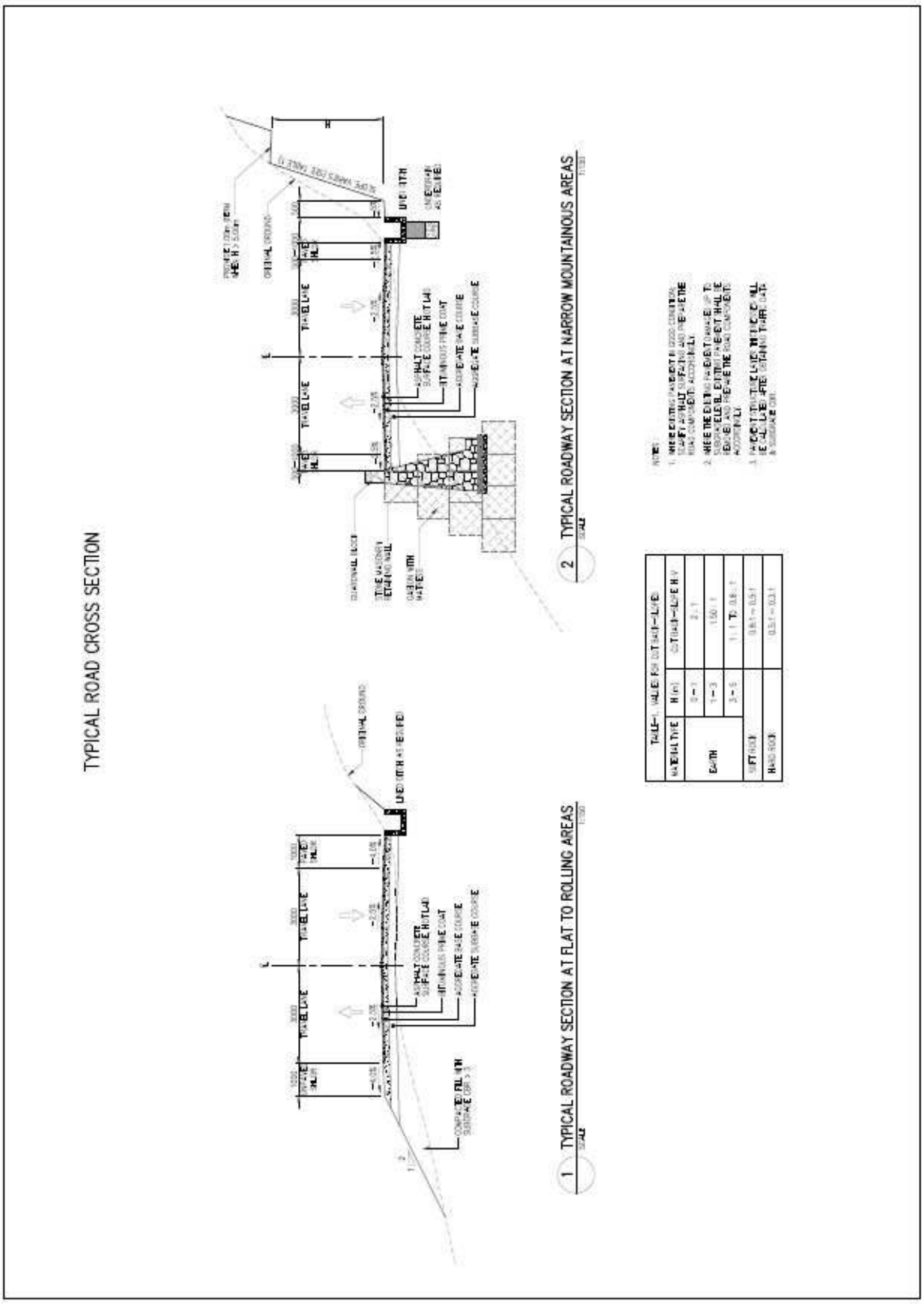
  Improvement of Rock mass classification

- Cut and Embankment Survey

  - selecting 10 sites of some size out of damaged cuts and embankments identified by reconnaissance
  - setting measuring line each block (with sub-measuring line)
  - detailed field survey
    1. estimation of extent of sliding area and division of movement block
    2. to grasp general characteristics of geology of sliding area
    3. to grasp geological structure, esp. fault and fracture system
    4. estimation of sliding surface

- Slope Protection Design

  - modifying cut slope grade on the basis of the comparison between rock mass classification prepared by reconnaissance and existing cut slope grade.
  - drawing the boundary of rock mass into the typical profiles
  - proposing some available countermeasures for unstable slopes and embankments.
  - applying soil bioengineering method to countermeasures
    1. collecting existing data/materials/reference books
    2. research the species/distribution/growing of plants on the existing cut slope
    3. proposing soil bioengineering countermeasures for cutting slope.


TYPICAL ROAD CROSS SECTION
1 TYPICAL ROADWAY SECTION AT FLAT TO ROLLING AREAS
2 TYPICAL ROADWAY SECTION AT NARROW MOUNTAINOUS AREAS

APPENDIX 4.6

Engineering Data for Economic Evaluation

Road Name			Manatuto - Natarbora						Jct Laclubar - Laclubar
Road ID No.			A09						C15
Road Section Name			Manatuto to Cribas		Cribas to Jct Laclubar	Jct Laclubar to Mane Hat	Mane Hat to Natarbora		Jct Laclubar to Laclubar
Road Section ID No			A09-1		A09-2	A09-3	A09-4		C15
Road Sub-Section			A09-1a	A09-1b	-	-	A09-4a	A09-4b	-
From (km)			65.2	82.0	88.0	99.5	133.0	140.5	0.0
To (km)			82.0	88.0	99.5	133.0	140.5	144.7	10.3
Length (km)			16.8	6.0	11.5	33.5	7.5	4.2	10.3
Road Width (m)	Existing		4.5	4.5	3.5 to 4	3 to 3.5	4.5	4.5	3 to3.5
	Proposed	Alt 0	4.5	4.5	3.5 to 4	3 to 3.5	4.5	4.5	3 to 3.5
		Alt 1	4.5	4.5	4.5	4.5	4.5	4.5	4.5
		Alt 2	4.5	4.5	4.5	4.5	4.5	4.5	4.5
		Alt 3	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Shoulder Width (m)	Existing		0.5 to1.0	1.0	0.5	0.5	0.5	0.5	0 to 0.5
	Proposed	Alt 0	0.5 to 1.0	1.0	0.5	0.5	0.5	0.5	0 to 0.5
		Alt 1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Alt 2	1.0	1.0	1.0	1.0	1.0	1.0	1.0
		Alt 3	1.0	1.0	0.5 to 1.0	0.5 to 1.0	1.0	1.0	0.5 to 1.0
Road Roughness (IRI Value)	Existing		11.0	10.0	27.4	31.4	29.0	10.4	34.0
	Post-work	Alt 0	9.4	8.5	23.3	25.0	24.7	8.8	25.0
		Alt 1	3.5	3.5	3.5	3.5	3.5	3.5	3.5
		Alt 2	3.5	3.5	3.5	3.5	3.5	3.5	3.5
		Alt 3	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total Works Cost (1000$/km)	Alt 0		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Alt 1		528.80	199.06	714.01	677.67	515.37	208.41	633.91
	Alt 2		528.80	512.73	714.01	677.67	515.37	502.97	633.91
	Alt 3		719.13	705.17	982.89	931.20	716.66	701.78	876.29
Maintenance Cost (1000$/km)	Alt 0 (Essential)		12.66	8.31	14.17	19.12	19.12	9.76	23.73
	Alt 1 (Normal)		4.22	5.14	4.22	5.14	4.22	5.14	5.14
	Alt 2 (Normal)		4.22	4.22	4.22	5.14	4.22	4.22	5.14
	Alt 3 (Normal)		3.69	3.69	3.69	4.48	3.69	3.69	4.48

Engineering Data for Economic Evaluation

Road Name			Manatuto - Natarbora						Jct Laclubar - Laclubar
Road ID No.			A09						C15
Road Section Name			Manatuto to Cribas		Cribas to Jct Laclubar	Jct Laclubar to Mane Hat	Mane Hat to Natarbora		Jct Laclubar to Laclubar
Road Section ID No			A09-1		A09-2	A09-3	A09-4		C15
Road Sub-Section			A09-1a	A09-1b	-	-	A09-4a	A09-4b	-
From (km)			65.2	82.0	88.0	99.5	133.0	140.5	0.0
To (km)			82.0	88.0	99.5	133.0	140.5	144.7	10.3
Length (km)			16.8	6.0	11.5	33.5	7.5	4.2	10.3
Road Works Cost (1000$/km)	Alt 0		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Alt 1		467.25	175.73	539.66	577.52	502.70	207.82	571.39
	Alt 2		467.25	466.06	539.66	577.52	502.70	501.78	571.39
	Alt 3		650.20	649.17	755.94	813.35	701.46	700.35	802.70
Bridge & Special Culvert Works Cost (1000$/km)	Alt 0		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Alt 1		61.55	23.33	174.35	100.15	12.67	0.60	62.52
	Alt 2		61.55	46.67	174.35	100.15	12.67	1.19	62.52
	Alt 3		68.93	56.00	226.96	117.85	15.20	1.43	73.59
Total Works Cost (1000$/km)	Alt 0		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Alt 1		528.80	199.06	714.01	677.67	515.37	208.41	633.91
	Alt 2		528.80	512.73	714.01	677.67	515.37	502.97	633.91
	Alt 3		719.13	705.17	982.89	931.20	716.66	701.78	876.29

COST ESTIMATES OF CIVIL WORKS

Section	Sub-Section	Length (km)	Alternate	Cost Estimates ($ 000)									
				Gen. Rqmnts	Earth works	Subbase & Base Course	Surface Course	Bridge & Culvert Const.	Drainage & Slope Protec.	Miscl.	Bio-Engg	TOTAL ($ 000)	$ 000/KM
A09-1	A09-1a	16.8	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			1	250.78	373.75	3599.17	2023.87	1034.00	508.40	420.55	15.29	8225.81	489.63
			2	250.78	373.75	3599.17	2023.87	1034.00	508.40	420.55	15.29	8225.81	489.63
			3	358.26	747.49	4336.35	3373.12	1158.00	635.50	560.73	16.98	11186.44	665.86
	A09-1b	6	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			1	38.39	53.39	464.61	72.28	140.00	181.57	150.20	5.46	1105.89	184.32
			2	89.57	133.48	1285.42	722.81	280.00	181.57	150.20	5.46	2848.50	474.75
			3	127.95	266.96	1548.70	1204.69	336.00	226.96	200.26	6.07	3917.59	652.93
A09-2	-	11.5	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			1	208.43	387.23	2344.49	1470.33	2005.00	796.46	353.78	37.14	7602.86	661.12
			2	208.43	387.23	2344.49	1470.33	2005.00	796.46	353.78	37.14	7602.86	661.12
			3	297.76	774.46	2824.68	2450.55	2610.00	995.57	471.70	41.27	10466.00	910.09
A09-3	-	33.5	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			1	512.58	1461.59	6453.72	4548.77	3355.00	3433.27	1068.79	186.71	21020.44	627.48
			2	512.58	1461.59	6453.72	4548.77	3355.00	3433.27	1068.79	186.71	21020.44	627.48
			3	732.26	2923.19	7775.56	7581.29	3948.00	4291.59	1425.05	207.46	28884.39	862.22
A09-4	A09-4a	7.5	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			1	118.63	223.30	1611.39	900.43	95.00	403.52	217.28	9.39	3578.95	477.19
			2	118.63	223.30	1611.39	900.43	95.00	403.52	217.28	9.39	3578.95	477.19
			3	169.48	446.61	1941.43	1500.72	114.00	504.40	289.71	10.44	4976.78	663.57
	A09-4b	4.2	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			1	28.47	50.02	326.16	50.42	2.50	225.97	121.68	5.26	810.49	192.97
			2	66.44	125.05	902.38	504.24	5.00	225.97	121.68	5.26	1956.01	465.72
			3	94.91	250.10	1087.20	840.40	6.00	282.46	162.24	5.85	2729.16	649.80
C15	-	10.3	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			1	227.65	423.63	2064.21	1342.27	644.00	955.49	345.17	43.25	6045.66	586.96
			2	227.65	423.63	2064.21	1342.27	644.00	955.49	345.17	43.25	6045.66	586.96
			3	325.21	847.26	2487.00	2237.11	758.00	1194.36	460.23	48.05	8357.22	811.38

Note: The summary of cost is based on unit cost of 2012. An increase of 8% should be applied for the cost estimates of current year 2013

Cost Estimates
Manatuto – Natarbora Road (A09)
Manatuto – Cribas (A09–1), km 65.2 – km 88, Length = 22.8 kms

SECTION	DESCRIPTION	UNIT	QTY	DIRECT COST		INDIRECT COST						TOTAL COST
						MARK UP				TAX	TOTAL	
				UNIT COST	TOTAL	OCM %	PROFIT %	TOTAL %	TOTAL AMOUNT	2% of (6)+(10)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
101	**FACILITIES FOR THE ENGINEERS**											
101.2b	Provide, Operate and Maintain Main Office and Laboratory for the Engineer on Rental Basis	mo.	18	1,900.00	34200	10	10	20	6840	821	7661	41861
101.2c	Provide, Operate and Maintain Living Quarters for the the Engineer on Rental Basis	mo.	18	1,100.00	19800	10	10	20	3960	475	4435	24235
101.2d	Provide Equipt, Furnitures/Fixtures and appliances for the Main Office, Lab & Living Qrts for the Engr.	l.s.	1	23,360.00	23360	10	10	20	4672	561	5233	28593
101.2e	Provide and Maintain Communication Facility for the Engineer	mo.	18	750.00	13500	10	10	20	2700	324	3024	16524
101.2f	Provide Supplies and Consumable Stores for Field Office, Laboratory and Living Quarters for the Engineer	mo.	18	586.89	10564	10	10	20	2113	254	2366	12930
101.2.1a	Provide, Operate and Maintain Service Vehicle for the Enginee, 4WD pick-up double crew cab (4 units)	mo.	18	2,257.38	40633	10	10	20	8127	975	9102	49735
101.3.1a	Provide and Maintain Survey Instruments/Equipment for the assistance to the engineer	l.s.	1	12,000.00	12000	10	10	20	2400	288	2688	14688
101.3.1b	Provide and Maintain Laboratory Testing Equipment and Apparatus	l.s.	1	18,000.00	18000	10	10	20	3600	432	4032	22032
101.3.c	Provision of Survey Personnel	mo.	18	1,800.00	32400	10	10	20	6480	778	7258	39658
101.3.d	Provision of Laboratory Personnel	mo.	18	2,300.00	41400	10	10	20	8280	994	9274	50674
101.4.1	Progress Photographs	mo.	18	120.00	2160	10	10	20	432	52	484	2644
										Sub-Total (Facilities for the Engineer)		**303,573**
102	**OTHER GENERAL REQUIREMENTS**											
102.1a	Mobilization (0.75% of Civil Works)	l.s.	1	111,910	111910	10	10	20	22382	2686	25068	136978
102.1b	Demobilization (0.25% of Civil Works)	l.s.	1	37,303	37303	10	10	20	7461	895	8356	45659
200	**EARTHWORKS**									**Sub-Total (Other General Requirements)**		**182,638**
201 (1)	Clearing and Grubbing	ha	26	2,283.00	58958	10	10	20	11792	1415	13207	72165
201(3)	Individual Removal of Trees (Small)	nr	1298	42.00	54495	10	10	20	10899	1308	12207	66702
201(4)	Individual Removal of Trees (Small Large)	nr	728	120.00	87300	10	10	20	17460	2095	19555	106855
202(1)a	Removal of Box Culverts (all sizes)	m		27.10	0	10	10	20	0	0	0	0
202(2)	Removal of existing Structures (inlet & outlet structures)	nr		20.30	0	10	10	20	0	0	0	0
202(2)a	Removal of existing Baily Bridge	nr		7,000.00	0	10	10	20	0	0	0	0
202(3)	Removal of existing Penetration Macadam	m^2	54720	1.75	95760	10	10	20	19152	2298	21450	117210
202(4)a	Removal of existing Pipe, 760mm dia. or less	m		18.10	0	10	10	20	0	0	0	0
202(4)b	Removal of existing Pipe, 910mm dia. or more	m		23.65	0	10	10	20	0	0	0	0
202(4)c	Removal of existing Lined Ditch	m		4.10	0	10	10	20	0	0	0	0
202(4)d	Removal of existing Stone Masonry Retaining Wall	m		10.25	0	10	10	20	0	0	0	0
203(4)e	Removal of existing Gabions	m		8.30	0	10	10	20	0	0	0	0
203(1)	Unsuitable Excavation	m^3		4.50	0	10	10	20	0	0	0	0
203(2)	Surplus Common Excavation	m^3	30825	3.80	117135	10	10	20	23427	2811	26238	143373
203(3)a	Surplus Hard Rock Excation	m^3	1675	21.60	36180	10	10	20	7236	868	8104	44284
203(3)b	Surplus Soft Rock Excavation	m^3	9095	13.00	118235	10	10	20	23647	2838	26485	144720
204(1)	Structure Excavation	m^3		4.85	0	10	10	20	0	0	0	0
204(3)	Foundation Fill	m^3		35.30	0	10	10	20	0	0	0	0
204(6)	Pipe Culverts and Lined Drain Excavation	m^3		5.75	0	10	10	20	0	0	0	0
205(1)a	Embankment from Roadway Excavation	m^3	35580	4.20	149436	10	10	20	29887	3586	33474	182910
205(1)b	Embankment Selected Borrow Excavation	m^3	1475	22.50	33188	10	10	20	6638	797	7434	40622
206(1)	Subgrade Preparation (Common Material)	m^2	25850	1.15	29728	10	10	20	5946	713	6659	36386
206(2)a	Subgrade Preparation (Existing Macadam Pavement)	m^2	28210	0.95	26800	10	10	20	5360	643	6003	32803
206(2)b	Subgrade Preparation (Existing Gravel Shoulder)	m^2	17990	1.20	21588	10	10	20	4318	518	4836	26424
300	**SUBBASE AND BASE COURSE**										**Sub-Total (Earthworks)**	**1,014,454**
301	Aggregate Subbase Course	m^3	36140	59.00	2132288	10	10	20	426458	51175	477633	2609921
303(1)	Crushed Aggregate Base Course, Grading B	m^3	41809	64.00	2675756	10	10	20	535151	64218	599369	3275125
400	**SURFACE COURSE**										**Sub-Total (Subbase & Base Course)**	**5,885,045**

402(1)	Bituminous Prime Coat (Cut Back Asphalt Grade MC-70)	ton	277	1,595.00	442351	10	10	20	88470	10616	99087	541438
403(2)	Bituminous Tack Coat (Emulsified Asphalt Grade CSS-1)	ton	1	1,686.00	843	10	10	20	169	20	189	1032
411(1)	Bitumous Concrete Surface Course, Hot Laid 50mm thick	ton	18947	174.00	3296848	10	10	20	659370	79124	738494	4035341
500	**BRIDGE & BOX CULVERT CONSTRUCTION**										**Sub-Total (Surface Course)**	**4,577,811**
501A(1)	Low-Strain Dynamic Method: Pile Integrity Test (PIT)	nr		125.00	0	10	10	20	0	0	0	0
501B(1)	High-Strain Dynamic Pile Test	nr		240.00	0	10	10	20	0	0	0	0
501(16)	Concrete Piles cast in Drilled Holes -800 mm diameter	m		1,044.00	0	10	10	20	0	0	0	0
502	Concrete Railing	m		155.00	0	10	10	20	0	0	0	0
504A(1)	Steel Decking for Slab (Base metal, 0.60 mm thickness)	m^2		335.00	0	10	10	20	0	0	0	0
505(2)	Reinforcing Steel Bars, Grade 60	kg		1.90	0	10	10	20	0	0	0	0
506(1)	Structural Concrete, Class A	m^3		219.00	0	10	10	20	0	0	0	0
506(2)	Structural Concrete, Class B	m^3		188.00	0	10	10	20	0	0	0	0
506(3)	Structural Concrete, Class C	m^3		204.00	0	10	10	20	0	0	0	0
507(1)	Prestressed Concrete AASHTO Type IV Girder - 23.90 m length	nr		42,320.00	0	10	10	20	0	0	0	0
508(1)	Elastomeric bearing Pad (Free - 660mmx306mmx52mm)	nr		164.00	0	10	10	20	0	0	0	0
508(2)	Bridge Drainage Pipe PVC 200 mm diameter	m		7.20	0	10	10	20	0	0	0	0
513	Expansion Joint - Neoprene Type for 50 mm gap	a		212.00	0	10	10	20	0	0	0	0
600	**DRAINAGE AND SLOPE PROTECTION WORKS**										**Sub-Total (Bridge & Box Culvert)**	**1,494,000**
601(1)a	RC Pipe Culvert, 910mm diameter	m		328.00	0	10	10	20	0	0	0	0
601(1)b	RC Pipe Culvert, 1070mm diameter	m		362.00	0	10	10	20	0	0	0	0
601(1)c	RC Pipe Culvert, 1220mm diameter	m		411.00	0	10	10	20	0	0	0	0
601(1)d	RC Pipe Culvert, 1520mm diameter	m		552.00	0	10	10	20	0	0	0	0
603(2)	Stone Masonry Curb Inlet Manhole	nr		457.00	0	10	10	20	0	0	0	0
604(3)a	Cleaning Culverts in place (910 mm diameter or less)	m		2.50	0	10	10	20	0	0	0	0
604(3)b	Cleaning Culverts in place (1220 mm diameter or more)	m		2.90	0	10	10	20	0	0	0	0
604(3)c	Cleaning of Box Culverts (all sizes)	m		4.00	0	10	10	20	0	0	0	0
604(4)a	Reconditioning of Drainage Structures (Inlets and Outlets)	nr		20.80	0	10	10	20	0	0	0	0
604(4)b	Reconditioning of Drainage Structures (Lined Ditch Type B-1)	m		3.70	0	10	10	20	0	0	0	0
604(4)c	Reconditioning of Drainage Structures (Lined Ditch Type B-3)	m		4.40	0	10	10	20	0	0	0	0
605(5)	Grouted Riprap, Class A	m^3	1635	70.50	115268	10	10	20	23054	2766	25820	141087
606	Stone Masonry	m^3	4750	76.00	361000	10	10	20	72200	8664	80864	441864
607	Hand Laid Rock Embankment	m^3		35.00	0	10	10	20	0	0	0	0
610	Gabions	m^3	2640	86.50	228360	10	10	20	45672	5481	51153	279513
700	**MISCELLANEOUS STRUCTURES**										**Sub-Total (Drainage & Slope Protection Works)**	**862,464**
701(3)	Curb and Gutter (Type A), Curb with Precast ????	m	800	35.00	28000	10	10	20	5600	672	6272	34272
703(4)	Guide Posts	nr	91.2	39.50	3602	10	10	20	720	86	807	4409
704(3)a	Metal Guardrail (Metal Beam)	m	775	69.00	53475	10	10	20	10695	1283	11978	65453
704(3)b	Metal End Guardrail	nr	15	49.00	735	10	10	20	147	18	165	900
704A(2)	Remove, Repair and Re-install Guardrail Beam	m	1	17.00	17	10	10	20	3	0	4	21
706(1)	Warning Signs	nr	79.8	295.00	23541	10	10	20	4708	565	5273	28814
706(2)	Regulatory Signs	nr	34.2	295.00	10089	10	10	20	2018	242	2260	12349
706(3)	Informatory Signs	nr	10	1,250.00	12500	10	10	20	2500	300	2800	15300
707(1)	Pavement Markings (Premixed Reflective), White/Yellow	m^2	100	26.10	2610	10	10	20	522	63	585	3195
710(1)a	Reflectorized Thermoplastic Pavement Markings (White)	m^2	5016	75.00	376200	10	10	20	75240	9029	84269	460469
710(1)b	Reflectorized Thermoplastic Pavement Markings (Yellow)	m^2	1405	79.00	110956	10	10	20	22191	2663	24854	135810
800	**BIO-ENGINEERING**										**Sub-Total (Miscellaneous Structures)**	**760,991**
803(1)	Slope Trimming and Preparation	m^2	6200	1.40	8680	10	10	20	1736	208	1944	10624
805(3)	Planting of Grass Slips	m^2	3720	2.50	9300	10	10	20	1860	223	2083	11383
805(4)	Planting Tree/Shrub	nr	310	2.75	853	10	10	20	171	20	191	1043
											Sub-Total (Bio-Engineering)	**23,051**
											OTAL CIVIL WORKS COST except MOB/DEMOB	**14,921,389**
											TOTAL CIVIL WORKS COST with MOB/DEMOB	**15,104,027**
											Cost $M/KM	**0.66**

Note: Bridges and special culverts in separate detail estimate.

Cost Estimates
Manatuto – Natarbora Road (A09)
Cribas – Jct Laclubar (A09–2), km 88 – km 99.5, Length = 11.5 kms

SECTION	DESCRIPTION	UNIT	QTY	DIRECT COST		INDIRECT COST						TOTAL COST
						MARK UP				TAX	TOTAL	
				UNIT COST	TOTAL	OCM %	PROFIT %	TOTAL %	TOTAL AMOUNT	2% of (6)+(10)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
101	**FACILITIES FOR THE ENGINEERS**											
101.2b	Provide, Operate and Maintain Main Office and Laboratory for the Engineer on Rental Basis	mo.	8	1,900.00	15200	10	10	20	3040	365	3405	18605
101.2c	Provide, Operate and Maintain Living Quarters for the the Engineer on Rental Basis	mo.	8	1,100.00	8800	10	10	20	1760	211	1971	10771
101.2d	Provide Equipt, Furnitures/Fixtures and appliances for the Main Office, Lab & Living Qrts for the Engr.	l.s.	1	23,360.00	23360	10	10	20	4672	561	5233	28593
101.2e	Provide and Maintain Communication Facility for the Engineer	mo.	8	750.00	6000	10	10	20	1200	144	1344	7344
101.2f	Provide Supplies and Consumable Stores for Field Office, Laboratory and Living Quarters for the Engineer	mo.	8	586.89	4695	10	10	20	939	113	1052	5747
101.2.1a	Provide, Operate and Maintain Service Vehicle for the Enginee, 4WD pick-up double crew cab (4 units)	mo.	8	2,257.38	18059	10	10	20	3612	433	4045	22104
101.3.1a	Provide and Maintain Survey Instruments/Equipment for the assistance to the engineer	l.s.	1	12,000.00	12000	10	10	20	2400	288	2688	14688
101.3.1b	Provide and Maintain Laboratory Testing Equipment and Apparatus	l.s.	1	18,000.00	18000	10	10	20	3600	432	4032	22032
101.3.c	Provision of Survey Personnel	mo.	8	1,800.00	14400	10	10	20	2880	346	3226	17626
101.3.d	Provision of Laboratory Personnel	mo.	8	2,300.00	18400	10	10	20	3680	442	4122	22522
101.4.1	Progress Photographs	mo.	8	120.00	960	10	10	20	192	23	215	1175
									Sub-Total (Facilities for the Engineer)			**171,206**
102	**OTHER GENERAL REQUIREMENTS**											
102.1a	Mobilization (0.75% of Civil Works)	l.s.	1	77,546	77546	10	10	20	15509	1861	17370	94916
102.1b	Demobilization (0.25% of Civil Works)	l.s.	1	25,849	25849	10	10	20	5170	620	5790	31639
200	**EARTHWORKS**									**Sub-Total (Other General Requirements)**		**126,555**
201 (1)	Clearing and Grubbing	ha	16	2,283.00	37384	10	10	20	7477	897	8374	45758
201(3)	Individual Removal of Trees (Small)	nr	875	42.00	36750	10	10	20	7350	882	8232	44982
201(4)	Individual Removal of Trees (Small Large)	nr	588	120.00	70500	10	10	20	14100	1692	15792	86292
202(1)a	Removal of Box Culverts (all sizes)	m		27.10	0	10	10	20	0	0	0	0
202(2)	Removal of existing Structures (inlet & outlet structures)	nr		20.30	0	10	10	20	0	0	0	0
202(2)a	Removal of existing Baily Bridge	nr		7,000.00	0	10	10	20	0	0	0	0
202(3)	Removal of existing Penetration Macadam	m^2	27600	1.75	48300	10	10	20	9660	1159	10819	59119
202(4)a	Removal of existing Pipe, 760mm dia. or less	m		18.10	0	10	10	20	0	0	0	0
202(4)b	Removal of existing Pipe, 910mm dia. or more	m		23.65	0	10	10	20	0	0	0	0
202(4)c	Removal of existing Lined Ditch	m		4.10	0	10	10	20	0	0	0	0
202(4)d	Removal of existing Stone Masonry Retaining Wall	m		10.25	0	10	10	20	0	0	0	0
203(4)e	Removal of existing Gabions	m		8.30	0	10	10	20	0	0	0	0
203(1)	Unsuitable Excavation	m^3		4.50	0	10	10	20	0	0	0	0
203(2)	Surplus Common Excavation	m^3	24125	3.80	91675	10	10	20	18335	2200	20535	112210
203(3)a	Surplus Hard Rock Excation	m^3	1665	21.60	35964	10	10	20	7193	863	8056	44020
203(3)b	Surplus Soft Rock Excavation	m^3	11825	13.00	153725	10	10	20	30745	3689	34434	188159
204(1)	Structure Excavation	m^3		4.85	0	10	10	20	0	0	0	0
204(3)	Foundation Fill	m^3		35.30	0	10	10	20	0	0	0	0
204(6)	Pipe Culverts and Lined Drain Excavation	m^3		5.75	0	10	10	20	0	0	0	0
205(1)a	Embankment from Roadway Excavation	m^3	17750	4.20	74550	10	10	20	14910	1789	16699	91249
205(1)b	Embankment Selected Borrow Excavation	m^3	2100	22.50	47250	10	10	20	9450	1134	10584	57834
206(1)	Subgrade Preparation (Common Material)	m^2	9150	1.15	10523	10	10	20	2105	253	2357	12880
206(2)a	Subgrade Preparation (Existing Macadam Pavement)	m^2	14000	0.95	13300	10	10	20	2660	319	2979	16279
206(2)b	Subgrade Preparation (Existing Gravel Shoulder)	m^2	10675	1.20	12810	10	10	20	2562	307	2869	15679
300	**SUBBASE AND BASE COURSE**										**Sub-Total (Earthworks)**	**774,462**
301	Aggregate Subbase Course	m^3	17862	59.00	1053880	10	10	20	210776	25293	236069	1289949
303(1)	Crushed Aggregate Base Course, Grading B	m^3	19592	64.00	1253868	10	10	20	250774	30093	280866	1534734
400	**SURFACE COURSE**										**Sub-Total (Subbase & Base Course)**	**2,824,684**

402(1)	Bituminous Prime Coat (Cut Back Asphalt Grade MC-70)	ton	148	1,595.00	236361	10	10	20	47272	5673	52945	289306
403(2)	Bituminous Tack Coat (Emulsified Asphalt Grade CSS-1)	ton	1	1,686.00	843	10	10	20	169	20	189	1032
411(1)	Bitumous Concrete Surface Course, Hot Laid 50mm thick	ton	10143	174.00	1764882	10	10	20	352976	42357	395334	2160216
500	**BRIDGE & BOX CULVERT CONSTRUCTION**										**Sub-Total (Surface Course)**	**2,450,554**
501A(1)	Low-Strain Dynamic Method: Pile Integrity Test (PIT)	nr		125.00	0	10	10	20	0	0	0	0
501B(1)	High-Strain Dynamic Pile Test	nr		240.00	0	10	10	20	0	0	0	0
501(16)	Concrete Piles cast in Drilled Holes -800 mm diameter	m		1,044.00	0	10	10	20	0	0	0	0
502	Concrete Railing	m		155.00	0	10	10	20	0	0	0	0
504A(1)	Steel Decking for Slab (Base metal, 0.60 mm thickness)	m^2		335.00	0	10	10	20	0	0	0	0
505(2)	Reinforcing Steel Bars, Grade 60	kg		1.90	0	10	10	20	0	0	0	0
506(1)	Structural Concrete, Class A	m^3		219.00	0	10	10	20	0	0	0	0
506(2)	Structural Concrete, Class B	m^3		188.00	0	10	10	20	0	0	0	0
506(3)	Structural Concrete, Class C	m^3		204.00	0	10	10	20	0	0	0	0
507(1)	Prestressed Concrete AASHTO Type IV Girder - 23.90 m length	nr		42,320.00	0	10	10	20	0	0	0	0
508(1)	Elastomeric bearing Pad (Free - 660mmx306mmx52mm)	nr		164.00	0	10	10	20	0	0	0	0
508(2)	Bridge Drainage Pipe PVC 200 mm diameter	m		7.20	0	10	10	20	0	0	0	0
513	Expansion Joint - Neoprene Type for 50 mm gap	a		212.00	0	10	10	20	0	0	0	0
600	**DRAINAGE AND SLOPE PROTECTION WORKS**										**Sub-Total (Bridge & Box Culvert)**	**2,610,000**
601(1)a	RC Pipe Culvert, 910mm diameter	m		328.00	0	10	10	20	0	0	0	0
601(1)b	RC Pipe Culvert, 1070mm diameter	m		362.00	0	10	10	20	0	0	0	0
601(1)c	RC Pipe Culvert, 1220mm diameter	m		411.00	0	10	10	20	0	0	0	0
601(1)d	RC Pipe Culvert, 1520mm diameter	m		552.00	0	10	10	20	0	0	0	0
603(2)	Stone Masonry Curb Inlet Manhole	nr		457.00	0	10	10	20	0	0	0	0
604(3)a	Cleaning Culverts in place (910 mm diameter or less)	m		2.50	0	10	10	20	0	0	0	0
604(3)b	Cleaning Culverts in place (1220 mm diameter or more)	m		2.90	0	10	10	20	0	0	0	0
604(3)c	Cleaning of Box Culverts (all sizes)	m		4.00	0	10	10	20	0	0	0	0
604(4)a	Reconditioning of Drainage Structures (Inlets and Outlets)	nr		20.80	0	10	10	20	0	0	0	0
604(4)b	Reconditioning of Drainage Structures (Lined Ditch Type B-1)	m		3.70	0	10	10	20	0	0	0	0
604(4)c	Reconditioning of Drainage Structures (Lined Ditch Type B-3)	m		4.40	0	10	10	20	0	0	0	0
605(5)	Grouted Riprap, Class A	m^3	2050	70.50	144525	10	10	20	28905	3469	32374	176899
606	Stone Masonry	m^3	5500	76.00	418000	10	10	20	83600	10032	93632	511632
607	Hand Laid Rock Embankment	m^3		35.00	0	10	10	20	0	0	0	0
610	Gabions	m^3	2900	86.50	250850	10	10	20	50170	6020	56190	307040
700	**MISCELLANEOUS STRUCTURES**										**Sub-Total (Drainage & Slope Protection Works)**	**995,571**
701(3)	Curb and Gutter (Type A), Curb with Precast ????	m	800	35.00	28000	10	10	20	5600	672	6272	34272
703(4)	Guide Posts	nr	46	39.50	1817	10	10	20	363	44	407	2224
704(3)a	Metal Guardrail (Metal Beam)	m	1015	69.00	70035	10	10	20	14007	1681	15688	85723
704(3)b	Metal End Guardrail	nr	15	49.00	735	10	10	20	147	18	165	900
704A(2)	Remove, Repair and Re-install Guardrail Beam	m	1	17.00	17	10	10	20	3	0	4	21
706(1)	Warning Signs	nr	40.6	295.00	11977	10	10	20	2395	287	2683	14660
706(2)	Regulatory Signs	nr	17.4	295.00	5133	10	10	20	1027	123	1150	6283
706(3)	Informatory Signs	nr	10	1,250.00	12500	10	10	20	2500	300	2800	15300
707(1)	Pavement Markings (Premixed Reflective), White/Yellow	m^2	100	26.10	2610	10	10	20	522	63	585	3195
710(1)a	Reflectorized Thermoplastic Pavement Markings (White)	m^2	2530	75.00	189750	10	10	20	37950	4554	42504	232254
710(1)b	Reflectorized Thermoplastic Pavement Markings (Yellow)	m^2	795	79.00	62805	10	10	20	12561	1507	14068	76873
800	**BIO-ENGINEERING**										**Sub-Total (Miscellaneous Structures)**	**471,704**
803(1)	Slope Trimming and Preparation	m^2	11100	1.40	15540	10	10	20	3108	373	3481	19021
805(3)	Planting of Grass Slips	m^2	6660	2.50	16650	10	10	20	3330	400	3730	20380
805(4)	Planting Tree/Shrub	nr	555	2.75	1526	10	10	20	305	37	342	1868
											Sub-Total (Bio-Engineering)	**41,269**
											TOTAL CIVIL WORKS COST except MOB/DEMOB	**10,339,449**
											TOTAL CIVIL WORKS COST with MOB/DEMOB	**10,466,004**
											Cost $M/KM	**0.91**

Note: Bridges and special culverts in separate detail estimate.

Cost Estimates
Manatuto – Natarbora Road (A09)
Jct Laclubar – Mane Hat (A09-3), km 99.5 – km 133, Length = 33.5 kms

SECTION	DESCRIPTION	UNIT	QTY	DIRECT COST		INDIRECT COST						TOTAL COST
						MARK UP				TAX	TOTAL	
				UNIT COST	TOTAL	OCM %	PROFIT %	TOTAL %	TOTAL AMOUNT	2% of (6)+(10)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
101	**FACILITIES FOR THE ENGINEERS**											
101.2b	Provide, Operate and Maintain Main Office and Laboratory for the Engineer on Rental Basis	mo.	24	1,900.00	45600	10	10	20	9120	1094	10214	55814
101.2c	Provide, Operate and Maintain Living Quarters for the the Engineer on Rental Basis	mo.	24	1,100.00	26400	10	10	20	5280	634	5914	32314
101.2d	Provide Equipt, Furnitures/Fixtures and appliances for the Main Office, Lab & Living Qrts for the Engr.	l.s.	1	23,360.00	23360	10	10	20	4672	561	5233	28593
101.2e	Provide and Maintain Communication Facility for the Engineer	mo.	24	750.00	18000	10	10	20	3600	432	4032	22032
101.2f	Provide Supplies and Consumable Stores for Field Office, Laboratory and Living Quarters for the Engineer	mo.	24	586.89	14085	10	10	20	2817	338	3155	17240
101.2.1a	Provide, Operate and Maintain Service Vehicle for the Enginee, 4WD pick-up double crew cab (4 units)	mo.	24	2,257.38	54177	10	10	20	10835	1300	12136	66313
101.3.1a	Provide and Maintain Survey Instruments/Equipment for the assistance to the engineer	l.s.	1	12,000.00	12000	10	10	20	2400	288	2688	14688
101.3.1b	Provide and Maintain Laboratory Testing Equipment and Apparatus	l.s.	1	18,000.00	18000	10	10	20	3600	432	4032	22032
101.3.c	Provision of Survey Personnel	mo.	24	1,800.00	43200	10	10	20	8640	1037	9677	52877
101.3.d	Provision of Laboratory Personnel	mo.	24	2,300.00	55200	10	10	20	11040	1325	12365	67565
101.4.1	Progress Photographs	mo.	24	120.00	2880	10	10	20	576	69	645	3525
										Sub-Total (Facilities for the Engineer)		**382,993**
102	**OTHER GENERAL REQUIREMENTS**											
102.1a	Mobilization (0.75% of Civil Works)	l.s.	1	214,013	214013	10	10	20	42803	5136	47939	261952
102.1b	Demobilization (0.25% of Civil Works)	l.s.	1	71,338	71338	10	10	20	14268	1712	15980	87317
200	**EARTHWORKS**									**Sub-Total (Other General Requirements)**		**349,270**
201 (1)	Clearing and Grubbing	ha	56	2,283.00	127563	10	10	20	25513	3062	28574	156137
201(3)	Individual Removal of Trees (Small)	nr	3125	42.00	131250	10	10	20	26250	3150	29400	160650
201(4)	Individual Removal of Trees (Small Large)	nr	2288	120.00	274500	10	10	20	54900	6588	61488	335988
202(1)a	Removal of Box Culverts (all sizes)	m		27.10	0	10	10	20	0	0	0	0
202(2)	Removal of existing Structures (inlet & outlet structures)	nr		20.30	0	10	10	20	0	0	0	0
202(2)a	Removal of existing Baily Bridge	nr		7,000.00	0	10	10	20	0	0	0	0
202(3)	Removal of existing Penetration Macadam	m^2	80400	1.75	140700	10	10	20	28140	3377	31517	172217
202(4)a	Removal of existing Pipe, 760mm dia. or less	m		18.10	0	10	10	20	0	0	0	0
202(4)b	Removal of existing Pipe, 910mm dia. or more	m		23.65	0	10	10	20	0	0	0	0
202(4)c	Removal of existing Lined Ditch	m		4.10	0	10	10	20	0	0	0	0
202(4)d	Removal of existing Stone Masonry Retaining Wall	m		10.25	0	10	10	20	0	0	0	0
203(4)e	Removal of existing Gabions	m		8.30	0	10	10	20	0	0	0	0
203(1)	Unsuitable Excavation	m^3		4.50	0	10	10	20	0	0	0	0
203(2)	Surplus Common Excavation	m^3	105425	3.80	400615	10	10	20	80123	9615	89738	490353
203(3)a	Surplus Hard Rock Excation	m^3	6005	21.60	129708	10	10	20	25942	3113	29055	158763
203(3)b	Surplus Soft Rock Excavation	m^3	53925	13.00	701025	10	10	20	140205	16825	157030	858055
204(1)	Structure Excavation	m^3		4.85	0	10	10	20	0	0	0	0
204(3)	Foundation Fill	m^3		35.30	0	10	10	20	0	0	0	0
204(6)	Pipe Culverts and Lined Drain Excavation	m^3		5.75	0	10	10	20	0	0	0	0
205(1)a	Embankment from Roadway Excavation	m^3	35350	4.20	148470	10	10	20	29694	3563	33257	181727
205(1)b	Embankment Selected Borrow Excavation	m^3	9200	22.50	207000	10	10	20	41400	4968	46368	253368
206(1)	Subgrade Preparation (Common Material)	m^2	38950	1.15	44793	10	10	20	8959	1075	10034	54826
206(2)a	Subgrade Preparation (Existing Macadam Pavement)	m^2	43400	0.95	41230	10	10	20	8246	990	9236	50466
206(2)b	Subgrade Preparation (Existing Gravel Shoulder)	m^2	34475	1.20	41370	10	10	20	8274	993	9267	50637
300	**SUBBASE AND BASE COURSE**										**Sub-Total (Earthworks)**	**2,923,185**
301	Aggregate Subbase Course	m^3	50879	59.00	3001854	10	10	20	600371	72044	672415	3674269
303(1)	Crushed Aggregate Base Course, Grading B	m^3	52355	64.00	3350732	10	10	20	670146	80418	750564	4101296
400	**SURFACE COURSE**										**Sub-Total (Subbase & Base Course)**	**7,775,565**

402(1)	Bituminous Prime Coat (Cut Back Asphalt Grade MC-70)	ton	458	1,595.00	730288	10	10	20	146058	17527	163585	893873
403(2)	Bituminous Tack Coat (Emulsified Asphalt Grade CSS-1)	ton	1	1,686.00	843	10	10	20	169	20	189	1032
411(1)	Bitumous Concrete Surface Course, Hot Laid 50mm thick	ton	31395	174.00	5462730	10	10	20	1092546	131106	1223652	6686382
500	**BRIDGE & BOX CULVERT CONSTRUCTION**										**Sub-Total (Surface Course)**	**7,581,286**
501A(1)	Low-Strain Dynamic Method: Pile Integrity Test (PIT)	nr		125.00	0	10	10	20	0	0	0	0
501B(1)	High-Strain Dynamic Pile Test	nr		240.00	0	10	10	20	0	0	0	0
501(16)	Concrete Piles cast in Drilled Holes -800 mm diameter	m		1,044.00	0	10	10	20	0	0	0	0
502	Concrete Railing	m		155.00	0	10	10	20	0	0	0	0
504A(1)	Steel Decking for Slab (Base metal, 0.60 mm thickness)	m^2		335.00	0	10	10	20	0	0	0	0
505(2)	Reinforcing Steel Bars, Grade 60	kg		1.90	0	10	10	20	0	0	0	0
506(1)	Structural Concrete, Class A	m^3		219.00	0	10	10	20	0	0	0	0
506(2)	Structural Concrete, Class B	m^3		188.00	0	10	10	20	0	0	0	0
506(3)	Structural Concrete, Class C	m^3		204.00	0	10	10	20	0	0	0	0
507(1)	Prestressed Concrete AASHTO Type IV Girder - 23.90 m length	nr		42,320.00	0	10	10	20	0	0	0	0
508(1)	Elastomeric bearing Pad (Free - 660mmx306mmx52mm)	nr		164.00	0	10	10	20	0	0	0	0
508(2)	Bridge Drainage Pipe PVC 200 mm diameter	m		7.20	0	10	10	20	0	0	0	0
513	Expansion Joint - Neoprene Type for 50 mm gap	a		212.00	0	10	10	20	0	0	0	0
600	**DRAINAGE AND SLOPE PROTECTION WORKS**										**Sub-Total (Bridge & Box Culvert)**	**3,948,000**
601(1)a	RC Pipe Culvert, 910mm diameter	m		328.00	0	10	10	20	0	0	0	0
601(1)b	RC Pipe Culvert, 1070mm diameter	m		362.00	0	10	10	20	0	0	0	0
601(1)c	RC Pipe Culvert, 1220mm diameter	m		411.00	0	10	10	20	0	0	0	0
601(1)d	RC Pipe Culvert, 1520mm diameter	m		552.00	0	10	10	20	0	0	0	0
603(2)	Stone Masonry Curb Inlet Manhole	nr		457.00	0	10	10	20	0	0	0	0
604(3)a	Cleaning Culverts in place (910 mm diameter or less)	m		2.50	0	10	10	20	0	0	0	0
604(3)b	Cleaning Culverts in place (1220 mm diameter or more)	m		2.90	0	10	10	20	0	0	0	0
604(3)c	Cleaning of Box Culverts (all sizes)	m		4.00	0	10	10	20	0	0	0	0
604(4)a	Reconditioning of Drainage Structures (Inlets and Outlets)	nr		20.80	0	10	10	20	0	0	0	0
604(4)b	Reconditioning of Drainage Structures (Lined Ditch Type B-1)	m		3.70	0	10	10	20	0	0	0	0
604(4)c	Reconditioning of Drainage Structures (Lined Ditch Type B-3)	m		4.40	0	10	10	20	0	0	0	0
605(5)	Grouted Riprap, Class A	m^3	9000	70.50	634500	10	10	20	126900	15228	142128	776628
606	Stone Masonry	m^3	23900	76.00	1816400	10	10	20	363280	43594	406874	2223274
607	Hand Laid Rock Embankment	m^3		35.00	0	10	10	20	0	0	0	0
610	Gabions	m^3	12200	86.50	1055300	10	10	20	211060	25327	236387	1291687
700	**MISCELLANEOUS STRUCTURES**										**Sub-Total (Drainage & Slope Protection Works)**	**4,291,589**
701(3)	Curb and Gutter (Type A), Curb with Precast ????	m	800	35.00	28000	10	10	20	5600	672	6272	34272
703(4)	Guide Posts	nr	134	39.50	5293	10	10	20	1059	127	1186	6479
704(3)a	Metal Guardrail (Metal Beam)	m	4495	69.00	310155	10	10	20	62031	7444	69475	379630
704(3)b	Metal End Guardrail	nr	15	49.00	735	10	10	20	147	18	165	900
704A(2)	Remove, Repair and Re-install Guardrail Beam	m	1	17.00	17	10	10	20	3	0	4	21
706(1)	Warning Signs	nr	117.6	295.00	34692	10	10	20	6938	833	7771	42463
706(2)	Regulatory Signs	nr	50.4	295.00	14868	10	10	20	2974	357	3330	18198
706(3)	Informatory Signs	nr	10	1,250.00	12500	10	10	20	2500	300	2800	15300
707(1)	Pavement Markings (Premixed Reflective), White/Yellow	m^2	100	26.10	2610	10	10	20	522	63	585	3195
710(1)a	Reflectorized Thermoplastic Pavement Markings (White)	m^2	7370	75.00	552750	10	10	20	110550	13266	123816	676566
710(1)b	Reflectorized Thermoplastic Pavement Markings (Yellow)	m^2	2565	79.00	202635	10	10	20	40527	4863	45390	248025
800	**BIO-ENGINEERING**										**Sub-Total (Miscellaneous Structures)**	**1,425,048**
803(1)	Slope Trimming and Preparation	m^2	55800	1.40	78120	10	10	20	15624	1875	17499	95619
805(3)	Planting of Grass Slips	m^2	33480	2.50	83700	10	10	20	16740	2009	18749	102449
805(4)	Planting Tree/Shrub	nr	2790	2.75	7673	10	10	20	1535	184	1719	9391
											Sub-Total (Bio-Engineering)	**207,459**
											OTAL CIVIL WORKS COST except MOB/DEMOB	**28,535,125**
											TOTAL CIVIL WORKS COST with MOB/DEMOB	**28,884,394**
											Cost $M/KM	**0.86**

Cost Estimates
Manatuto – Natarbora Road (A09)
Mane Hat – Natarbora (A09-4), km 133 – km 144.7, Length = 11.7 kms

SECTION	DESCRIPTION	UNIT	QTY	DIRECT COST		INDIRECT COST						TOTAL COST
						MARK UP				TAX	TOTAL	
				UNIT COST	TOTAL	OCM %	PROFIT %	TOTAL %	TOTAL AMOUNT	2% of (6)+(10)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
101	**FACILITIES FOR THE ENGINEERS**											
101.2b	Provide, Operate and Maintain Main Office and Laboratory for the Engineer on Rental Basis	mo.	8	1,900.00	15200	10	10	20	3040	365	3405	18605
101.2c	Provide, Operate and Maintain Living Quarters for the the Engineer on Rental Basis	mo.	8	1,100.00	8800	10	10	20	1760	211	1971	10771
101.2d	Provide Equipt, Furnitures/Fixtures and appliances for the Main Office, Lab & Living Qrts for the Engr.	l.s.	1	23,360.00	23360	10	10	20	4672	561	5233	28593
101.2e	Provide and Maintain Communication Facility for the Engineer	mo.	8	750.00	6000	10	10	20	1200	144	1344	7344
101.2f	Provide Supplies and Consumable Stores for Field Office, Laboratory and Living Quarters for the Engineer	mo.	8	586.89	4695	10	10	20	939	113	1052	5747
101.2.1a	Provide, Operate and Maintain Service Vehicle for the Enginee, 4WD pick-up double crew cab (4 units)	mo.	8	2,257.38	18059	10	10	20	3612	433	4045	22104
101.3.1a	Provide and Maintain Survey Instruments/Equipment for the assistance to the engineer	l.s.	1	12,000.00	12000	10	10	20	2400	288	2688	14688
101.3.1b	Provide and Maintain Laboratory Testing Equipment and Apparatus	l.s.	1	18,000.00	18000	10	10	20	3600	432	4032	22032
101.3.c	Provision of Survey Personnel	mo.	8	1,800.00	14400	10	10	20	2880	346	3226	17626
101.3.d	Provision of Laboratory Personnel	mo.	8	2,300.00	18400	10	10	20	3680	442	4122	22522
101.4.1	Progress Photographs	mo.	8	120.00	960	10	10	20	192	23	215	1175
										Sub-Total (Facilities for the Engineer)		**171,206**
102	**OTHER GENERAL REQUIREMENTS**											
102.1a	Mobilization (0.75% of Civil Works)	l.s.	1	57,096	57096	10	10	20	11419	1370	12789	69885
102.1b	Demobilization (0.25% of Civil Works)	l.s.	1	19,032	19032	10	10	20	3806	457	4263	23295
200	**EARTHWORKS**									**Sub-Total (Other General Requirements)**		**93,180**
201 (1)	Clearing and Grubbing	ha	15	2,283.00	35272	10	10	20	7054	847	7901	43173
201(3)	Individual Removal of Trees (Small)	nr	773	42.00	32445	10	10	20	6489	779	7268	39713
201(4)	Individual Removal of Trees (Small Large)	nr	480	120.00	57600	10	10	20	11520	1382	12902	70502
202(1)a	Removal of Box Culverts (all sizes)	m		27.10	0	10	10	20	0	0	0	0
202(2)	Removal of existing Structures (inlet & outlet structures)	nr		20.30	0	10	10	20	0	0	0	0
202(2)a	Removal of existing Baily Bridge	nr		7,000.00	0	10	10	20	0	0	0	0
202(3)	Removal of existing Penetration Macadam	m^2	28080	1.75	49140	10	10	20	9828	1179	11007	60147
202(4)a	Removal of existing Pipe, 760mm dia. or less	m		18.10	0	10	10	20	0	0	0	0
202(4)b	Removal of existing Pipe, 910mm dia. or more	m		23.65	0	10	10	20	0	0	0	0
202(4)c	Removal of existing Lined Ditch	m		4.10	0	10	10	20	0	0	0	0
202(4)d	Removal of existing Stone Masonry Retaining Wall	m		10.25	0	10	10	20	0	0	0	0
203(4)e	Removal of existing Gabions	m		8.30	0	10	10	20	0	0	0	0
203(1)	Unsuitable Excavation	m^3		4.50	0	10	10	20	0	0	0	0
203(2)	Surplus Common Excavation	m^3	7140	3.80	27132	10	10	20	5426	651	6078	33210
203(3)a	Surplus Hard Rock Excation	m^3	2250	21.60	48600	10	10	20	9720	1166	10886	59486
203(3)b	Surplus Soft Rock Excavation	m^3	7590	13.00	98670	10	10	20	19734	2368	22102	120772
204(1)	Structure Excavation	m^3		4.85	0	10	10	20	0	0	0	0
204(3)	Foundation Fill	m^3		35.30	0	10	10	20	0	0	0	0
204(6)	Pipe Culverts and Lined Drain Excavation	m^3		5.75	0	10	10	20	0	0	0	0
205(1)a	Embankment from Roadway Excavation	m^3	34110	4.20	143262	10	10	20	28652	3438	32091	175353
205(1)b	Embankment Selected Borrow Excavation	m^3	1875	22.50	42188	10	10	20	8438	1013	9450	51638
206(1)	Subgrade Preparation (Common Material)	m^2	8550	1.15	9833	10	10	20	1967	236	2202	12035
206(2)a	Subgrade Preparation (Existing Macadam Pavement)	m^2	12720	0.95	12084	10	10	20	2417	290	2707	14791
206(2)b	Subgrade Preparation (Existing Gravel Shoulder)	m^2	10815	1.20	12978	10	10	20	2596	311	2907	15885
300	**SUBBASE AND BASE COURSE**										**Sub-Total (Earthworks)**	**696,705**
301	Aggregate Subbase Course	m^3	18568	59.00	1095506	10	10	20	219101	26292	245393	1340899
303(1)	Crushed Aggregate Base Course, Grading B	m^3	21545	64.00	1378868	10	10	20	275774	33093	308867	1687735
400	**SURFACE COURSE**										**Sub-Total (Subbase & Base Course)**	**3,028,634**

402(1)	Bituminous Prime Coat (Cut Back Asphalt Grade MC-70)	ton	142	1,595.00	226196	10	10	20	45239	5429	50668	276864
403(2)	Bituminous Tack Coat (Emulsified Asphalt Grade CSS-1)	ton	1	1,686.00	843	10	10	20	169	20	189	1032
411(1)	Bitumous Concrete Surface Course, Hot Laid 50mm thick	ton	9688	174.00	1685642	10	10	20	337128	40455	377584	2063226
500	**BRIDGE & BOX CULVERT CONSTRUCTION**										**Sub-Total (Surface Course)**	**2,341,122**
501A(1)	Low-Strain Dynamic Method: Pile Integrity Test (PIT)	nr		125.00	0	10	10	20	0	0	0	0
501B(1)	High-Strain Dynamic Pile Test	nr		240.00	0	10	10	20	0	0	0	0
501(16)	Concrete Piles cast in Drilled Holes -800 mm diameter	m		1,044.00	0	10	10	20	0	0	0	0
502	Concrete Railing	m		155.00	0	10	10	20	0	0	0	0
504A(1)	Steel Decking for Slab (Base metal, 0.60 mm thickness)	m^2		335.00	0	10	10	20	0	0	0	0
505(2)	Reinforcing Steel Bars, Grade 60	kg		1.90	0	10	10	20	0	0	0	0
506(1)	Structural Concrete, Class A	m^3		219.00	0	10	10	20	0	0	0	0
506(2)	Structural Concrete, Class B	m^3		188.00	0	10	10	20	0	0	0	0
506(3)	Structural Concrete, Class C	m^3		204.00	0	10	10	20	0	0	0	0
507(1)	Prestressed Concrete AASHTO Type IV Girder - 23.90 m length	nr		42,320.00	0	10	10	20	0	0	0	0
508(1)	Elastomeric bearing Pad (Free - 660mmx306mmx52mm)	nr		164.00	0	10	10	20	0	0	0	0
508(2)	Bridge Drainage Pipe PVC 200 mm diameter	m		7.20	0	10	10	20	0	0	0	0
513	Expansion Joint - Neoprene Type for 50 mm gap	a		212.00	0	10	10	20	0	0	0	0
600	**DRAINAGE AND SLOPE PROTECTION WORKS**										**Sub-Total (Bridge & Box Culvert)**	**120,000**
601(1)a	RC Pipe Culvert, 910mm diameter	m		328.00	0	10	10	20	0	0	0	0
601(1)b	RC Pipe Culvert, 1070mm diameter	m		362.00	0	10	10	20	0	0	0	0
601(1)c	RC Pipe Culvert, 1220mm diameter	m		411.00	0	10	10	20	0	0	0	0
601(1)d	RC Pipe Culvert, 1520mm diameter	m		552.00	0	10	10	20	0	0	0	0
603(2)	Stone Masonry Curb Inlet Manhole	nr		457.00	0	10	10	20	0	0	0	0
604(3)a	Cleaning Culverts in place (910 mm diameter or less)	m		2.50	0	10	10	20	0	0	0	0
604(3)b	Cleaning Culverts in place (1220 mm diameter or more)	m		2.90	0	10	10	20	0	0	0	0
604(3)c	Cleaning of Box Culverts (all sizes)	m		4.00	0	10	10	20	0	0	0	0
604(4)a	Reconditioning of Drainage Structures (Inlets and Outlets)	nr		20.80	0	10	10	20	0	0	0	0
604(4)b	Reconditioning of Drainage Structures (Lined Ditch Type B-1)	m		3.70	0	10	10	20	0	0	0	0
604(4)c	Reconditioning of Drainage Structures (Lined Ditch Type B-3)	m		4.40	0	10	10	20	0	0	0	0
605(5)	Grouted Riprap, Class A	m^3	1605	70.50	113153	10	10	20	22631	2716	25346	138499
606	Stone Masonry	m^3	4170	76.00	316920	10	10	20	63384	7606	70990	387910
607	Hand Laid Rock Embankment	m^3		35.00	0	10	10	20	0	0	0	0
610	Gabions	m^3	2460	86.50	212790	10	10	20	42558	5107	47665	260455
700	**MISCELLANEOUS STRUCTURES**										**Sub-Total (Drainage & Slope Protection Works)**	**786,864**
701(3)	Curb and Gutter (Type A), Curb with Precast ????	m	800	35.00	28000	10	10	20	5600	672	6272	34272
703(4)	Guide Posts	nr	46.8	39.50	1849	10	10	20	370	44	414	2263
704(3)a	Metal Guardrail (Metal Beam)	m	792	69.00	54648	10	10	20	10930	1312	12241	66889
704(3)b	Metal End Guardrail	nr	15	49.00	735	10	10	20	147	18	165	900
704A(2)	Remove, Repair and Re-install Guardrail Beam	m	1	17.00	17	10	10	20	3	0	4	21
706(1)	Warning Signs	nr	41.3	295.00	12184	10	10	20	2437	292	2729	14913
706(2)	Regulatory Signs	nr	17.7	295.00	5222	10	10	20	1044	125	1170	6391
706(3)	Informatory Signs	nr	10	1,250.00	12500	10	10	20	2500	300	2800	15300
707(1)	Pavement Markings (Premixed Reflective), White/Yellow	m^2	100	26.10	2610	10	10	20	522	63	585	3195
710(1)a	Reflectorized Thermoplastic Pavement Markings (White)	m^2	2574	75.00	193050	10	10	20	38610	4633	43243	236293
710(1)b	Reflectorized Thermoplastic Pavement Markings (Yellow)	m^2	740	79.00	58421	10	10	20	11684	1402	13086	71507
800	**BIO-ENGINEERING**										**Sub-Total (Miscellaneous Structures)**	**451,943**
803(1)	Slope Trimming and Preparation	m^2	4380	1.40	6132	10	10	20	1226	147	1374	7506
805(3)	Planting of Grass Slips	m^2	2628	2.50	6570	10	10	20	1314	158	1472	8042
805(4)	Planting Tree/Shrub	nr	219	2.75	602	10	10	20	120	14	135	737
											Sub-Total (Bio-Engineering)	**16,284**
											OTAL CIVIL WORKS COST except MOB/DEMOB	**7,612,758**
											TOTAL CIVIL WORKS COST with MOB/DEMOB	**7,705,938**
											Cost $M/KM	**0.66**

Note: Bridges and special culverts in separate detail estimate.

Cost Estimates
Junction Laclubar – Laclubar
C15, km 0 – km 10.3, Length = 10.3 kms

SECTION	DESCRIPTION	UNIT	QTY	DIRECT COST		INDIRECT COST						TOTAL COST
						MARK UP				TAX	TOTAL	
				UNIT COST	TOTAL	OCM %	PROFIT %	TOTAL %	TOTAL AMOUNT	2% of (6)+(10)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
101	**FACILITIES FOR THE ENGINEERS**											
101.2b	Provide, Operate and Maintain Main Office and Laboratory for the Engineer on Rental Basis	mo.	12	1,900.00	22800	10	10	20	4560	547	5107	27907
101.2c	Provide, Operate and Maintain Living Quarters for the the Engineer on Rental Basis	mo.	12	1,100.00	13200	10	10	20	2640	317	2957	16157
101.2d	Provide Equipt, Furnitures/Fixtures and appliances for the Main Office, Lab & Living Qrts for the Engr.	l.s.	1	23,360.00	23360	10	10	20	4672	561	5233	28593
101.2e	Provide and Maintain Communication Facility for the Engineer	mo.	12	750.00	9000	10	10	20	1800	216	2016	11016
101.2f	Provide Supplies and Consumable Stores for Field Office, Laboratory and Living Quarters for the Engineer	mo.	12	586.89	7043	10	10	20	1409	169	1578	8620
101.2.1a	Provide, Operate and Maintain Service Vehicle for the Enginee, 4WD pick-up double crew cab (4 units)	mo.	12	2,257.38	27089	10	10	20	5418	650	6068	33156
101.3.1a	Provide and Maintain Survey Instruments/Equipment for the assistance to the engineer	l.s.	1	12,000.00	12000	10	10	20	2400	288	2688	14688
101.3.1b	Provide and Maintain Laboratory Testing Equipment and Apparatus	l.s.	1	18,000.00	18000	10	10	20	3600	432	4032	22032
101.3.c	Provision of Survey Personnel	mo.	12	1,800.00	21600	10	10	20	4320	518	4838	26438
101.3.d	Provision of Laboratory Personnel	mo.	12	2,300.00	27600	10	10	20	5520	662	6182	33782
101.4.1	Progress Photographs	mo.	12	120.00	1440	10	10	20	288	35	323	1763
										Sub-Total (Facilities for the Engineer)		**224,153**
102	**OTHER GENERAL REQUIREMENTS**											
102.1a	Mobilization (0.75% of Civil Works)	l.s.	1	61,921	61921	10	10	20	12384	1486	13870	75792
102.1b	Demobilization (0.25% of Civil Works)	l.s.	1	20,640	20640	10	10	20	4128	495	4623	25264
										Sub-Total (Other General Requirements)		**101,055**
200	**EARTHWORKS**											
201 (1)	Clearing and Grubbing	ha	17	2,283.00	37727	10	10	20	7545	905	8451	46177
201(3)	Individual Removal of Trees (Small)	nr	893	42.00	37485	10	10	20	7497	900	8397	45882
201(4)	Individual Removal of Trees (Small Large)	nr	635	120.00	76200	10	10	20	15240	1829	17069	93269
202(1)a	Removal of Box Culverts (all sizes)	m		27.10	0	10	10	20	0	0	0	0
202(2)	Removal of existing Structures (inlet & outlet structures)	nr		20.30	0	10	10	20	0	0	0	0
202(2)a	Removal of existing Baily Bridge	nr		7,000.00	0	10	10	20	0	0	0	0
202(3)	Removal of existing Penetration Macadam	m^2	24720	1.75	43260	10	10	20	8652	1038	9690	52950
202(4)a	Removal of existing Pipe, 760mm dia. or less	m		18.10	0	10	10	20	0	0	0	0
202(4)b	Removal of existing Pipe, 910mm dia. or more	m		23.65	0	10	10	20	0	0	0	0
202(4)c	Removal of existing Lined Ditch	m		4.10	0	10	10	20	0	0	0	0
202(4)d	Removal of existing Stone Masonry Retaining Wall	m		10.25	0	10	10	20	0	0	0	0
203(4)e	Removal of existing Gabions	m		8.30	0	10	10	20	0	0	0	0
203(1)	Unsuitable Excavation	m^3		4.50	0	10	10	20	0	0	0	0
203(2)	Surplus Common Excavation	m^3	21255	3.80	80769	10	10	20	16154	1938	18092	98861
203(3)a	Surplus Hard Rock Excation	m^3	2251	21.60	48622	10	10	20	9724	1167	10891	59513
203(3)b	Surplus Soft Rock Excavation	m^3	13955	13.00	181415	10	10	20	36283	4354	40637	222052
204(1)	Structure Excavation	m^3		4.85	0	10	10	20	0	0	0	0
204(3)	Foundation Fill	m^3		35.30	0	10	10	20	0	0	0	0
204(6)	Pipe Culverts and Lined Drain Excavation	m^3		5.75	0	10	10	20	0	0	0	0
205(1)a	Embankment from Roadway Excavation	m^3	21500	4.20	90300	10	10	20	18060	2167	20227	110527
205(1)b	Embankment Selected Borrow Excavation	m^3	2715	22.50	61088	10	10	20	12218	1466	13684	74771
206(1)	Subgrade Preparation (Common Material)	m^2	8990	1.15	10339	10	10	20	2068	248	2316	12654
206(2)a	Subgrade Preparation (Existing Macadam Pavement)	m^2	12880	0.95	12236	10	10	20	2447	294	2741	14977
206(2)b	Subgrade Preparation (Existing Gravel Shoulder)	m^2	10640	1.20	12768	10	10	20	2554	306	2860	15628
300	**SUBBASE AND BASE COURSE**										**Sub-Total (Earthworks)**	**847,262**
301	Aggregate Subbase Course	m^3	15889	59.00	937450	10	10	20	187490	22499	209989	1147438
303(1)	Crushed Aggregate Base Course, Grading B	m^3	17100	64.00	1094414	10	10	20	218883	26266	245149	1339562
400	**SURFACE COURSE**										**Sub-Total (Subbase & Base Course)**	**2,487,000**

402(1)	Bituminous Prime Coat (Cut Back Asphalt Grade MC-70)	ton	135	1,595.00	215656	10	10	20	43131	5176	48307	263963
403(2)	Bituminous Tack Coat (Emulsified Asphalt Grade CSS-1)	ton	1	1,686.00	843	10	10	20	169	20	189	1032
411(1)	Bitumous Concrete Surface Course, Hot Laid 50mm thick	ton	9260	174.00	1611205	10	10	20	322241	38669	360910	1972115
500	**BRIDGE & BOX CULVERT CONSTRUCTION**										**Sub-Total (Surface Course)**	**2,237,110**
501A(1)	Low-Strain Dynamic Method: Pile Integrity Test (PIT)	nr		125.00	0	10	10	20	0	0	0	0
501B(1)	High-Strain Dynamic Pile Test	nr		240.00	0	10	10	20	0	0	0	0
501(16)	Concrete Piles cast in Drilled Holes -800 mm diameter	m		1,044.00	0	10	10	20	0	0	0	0
502	Concrete Railing	m		155.00	0	10	10	20	0	0	0	0
504A(1)	Steel Decking for Slab (Base metal, 0.60 mm thickness)	m^2		335.00	0	10	10	20	0	0	0	0
505(2)	Reinforcing Steel Bars, Grade 60	kg		1.90	0	10	10	20	0	0	0	0
506(1)	Structural Concrete, Class A	m^3		219.00	0	10	10	20	0	0	0	0
506(2)	Structural Concrete, Class B	m^3		188.00	0	10	10	20	0	0	0	0
506(3)	Structural Concrete, Class C	m^3		204.00	0	10	10	20	0	0	0	0
507(1)	Prestressed Concrete AASHTO Type IV Girder - 23.90 m length	nr		42,320.00	0	10	10	20	0	0	0	0
508(1)	Elastomeric bearing Pad (Free - 660mmx306mmx52mm)	nr		164.00	0	10	10	20	0	0	0	0
508(2)	Bridge Drainage Pipe PVC 200 mm diameter	m		7.20	0	10	10	20	0	0	0	0
513	Expansion Joint - Neoprene Type for 50 mm gap	a		212.00	0	10	10	20	0	0	0	0
600	**DRAINAGE AND SLOPE PROTECTION WORKS**										**Sub-Total (Bridge & Box Culvert)**	**758,000**
601(1)a	RC Pipe Culvert, 910mm diameter	m		328.00	0	10	10	20	0	0	0	0
601(1)b	RC Pipe Culvert, 1070mm diameter	m		362.00	0	10	10	20	0	0	0	0
601(1)c	RC Pipe Culvert, 1220mm diameter	m		411.00	0	10	10	20	0	0	0	0
601(1)d	RC Pipe Culvert, 1520mm diameter	m		552.00	0	10	10	20	0	0	0	0
603(2)	Stone Masonry Curb Inlet Manhole	nr		457.00	0	10	10	20	0	0	0	0
604(3)a	Cleaning Culverts in place (910 mm diameter or less)	m		2.50	0	10	10	20	0	0	0	0
604(3)b	Cleaning Culverts in place (1220 mm diameter or more)	m		2.90	0	10	10	20	0	0	0	0
604(3)c	Cleaning of Box Culverts (all sizes)	m		4.00	0	10	10	20	0	0	0	0
604(4)a	Reconditioning of Drainage Structures (Inlets and Outlets)	nr		20.80	0	10	10	20	0	0	0	0
604(4)b	Reconditioning of Drainage Structures (Lined Ditch Type B-1)	m		3.70	0	10	10	20	0	0	0	0
604(4)c	Reconditioning of Drainage Structures (Lined Ditch Type B-3)	m		4.40	0	10	10	20	0	0	0	0
605(5)	Grouted Riprap, Class A	m^3	2502.5	70.50	176426	10	10	20	35285	4234	39519	215946
606	Stone Masonry	m^3	6540	76.00	497040	10	10	20	99408	11929	111337	608377
607	Hand Laid Rock Embankment	m^3		35.00	0	10	10	20	0	0	0	0
610	Gabions	m^3	3495	86.50	302318	10	10	20	60464	7256	67719	370037
700	**MISCELLANEOUS STRUCTURES**										**Sub-Total (Drainage & Slope Protection Works)**	**1,194,359**
701(3)	Curb and Gutter (Type A), Curb with Precast ????	m	800	35.00	28000	10	10	20	5600	672	6272	34272
703(4)	Guide Posts	nr	41.2	39.50	1627	10	10	20	325	39	365	1992
704(3)a	Metal Guardrail (Metal Beam)	m	1250	69.00	86250	10	10	20	17250	2070	19320	105570
704(3)b	Metal End Guardrail	nr	15	49.00	735	10	10	20	147	18	165	900
704A(2)	Remove, Repair and Re-install Guardrail Beam	m	1	17.00	17	10	10	20	3	0	4	21
706(1)	Warning Signs	nr	36.4	295.00	10738	10	10	20	2148	258	2405	13143
706(2)	Regulatory Signs	nr	15.6	295.00	4602	10	10	20	920	110	1031	5633
706(3)	Informatory Signs	nr	10	1,250.00	12500	10	10	20	2500	300	2800	15300
707(1)	Pavement Markings (Premixed Reflective), White/Yellow	m^2	100	26.10	2610	10	10	20	522	63	585	3195
710(1)a	Reflectorized Thermoplastic Pavement Markings (White)	m^2	2266	75.00	169950	10	10	20	33990	4079	38069	208019
710(1)b	Reflectorized Thermoplastic Pavement Markings (Yellow)	m^2	747	79.00	58974	10	10	20	11795	1415	13210	72184
800	**BIO-ENGINEERING**										**Sub-Total (Miscellaneous Structures)**	**460,228**
803(1)	Slope Trimming and Preparation	m^2	12925	1.40	18095	10	10	20	3619	434	4053	22148
805(3)	Planting of Grass Slips	m^2	7755	2.50	19388	10	10	20	3878	465	4343	23730
805(4)	Planting Tree/Shrub	nr	646.25	2.75	1777	10	10	20	355	43	398	2175
											Sub-Total (Bio-Engineering)	**48,054**
											OTAL CIVIL WORKS COST except MOB/DEMOB	**8,256,166**
											TOTAL CIVIL WORKS COST with MOB/DEMOB	**8,357,221**
											Cost $M/KM	**0.81**

Note: Bridges and special culverts in separate detail estimate

Structures Cost Estimates, Alt 3 (6m travel way)

Bridge Construction

Road	No	Sta.	Recomendation	Bridge Length		Road Width (m)	CONSTRUCTION FEE					
				Span	Length		Superstructure	Abutment	Pier	River Training	Other	TOTAL
A09-1a	1	81.20km	2-PC-DG	2.0	30.0	6.5		323,400		80,000	10,086	413,486
A09-2	2	92.40km	RC DG	1.0	20.0	8.0	176,000	386,400		80,000	16,061	658,461
	3	93.10km	RC-DG	1.0	22.0	8.0	200,640	386,400		80,000	16,677	683,717
	4	96.40km	RC DG	1.0	15.0	8.0	120,000	386,400		80,000	14,661	601,061
											Sub Total	1,943,239
A09-3	5	100.20km	PC DG							80,000	2,000	82,000
	6	103.80km	RC DG	1.0	15.0	8.0	120,000	386,400		80,000	14,661	601,061
	7	105.70km	RC DG	1.0	15.0	8.0	120,000	386,400		80,000	14,661	601,061
	8	113.40km	PC DG							80,000	2,000	82,000
	9	127.80km	RC DG	1.0	15.0	8.0	120,000	386,400		80,000	14,661	601,061
											Sub Total	1,967,183
A09-4a	10											0
	11											0
											Sub Total	0
C15	12	9.10km	RC-DG	1.0	15.0	8.0	120,000	386,400		80,000	14,661	601,061
											Total	4,924,969

CROSS PIPES

	START	END	Length (km)	Interval	Quantity	Rate	Cost
A09-1a	65.2	82.0	16.8	@0.4	42	6,000	252,000
A09-1b	82.0	88.0	6.0	@0.4	15	6,000	90,000
A09-2	88.0	99.5	11.5	@0.4	29	6,000	174,000
A09-3	99.5	133.0	33.5	@0.4	84	6,000	504,000
A09-4a	133.0	140.5	7.5	@0.4	19	6,000	114,000
A09-4b	140.5	144.7	4.2	@5.0	1	6,000	6,000
C15	0.0	10.3	10.3	@0.4	26	6,000	156,000
Total					216		1,296,000

Special Culvert

Road	No	Sta.	Recomendation	CONSTRUCTION FEE			
				BOX	River Training	Other	TOTAL
A09-1a	1	69.80km	RC-Box Culvert	160,000	80,000	6,000	246,000
	2	71.20km	RC-Box Culvert	160,000	80,000	6,000	246,000
						Sub Total	492,000
A09-1b	3	87.50km	RC-Box Culvert	160,000	80,000	6,000	246,000
A09-2	4	97.20km	RC-Box Culvert	160,000	80,000	6,000	246,000
	5	97.80km	RC-Box Culvert	160,000	80,000	6,000	246,000
						Sub Total	492,000
A09-3	6	103.60km	RC-Box Culvert	160,000	80,000	6,000	246,000
	7	105.00km	RC-Box Culvert	160,000	80,000	6,000	246,000
	8	107.70km	RC-Box Culvert	160,000	80,000	6,000	246,000
	9	110.40km	RC-Box Culvert	160,000	80,000	6,000	246,000
	10	111.80km	RC-Box Culvert	160,000	80,000	6,000	246,000
	11	115.40km	RC-Box Culvert	160,000	80,000	6,000	246,000
						Sub Total	1,476,000
						Total	2,706,000

Summary of Cost, Alt.3 (6m travel way)

Section	Estimated Cost (US$ thousand)			
	Bridge	Special Culvert	Cross Pipe	Total
A09-1a	414	492	252	1,158
A09-1b	0	246	90	336
A09-2	1,944	492	174	2,610
A09-3	1,968	1,476	504	3,948
A09-4a	0	0	114	114
A09-4b	0	0	6	6
C15	602	0	156	758
TOTAL	4,928	2,706	1,296	8,930

Structure Cost Estimates, Alt 1 & 2 (4.5m travel way)

Bridge Construction

Road	No	Sta.	Proposal	Bridge Length (m)		Road Width (m)	Estimated Cost					
				Span	Length		Superstructure	Abutment	Pier	River Training	Other	TOTAL
A09-1a	1	81.20km	Steel Truss	1.0	50.0	6.5	0	323,400		80,000	10,086	413,486
A09-2	2	92.40km	RC DG	1.0	20.0	6.5	143,000	323,400		80,000	13,661	560,061
	3	93.10km	RC-DG	1.0	22.0	6.5	163,020	323,400		80,000	14,161	580,581
	4	96.40km	RC DG	1.0	15.0	6.5	97,500	323,400		80,000	12,523	513,423
											Sub Total	1,654,065
A09-3	5	100.20km	PC DG							80,000	2,000	82,000
	6	103.80km	RC DG	1.0	15.0	6.5	97,500	323,400		80,000	12,523	513,423
	7	105.70km	RC DG	1.0	15.0	6.5	97,500	323,400		80,000	12,523	513,423
	8	113.40km	PC DG							80,000	2,000	82,000
	9	127.80km	RC DG	1.0	15.0	6.5	97,500	323,400		80,000	12,523	513,423
											Sub Total	1,704,269
C15	12	9.10km	RC-DG	1.0	15.0	6.5	97,500	323,400		80,000	12,523	513,423
											Total	4,285,243

CROSS PIPES

	START	END	Length (km)	Interval	Quantity	Rate	Cost
A09-1a	65.2	82.0	16.8	@0.4	42	5,000	210,000
A09-1b	82.0	88.0	6.0	@0.4	15	5,000	75,000
A09-2	88.0	99.5	11.5	@0.4	29	5,000	145,000
A09-3	99.5	133.0	33.5	@0.4	84	5,000	420,000
A09-4a	133.0	140.5	7.5	@0.4	19	5,000	95,000
A09-4b	140.5	144.7	4.2	@5.0	1	5,000	5,000
C15	0.0	10.3	10.3	@0.4	26	5,000	130,000
Total					216		1,080,000

Special Culvert

Road	No	Sta.	Recomendation	Estimated Cost			
				BOX	River Training	Other	TOTAL
A09-1a	1	69.80km	RC-Box Culvert	120,000	80,000	5,000	205,000
	2	71.20km	RC-Box Culvert	120,000	80,000	5,000	205,000
						Sub Total	410,000
A09-1b	3	87.50km	RC-Box Culvert	120,000	80,000	5,000	205,000
A09-2	5	97.80km	RC-Box Culvert	120,000	80,000	5,000	205,000
A09-3	6	103.60km	RC-Box Culvert	120,000	80,000	5,000	205,000
	7	105.00km	RC-Box Culvert	120,000	80,000	5,000	205,000
	8	107.70km	RC-Box Culvert	120,000	80,000	5,000	205,000
	9	110.40km	RC-Box Culvert	120,000	80,000	5,000	205,000
	10	111.80km	RC-Box Culvert	120,000	80,000	5,000	205,000
	11	115.40km	RC-Box Culvert	120,000	80,000	5,000	205,000
						Sub Total	1,230,000
						Total	2,050,000

Summary of Cost, Alternate 1 & 2, 4.5m travel way

Section	Estimated Cost (US$ thousand)			
	Bridge	Special Culvert	Cross Pipe	Total
A09-1a	414	410	210	1,034
A09-1b	0	205	75	280
A09-2	1,655	205	145	2,005
A09-3	1,705	1,230	420	3,355
A09-4a	0	0	95	95
A09-4b	0	0	5	5
C15	514	0	130	644
TOTAL	4,288	2,050	1,080	7,418

CHAPTER 5: SOCIAL & POVERTY ASSESSMENT (PSA) AND SAFEGUARDS

5.1 Socio-Economic Context of Regions and Districts

This Feasibility Study applies to the five road link of the National and District Road of Manatuto-Laclubar-Natarbora road project. The components are the A09-1 (22.8 km), A09-02 (11.50 km), A09-03 (33.5 km), A09-4 (11.70 km) and C15 (10.3 km). The total project length is almost 90 km with a road characteristics may vary over each link (particularly when the link is long and runs over none-uniform terrain).
This 90 km road length is traversing from a flat to rolling terrain in the North, meandering the high mountainous spine of the country (elevation up to 1,400 m above sea level) in the Centre, and descending towards the coastal plain in the South.

5.1.1 General

Timor-Leste comprises distinct topographical bands, including the broad plains along the south coast, the undulating plateaus of the east, and the steep and rugged mountains of the western interior. In terms of elevation the country is divided into three distinct zones, each with its own physical and socio-economic characteristics.

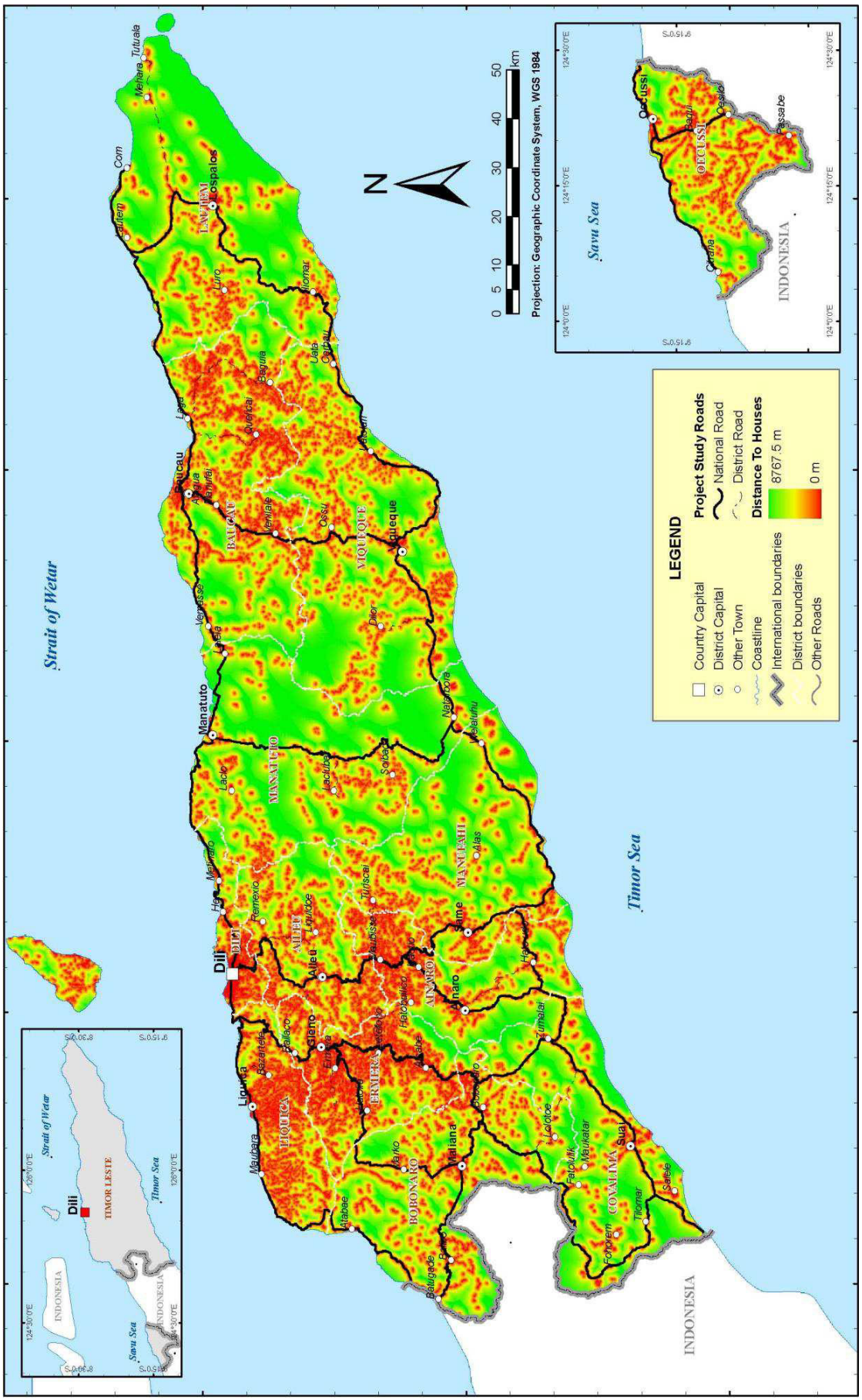
Zone 1 - between 0 and 500 m above sea level, occupies approximately 65% of the total area, including a broad band along the entire length of the south coast, most of Baucau, Lautem and Viqueque districts in the east, and a narrow band along the north coast. Nearly two-thirds (61%) of the country's total population live in this low-lying zone and it also accounts for most of Timor-Leste's arable land and is best connected in terms of transportation and communications infrastructure;

Zone 2 - between 500 and 1,500 m above sea level accounts for a third of Timor-Leste's total land area and 37% of the population. This is the coffee-growing zone of the western highlands; and

Zone 3 – areas > 1,500 m above sea level which account for 3% of the land area and 2% of the population of the country. This high elevation zone is characterized by high annual rainfall, cool temperatures and poor, rocky soils. It is the most sparsely populated and least productive of Timor-Leste's three zones.

The central area of the country is characterized by a more dispersed population which is focused along the Manatuto-Natarbora Road and includes the urban areas of Laclubar and Soibada.

Figure 5.2 – Distance to Inhabited Houses



5.2 National Poverty Reduction Strategy

The Government and ADB signed a poverty reduction partnership in October 2003, agreeing that ADB assistance would be based on careful analysis and consideration of priority activities to address poverty and the Millennium Development Goals (MDGs). The Government's National Development Plan (NDP) incorporates a poverty reduction strategy focusing on (i) promoting opportunities for the poor; (ii) improving their access to basic social services; (iii) enhancing security, including reducing vulnerability to shocks, and improving food security; and (iv) empowering the poor.

In 2005−2006 a Country Strategy and Program Update (CSPU) was prepared by the Asian Development Bank (ADB) for Timor-Leste. It focuses on capacity building for economic management, microfinance development, and infrastructure development. The CSPU notes that pervasive poverty and slow social development require a focus on development that will directly benefit the poor, and that consistent with ADB's Pacific Strategy 2005−2009: Turning a stagnant private sector into a dynamic job creator is an essential element in the delivery of benefits to the poor.

The Country Operations Business Plan, 2008-2010, states that assistance provided by ADB over the preceding period (2006-2008) supported the Government in moving towards its four specific NDP goals: (i) provide roads and bridges for the movement of people and goods, orderly and efficient functioning of markets, and sustainable development; (ii) ensure that banking, credit, and microfinance services are available to all, including the poor and women; (iii) provide adequate, safe, and sustainable water supplies for the communities of Dili with the aim of full cost recovery; and (iv) facilitate, at the national level, the safe disposal of sewage and wastewater in urban areas.

This Project will provide support to the first goal of the NDP by upgrading, rehabilitating and maintaining essential components of the road network.

In the updated Timor Leste Standard of Living Survey (TLSLS 2009), it was concluded that final confirmation of the progress made in poverty reduction in Timor-Leste must ultimately be based on newer living standards surveys. Among others, the report indicates that between 2007 and 2009, poverty incidence in the country fell by about nine percentage points. This noticeable fall is partly due to the fact that poverty incidence had itself spiked in 2007 (because of the combined effects of civil unrest and lower agricultural production). It is also likely due to high rates of economic growth in the post-2007 period, including increased consumption due to rapidly rising government spending, particularly on social protection programs and labor-intensive infrastructure works.

5.3 Causes and Characteristics of Poverty

The National Development Plan (NDP) considers a number of factors to be the drivers of poverty in Timor-Leste including: (i) political, social, and economic turmoil resulting particularly from the violence of 1999; (ii) lack of ownership or access to adequate productive assets, including land, for example, 24% of families own less than 0.5 ha of agricultural land and 60% of households own between 0.5 and 2.0 ha; (iii) lack of productive skills, including literacy; (iv) lack of or inadequate access to social and economic services; (v) unexpected death and illness, including malaria, tuberculosis, sexually transmitted infections, and HIV/AIDS; and (vi) increases in the prices of basic necessities (e.g., food, clothing, and fuel) and services.

The (TLSLS) establishes the official poverty lines, based on average national prices, derived from lower and upper poverty lines both of which include food and essential non-food items (minimum basic needs). The food portion of the poverty line is anchored to a daily intake of 2,100 calories per person. The lower poverty line measures extreme poverty.

Based on the TLSLS 2007 methodology, the predicted poverty incidence for 2009 is 41%. This suggests a drop of around nine percentage points compared to 2007, when poverty incidence had risen very sharply following the crisis and subsequent economic shock. The poverty prevalence derived from the 2009 updated TLSLS are shown in Table 5.1.

Table 5.1 - National Poverty Prevalence 2009

	TLSS 2001	TLSLS 2007	2009 (Prediction)
Poverty Prevalence	36%	49.9%	41% CI.95 = 39.4, 42.5

Source: Timor-Leste: 2009 Update of Poverty Incidence

Poverty incidence increased over the period, 2001-2007, between the two TLSLS. Overall, the proportion of the population falling below the lower poverty line increased from a quarter to a third, and the proportion of the population falling below the upper poverty line increased from 36% to a half. For both measures the increase in urban poverty was larger than the increase in rural poverty. The central and western districts suffered an increase in poverty incidence (for both measures) while in the eastern districts poverty decreased for those in extreme poverty but increased by a small proportion for those falling below the upper poverty line.

Table 5.2 – Poverty Incidence 2001 and 2007

Location	2001 Poverty incidence (%)		2007 Poverty incidence (%)	
	Lower poverty line	Upper poverty line	Lower poverty line	Upper poverty line
Rural	29.7	39.7	37.3	51.5
Urban	11.3	25.2	21.7	45.2
East	16.4	24.7	12.6	26.5
Centre	30.4	41.2	41.0	57.8
West	23.3	37.4	35.6	55.1
Total	25.4	36.3	33.2	49.9

Source: Timor-Leste: Poverty in a Young Nation (November 2008)

The first ever poverty assessment for independent Timor-Leste was based on the 2001 Timor-Leste Living Standards Measurement Survey (TLSS 2001) and the national poverty headcount was estimated to be 36%3. Even though the country made significant strides in building state institutions and improving service delivery after 2001, non-oil economic activity decelerated as the emergency reconstruction phase ended and international presence in the country substantially reduced. All in all, the period 2001-07 saw a 12% decline in real non-oil GDP per capita. In addition, the civil unrest of 2006 led to around 150,000 internally displaced people (IDP) further constraining economic activity. With the economy contracting in 2006, poverty headcount in 2007 – derived from the TLSLS 2007 data – peaked at 49.9% as consumption dropped sharply in 2006/07.

The post-2007 period, however, has witnessed renewed economic growth and there is emerging evidence of poverty reduction in the country even though living standards surveys permitting definitive estimates of poverty prevalence have yet to be conducted. To begin with, economic performance has been strong over 2008-2009 with the estimated GDP growth rate exceeding 9.5% per annum. The agricultural sector, where most of the poor live, rebounded in 2008 and 2009. In particular, increased coffee production in 2008 likely had a positive impact on poverty reduction as coffee growers are among the poorest households in the country.

Based on an analysis of the 2007 TLSLS data, the characteristics of poverty include the following:

a. The total number of poor people in Timor-Leste is in the order of 522,000. Poverty incidence is high with half of the population falling below the upper poverty line and a third of the population falling below the lower poverty line;
b. Poverty incidence is higher in rural areas (37% and 52%, being the population falling below the lower and upper lines) than in urban areas (22% and 45%, being the population falling below the lower and upper lines), and with some 76% of the poor living in rural areas;

c. Reflecting the rural nature of poverty noted above, the poverty rate for people engaged in agriculture is 54% but the proportion of poor engaged in the agriculture sector is very high at 78% (89% in rural areas), and even in urban areas nearly half of the poor (49%) rely on agriculture as their main source of employment and income;
d. Children under the age of 15 years account for 43% of the total population but account for 49% of the total poor. There is also high poverty incidence amongst children 15 years and younger with more than half (56%) being poor. Young children i.e. those aged 5 years or younger represent 19% of the total population but account for 21% of the poor;
e. The older poor (61 years and older) account for a small proportion of the poor (3.1%) while this is less than their proportion of the total population (4.7%) poverty incidence in this age cohort is high with a third of all people 61 years and older being poor;
f. Those with no or only low levels of education account for most of the poor. The incidence of poverty (in the population 18 years and older) declines with level of education. The poverty rate for people without any education is 58%, with a primary education is 50%, with a secondary education is 34% and with a tertiary education is 18%.
g. On a head-count basis there is little gender difference in the incidence of poverty with males overall accounting for 50.2% of the poor and females overall accounting for 49.6% of the poor. In two age cohorts (25-34 years and 35-44 years) the proportion of poor women is higher than the proportion of poor men;
h. Controlling for household size, female headed households are poorer than male-headed households. Overall poverty incidence increases with household size but for any household size the incidence of poverty is higher for female-headed households; and
i. Poverty is concentrated in the central districts (which includes two of the districts in the sample project area; Ermera and Liquica) with a poverty incidence of 58% compared with 27% in the east and 55% in the west. The central districts also account for 64% of the poor which higher than their proportion of population (55%). Overall the depth of poverty is 13.6%, and is highest in the central rural area (19.4%) and lowest in the eastern rural area (4.8%).

Taking into account the rural nature of poverty, and that according to the TLSLS results most of the poor are engaged in low-productivity farming (80% of the total poor and 90% of the rural poor depend on the agriculture sector), improving access to markets as well as increasing availability and diversity of farming inputs have credible contributions to make to poverty reduction.

The poor are impeded by less and more difficult access than the non-poor. While the poor and non-poor make similar use of roads (purpose of trips), the roads serving the poor are farther away and of inferior condition. Some 64% of the poor, compared with 76% of the non-poor, have all weather access on the closest trafficable roads, in rural areas the proportion of poor with all-weather access on the closest trafficable roads decreases further to 58% (compared with 68% of the non-poor). The urban non-poor have the best access, with 95% of the population having all weather access on the closest trafficable roads and the walking time to get to those roads being in the order of seven minutes. The rural poor used the closest trafficable road an average of two times more per month than the rural non-poor (Table 5.3).

5.4 Poverty in the Project Area

Among the 13 districts of Timor Leste, manatuto is among the poorest with three-quarters of the population being poor and depth of poverty being 28% and 25% respectively.

Table 5.3 – Poverty Measures by District

District	Poverty measures (%)			% of pop	% of poor
	Incidence	Depth	Severity		
Bobonaro	54.5	12.6	4.2	9.5	10.4
Covalima	49.1	13.4	4.9	5.3	5.2
Oecussi	61.0	19.5	8.0	6.3	7.7
WEST	54.9	15.2	5.7	21.1	23.3
Manatuto	73.7	25.1	10.6	4.2	6.2
Manufahi	85.2	32.0	14.1	4.4	7.5
Ainaro	79.7	27.8	11.8	6.0	9.6
Dili	43.3	9.8	3.1	18.6	16.2
Aileu	68.6	19.8	7.4	5.8	8.0
Ermera	54.6	14.3	5.2	10.4	11.4
Liquica	44.9	11.9	4.4	6.1	5.5
CENTRE	64.3	20.1	8.1	55.5	64.4
Lautem	21.3	4.3	1.2	7.2	3.1
Baucau	22.3	3.0	0.6	11.3	5.1
Viqueque	43.4	9.8	3.0	5.0	4.4
EAST	29.0	5.7	1.6	23.5	12.6
Total	49.9	13.6	5.1		
Urban	45.2	11.8	4.2	26.3	23.8
Rural	51.5	14.2	5.3	73.7	76.2

Source: Poverty in a Young Nation (2008)

As shown on Table 5.4, the central districts account for 56% of the country's population but 64% of the total poor. In comparison, the eastern districts are relatively better off, accounting for 24% of the population but 13% of the total poor.

The three western districts account for 21% of the population and 23% of the poor. The incidence of poverty in the three districts in the sample project area range from 44.9% in Liquica to 54.6% in Ermera (Bobonaro in the West has a poverty incidence of 54.5%). Together these three districts account for 27.4% of the country's poor and 26% of the population.

There is not only extensive poverty in Timor-Leste, there is also significant income inequality as well. This can be demonstrated by comparing the shares of total expenditure of the two upper and lower income quintiles. The upper group (40% of the population) accounts for 66% of total expenditure compared to 18% for the lower group.

The TLSLS included a section on subjective wellbeing and adequacy of basic needs being met. Of the five subjective measures included, perceptions of three - adequacy of food consumption, clothing and access to education - had improved over the 2001 and 2007 TLSLS periods, while the proportion of population considering that housing (decreasing from 49% to 42%) and access to health care was less than adequate increased over the 2001 to 2007 period.

The subjective adequacy of household income also had improved for the larger proportion of the population with three-quarters stating their household income was less than adequate in 2001 but 70% stating this was the case in 2007. However, fewer rural people (74%) were satisfied with the adequacy of household income compared with urban people (56%).

Table 5. 4 – Differential Access to Roads

Nearest trafficable road	National			Rural			Urban		
	Total	Non-poor	Poor	Total	Non-poor	Poor	Total	Non-poor	Poor
Accessible in rainy season (% pop)	70.1	75.8	64.3	63.2	68.2	58.4	89.4	94.6	83.2
Walking time (minutes)	16.3	13.4	19.1	18.8	16.2	21.2	9.2	6.6	12.5
No. times used in last month	25.5	24.9	26.0	24.4	23.5	25.2	28.4	28.4	28.5

Source: Timor-Leste: Poverty in a Young Nation (November 2008)

The Timor Leste Survey of Living Standards TLSLS data shows that overall the rural population has significantly more limited access to social and economic facilities, and that travel times to key services and facilities are greater for the poor; one way travel times to primary and secondary schools take between 5 and 10 minutes longer for children from poor households than non-poor households, while travel times to the closest health facility is about 54 minutes overall but takes at least 6 more minutes for the poor. Travel to the nearest health facility in urban areas can take up to 11 minutes longer for the poor.

Table 5.5 – Differential Access to Key Services and Facilities

Service/Facility	National			Rural			Urban		
	Total	Non-poor	Poor	Total	Non-poor	Poor	Total	Non-poor	Poor
Secondary School									
Use facility regularly (%)	33.0	33.3	32.7	27.4	28.2	26.6	48.7	45.9	52.2
Distance (km)	3.6	3.6	3.5	4.5	4.7	4.3	2.1	2.0	2.2
One-way travel time (min)	56	51	61	70	65	74	34	30	39
Primary School									
Use facility regularly (%)	73.8	67.4	80.4	73.5	67.2	79.5	74.7	67.8	83.1
Distance (km)	2.8	2.8	2.8	3.0	3.1	3.0	1.1	1.0	1.2
One-way travel time (min)	28	26	31	30	28	32	23	20	25
Clinic									
Use facility regularly (%)	73.4	70.9	76.0	77.1	76.8	77.3	63.2	56.3	71.6
Distance (km)	2.8	2.8	2.8	3.0	3.1	3.0	2.1	2.0	2.1
One-way travel time (min)	54	51	57	60	58	62	34	28	39
Bus Stop/Terminal									
Use facility regularly (%)	26.9	27.6	26.1	23.5	23.6	23.3	36.4	37.4	35.1
Distance (km)	2.9	2.9	2.9	4.0	4.2	3.8	1.0	0.9	1.1
One-way travel time (min)	49	47	52	65	65	64	22	18	27

Source: Timor-Leste: Poverty in a Young Nation (November 2008)

The difference is even more marked when looking at access to the nearest veterinary facility, a key service for households which raise livestock. Bobonaro and Oecussi, followed by Covalima, Liquica

and Ermera are the largest producers of livestock (cattle, buffalo and horses) and poultry in the country. Veterinary facilities are available in Dili, Ermera, Liquica and Oecussi. The average travel time for non-poor households is 10 minutes while for poor households the travel time is more than one hour (64 minutes). The distance to travel to the facility is less than half a kilometer for the non-poor and 2.6 km for the poor.

The poor will be direct beneficiaries of the Project in terms of improving inferior quality roads and accessibility in all seasons, as well as potentially reducing travel times to the closest all-weather roads for those sucos and aldeias included in the CEC of the Project through improvement of selected feeder/rural roads from aldeias to the roads rehabilitated under the Project, as well as involvement of the communities in upgrading those roads and constructing small community facilities such as markets.

5.5 Socio-Economic Profile of the Manatuto District

Manatuto District is located in the central region, and in effect is the most central district. The district borders Ailieu and Manufahi to the west and Viqueque and Baucau to the west. Along with Lautem, Manatuto is (i) one of only two districts that border the coast along northern (Wetar Straight) and southern boundaries (Timor Sea); and (ii) spatially the second largest of the districts accounting for 12% of the country's land area.

The district's area is 1,783 km2. The district is divided into six sub-districts, and has a 2004 Census population of 36,897, and a projected population of nearly 81,200.

The average population density of the district is very low at 21 people per km2 and is highest in Manatuto sub-district (39 people per km2). Average household size is 4.4, and the overall dependency ratio is 93%, as shown in Table 5.6.

Table 5.6 – Demographic Data of Manatuto

Sub-District	Land area (km2)	Pop. (2004)	Projected pop. (2019)	Female to male ratio	Pop. density (per/km^2)	Av. H'hold size	Depend. ratio (%)
Barique/Natabor	397	4,874	10,727	0.90	12	4.4	89
Laclo	368	7,558	16,635	0.95	21	4.3	97
Laclubar	391	8,039	17,693	1.02	21	4.8	92
Laleia	226	3,211	7,067	1.02	14	3.5	89
Manatuto	271	10,455	23,011	0.97	39	4.5	85
Soibada	130	2,760	6,075	1.04	21	5.1	104
MANATUTO	1,783	36,897	81,208	0.98	21	4.4	93

Source: OCHA/UNMIT Timor Leste District Atlas; Profiling Districts of Timor Leste

"Other" language is the mother tongue of 59% of the population and Tetum-terik is the mother tongue of 28% of the population. Some 90% of the population can speak Tetum and another 59% can speak Bahasa Indonesia. Tetum and Bahasa Indonesia together are the main languages of a third of the population and Tetum is the main language of another third of the population. Some 10% of the population does not speak any of the four main languages. Tetun-terik is spoken in two sub-districts, Galoli language is spoken in three sub-districts and Idate is spoken in one sub-district.

About two-thirds of households are engaged in subsistence production; 61% cassava, 57% coconut, and 62% grow maize. Around a third of households are involved in production of higher-value crops such as rice (which at 54% makes Manatuto the third largest rice producing district), some 56% grow various fruits and 51% grow vegetables, but only a third grow coffee. There are in the order of 20,100 head of large livestock (cattle, buffalo and horse) in the district, giving an average of 2.4 head per household, and the third highest large livestock ownership in the country.

Literacy, the ability to read and write a letter in the language spoken in the households is low, but not the lowest, with 47% of the population 18 years and older not being able to do either. Disaggregating by sex shows that 54% of females and 40% of males are illiterate, which are similar to the national rates (54% and 37% respectively).

In terms of dwelling type, permanent houses make up two-thirds of the housing stock, with some 24% of the population living in semi-permanent dwellings, and 18% of the population living in traditional style houses. Over half (53%) of the population cited their dwelling as being in average condition, and 11% stated their dwelling was damaged (with 2% stating their dwelling unit was severely damaged), and a third of the population noted their dwelling was in good condition. Two-thirds of the population lives in houses with an iron or tin roof, and 10% live in dwellings with a palm or leaf roof. A third of the population lives in dwellings which have bamboo walls and 27% live in dwellings with concrete walls.

Manatuto has the second largest proportion of population (85%) which has access to drinking water from an improved source, however 89% still treat the water before drinking through boiling, filtering or adding chemicals. Two-thirds of the population has access to basic sanitation (pit latrine, septic tank, flush toilet), and nearly a third (30%) have electricity supplied from the national grid.

The poverty incidence in Manatuto is 73.7%, which is the third highest poverty rate in Timor-Leste. The district accounts for 4.2% of the total population but 6.2% of the total poor. The depth of poverty, i.e. how far below the poverty line the poor fall is 25.1%. About a quarter of the population does not consume enough food, which, in terms of population suffering food shortages, gives the district the highest food security in the country. Food shortages are experienced for 3.5 months per year. The main coping strategies for food shortages include eating less food (30%), switching from rice to corn or other food (86%), selling livestock or other assets (65%), and eating less meat and vegetables (67%).

Malnutrition rates for children under five years old are the lowest in the country. Some 32% of children under five years old are under-weight (compared with 49% nationally), with the severely underweight accounting for 3%, while some 17% of children under five years suffer wasting, compared with the national rate of 25%.

The subjective assessment included in the TLSLS indicated that half of the population considers the wellbeing of the household is about the same as it was in 2001 (compared with the national level of 54%), while a quarter of the population considers their household wellbeing to be better off, which is significantly higher than the national level of 9%.

The agricultural sector accounts for 81% of the labor force (aged between 15 and 64 years). The economic activity of just over a third of the population (37%) aged 12 years and older is farming, and accounts for the activity of 37% of females and 65% of males. Housework is the main economic activity of 23% of the population, which is the second largest proportion of population after Viqueque; accounting for 47% of female activities and none of the male activities. The unemployment rate in the district is high at 9%.

Taking both public and private schools, there are 39 primary schools, eight junior high schools and five secondary schools. With regard to health facilities, there are 13 health posts and six community health centers. The closest hospital is located in Dili.

Educational attainment in Manatuto is about average compared with other districts as well as nationally. On a national basis some 47% of the population (18 years and older) has received no education, in Manatuto this is 48%, both nationally and in the district 14% have completed secondary school. The proportion of females in the district without education is 58% compared with 42% of males.

The morbidity rate is the highest in the country at 31%. Among those with ailments some 97% reported the ailment was serious enough to disrupt daily activities, again the highest rate, with 81% seeking treatment. Of those not seeking treatment, a third reported the reason was the health facility was too far. The main means of transportation is by walking for 86% for those visiting a health care facility, and the average one-way travel time is 42 minutes which is lower than the average national travel time of 47 minutes.

Some 3% of the population owns a motorbike or scooter, compared with the national ownership rate of 7%, and 1% owns a car or truck, which is roughly a third of the national ownership rate.

In respect of access, more than three-quarters of the district's population live in areas where the closest vehicle accessible road is passable in the rainy season (i.e. an all-weather road), the average walking time to that road being 8.9 minutes which is the shortest travel time in the country. Access to facilities, based on average traveling times and average distance, is good with both the nearest health center and secondary school being about an hour away (60.5 and 50.9 minutes respectively), and the nearest primary school being 40 minutes away.

5.5.1 Language and Ethnicity Issue

In Timor-Leste ethnicity is bound up with language. Collectively, the Timorese refer to themselves as Maubere. The "official" languages include Tetum (comprising two dialiects) along with Portuguese, and in addition there are another two "working" languages" being Bahasa Indonesia and English.

There are 17 languages spoken across the country all of which can be classified as being derived from one of two broad language groups; Austronesian (Malayo-Polynesian) and Papuan (Melanesian). The largest Malayo-Polynesian groups are the Tetum, primarily in the north coast and around Dili; the Mambae, in the central mountains; the Tokodede in the area around Liquiçá; the Galoli between the tribes of Mambae and Makasae speakers; the Kemak in the north-central area of the island; and the Baikeno in the area around Pante Macassar. The main tribes of predominantly Papuan origin include the Bunak in the central interior of Timor island; the Fataluku at the eastern end of the island near Lospalos; and the Makasae, toward the eastern end of the island.

As shown in Table 5.7, in five districts there are as many as three different languages being used, while in two districts only one language is spoken.

Table 5.7 – Number of Languages Spoken by District

District	No. of languages spoken
Lautem	3
Baucau	3
Viqueque	3
Manatuto	3
Manufahi	2
Ainaro	1
Dili	2
Aileu	1
Ermera	3
Liquica	2
Bobonaro	2
Covalima	2
Oecusse	2

Source: Timor-Leste Census of Population & Housing 2011

As noted in the district profiles, in addition to the four main languages, a number of languages are spoken across the country depending on location. As shown in Table 5.8, the Census indicates that Tetum and Bahasa Indonesia are by far the most widely used languages throughout the country, with literacy rates ranging from 17% to just over 80% in each of Timor-Leste's 65 sub-districts. Portuguese ranks third with literacy rates ranging from 4% to 35%, and English is fourth with between 1% and 18% claiming some competency at sub-district level. These numbers highlight the importance of the local languages

Table 5.8 – Proficiency in Official and Working Languages

Language	Proportion able to speak, read and write (%)	
	Minimum	Maximum
Tetum	16.7	81.2
Portuguese	4.2	34.7
Bahasa Indonesia	17.1	80.2
English	0.7	17.7

Source: Census of Housing and Population 2011 (Directorate of National Statistics)

While people might be able to speak the official or working languages in addition to one of the main languages, only a small proportion may be familiar with technical and other words, phrases and concepts in relation to Project development. There is also a significant difference between mother tongue, main languages spoken, and ability to speak one of the four official or working languages. For example, in the three Western districts (Bobonaro, Covalima and Oecussi), for example, Tetum is the mother tongue of a quarter of the population (Tetum Prasa 8% and Tetum-terik 17%) yet three-quarters of the population can speak Tetum, and Tetum is the main language spoken by a third of the population. However, another third of the population cannot speak any of the four main (official and working) languages and speak other languages (Kemak, Bunak or Baequeno) as the "main" language.

Languages that are used extensively include Fataluku and Makasai in the east, Tetun-terik in the southeast and south-central regions, Mambai in the western highlands, and Bunak, Kemak and Tokodede in the west. In contrast, some languages are dominant in only one subdistrict, among them Naueti in Uatucarbau, Idate in Laclubar, Waima'a in Vemase, Midiki in Venilale and Raklunga/Rasik on Auturo, the island which is included in Dili district.

Three-quarters of the population speak Austronesian languages, with the two Tetum languages accounting for 29% and Mambai accounting for 23%. In terms of coverage, Mambai is spoken in the largest number of sub-districts (15) and districts (4). Of the population speaking Papuan languages, some 43% speak Makasai, and this language accounts for 12% of the total population. Both Makasai and Bunak are spoken in six sub-districts.

The Timorese population is indigenous based on the definition included in ADB's Policy on Indigenous People because it has: (i) collective attachment to geographically distinct territories; and (ii) descent from groups present in specific areas prior to the establishment of modern states and relative borders, due largely in respect of Timor-Leste being established as a sovereign nation in 2000. However, the language-based groups do not "self-identify" as distinct indigenous cultural groups, and have adopted Tetum and Portuguese as official languages, as well as two other "working" languages.

5.6 Consultation Meetings

Consultation meetings, conducted by the Consultant, focused on four Sub-District, Sucos and Aldeas, of the Manatuto District, located along the project road alignment. During the meetings, the Consultant presented the project to the affected communities, as well as and the "Resettlement Framework" indicating their rights and responsibilities.

Key local and national stakeholders consulted include:

- Local Individuals and Communities;
- Special Interest Groups;
- Government Authorities and Public Sector Agencies;
- Non-Government Organizations (Ngos);
- Financing Agency and Other International Development Agencies;
- Affected Persons

In total, 6 consultation meetings have been held at the District and Sub-District, Suco/Village level along the existing road corridor, involving a total of around 400 participants. The minutes of the meeting of consultation and pictures are given in Appendix 6.4. The Table 5.9 summarizes the consultation dates and program.

Table 5.9 Consultation Meetings

Sl No.	Date	Time	Venue
1,	February 18, 2013	9:00 AM	District Manatutu
2.	February 25, 2013	9:00 AM	Sub District Manatutu
3.	February 26, 2013	9:00 AM	Sede Suco Cribas
4.	February 26, 2013	2:00 PM	Sub District Laclubar
5.	February 27, 2013	9:00 AM	Sede Suco Manehat

6.	February 28, 2013	9:00 AM	Sede Suco Salao

A summary of the participating stakeholders, and activities which have been taken during the consultations meetings is shown in Table 5.10. Issues and concerns raised during the consultations were considered in the preparation of the RP. Particular importance was given to consult the leaders of local communities, particularly the District and Sub-District, Suco/Village and Hamlet Chiefs, residing along the project road corridor.

Particular attention was given to understand the affected populations' attitude towards the project design and potential benefits; and to create awareness regarding their entitlements and compensation payment procedures, as well as their grievances redress mechanism. While developing mitigation measures, their suggestions have been taken into account, to minimize negative impacts.

Community people of different areas expressed different concerns. However, the main issues concerning the project impacts and their suggestions for mitigation measures appeared similar.

Table 5.10 Summary of Stakeholder Consultations

Stakeholder Category	Activities Undertaken
National Level	Consultation with: • Project and Financial Manager, PMU, MoPW • Chief Technical Adviser, PMU • Director, National Statistics Directorate • Project Consultant
District Level	Consultation with: • District Administrator, Manatutu • Sub-district Administrators : Manatutu, Laclubar, Natarbora and Soibada • Representatives of government departments : DLPCS in Dili
Suco/Village Chief	• Consultation with the Suco Chiefs of likely affected sucos in the Project area (Aiteas, Ailili, Sau, Maabat, Manlala, Leohat Salao and Manehat)
Aldeia/Hamlet Chief	• Consultation with concerned chiefs of Aldeias
Suco/Villages	• 6-wise consultation meetings held - within Manatutu-Natarbora and Laclubar
Individual APs	• Consultation on the possible affected person regarding the RF, RP, their rights and responsibilities. Benefits of the project.
Special Interest Groups	• Discussions with specific groups of Project-affected people including women, farmers, the landless.
Financing Agency	• Discussion, on-site visit with ADB mission • Senior Infrastructure Specialist, ADB • Safeguard Specialist, Pacific Operations Division, Pacific Department, ADB, Manila, ADB representative in Timor Leste

5.6.1 Key Issues –Consultation Meetings

Consultations, especially at Sub-districs, Suco and Aldeia levels, were dominated by questions and concerns concerning land ownership issue, negotiated compensation for land and other assets lost, and impacts on livelihoods, impact on religious and cultural sites and on services. Key issues that were frequently raised in the consultation are summarized below.

5.6.2 Land Acquisition, Compensation and Livelihoods Restoration

Methods that will be used to determine compensation values for land, structures and other assets; responsibility for compensation determination (MoPW/PMU, DLPCS, Valuation Expert, Supervision Consultants or a compensation committee); whether compensation rates (e.g. for land) will be at the current market prices. Some specific questions and isuues include:

a. fate of people who have no legal right to the land on which they have settled, whether will be entitled to compensation for land, and for other losses, e.g., houses, crops, trees;
b. compensation for the houses that will be affected only in a part;
c. the method of compensation disbursements; timing of when compensation payments will be made;
d. Quality of the road and the relocation of the existing structures lies on the danger zone;
e. Suggestion on the improvement of the idle land for them to use for relocation of the possible affected house;
f. use of middlemen/agents in compensation payments;
g. The implementation of the ADB resettlement policy, Is this a reality, will can be materialize in this road project.

5.6.3 Services and Religious/Cultural Sites

The following are some of the issues to be address before the implementation of the project;

a. impact on existing religious sites, sanctuary places such as church and cemetery, and how would be treated;
b. impact on existing water and electrical facilities supplies;
c. Employment Opportunities;
d. assurance of employment opportunity for the affected and local people during road construction works.
e.

5.6.4 Community Attitude

Many people anticipated that the Project could lead to substantial development and the improvement of infrastructure, services and facilities in the area. The Project was seen as an opportunity to develop the region and its people. Almost all the participants indicated that the Project is necessary for improving connectivity, creating jobs, increasing agricultural productivity, and reducing poverty. During the survey, people most likely to be directly affected, were supportive of the Project. They also expressed their support for the Project, with the expectation of getting fair compensation for their affected assets.

Both in the course of consultations and during the survey period, the participants were asked about their preference for the type of compensation for their property. Almost all the respondents preferred "cash compensation" for loss of land, structures, trees and other assets.

5.6.5 Consultations' Summary

People see direct relationships between upgrading roads and their opportunities to diversify and expand their agricultural production, market cash crops, livestock and other products and, as a consequence, increase household incomes. They anticipate being able to strengthen existing income-generation activities and develop new businesses; increased numbers of people moving through the districts will expand their customer base.

They also appreciate that they and their families will become more mobile, with greater opportunities to travel easily and less expensively for health, education, social and family reasons as well as to seek work or conduct business. The response was universally positive when asked, during surveys or in consultation meetings, whether they believed the road improvements would yield benefits for their businesses and/or their households.

5.7 Beneficiary Profile

To prepare a profile of the beneficiaries of the project, a Household Survey was undertaken for the proposed road project. As shown in Table 5.11, some 9 sucos along the proposed road project were included in the survey.
Within each of the sucos, households, located along the road and away from the road were selected randomly. This is in order to include the wider catchment. The area covered by the survey was the Manatutu District, passing through the Sub-District of Laclubar, Soibada and Natarbora and covers the Sucos of Aiteas, Ailili, Sau, Maabat, Cribas, Orlalan, Manlala, Leohat, and Manehat, all along the project road alignment (roads A-09 and C-15).

Table 5.11 – Household Survey Sample, by Sub-District and Suco

Road	Sub-District Manatutu					Laclubar	Soibada		Natarbora
	Aiteas	Ailili	Sau	Maabat	Cribas	Orlalan	Manlala	Leohat	Manehat
No. of Aldea	2	3	2	2	4	8	2	2	3
A09(%)	7	8	15	10	47	-	11	17	28
C15(%)						16			

Source: Project Consultant Household Survey (Feb 2013)

The survey questionnaire included six sections, and obtained data on the following:

a. Household head;
b. Total household;
c. Livelihoods, income and expenditure;
d. Transport and travel;
e. Access to Infrastructure and services; and
f. Perceptions about the project.

The proportion of poor and non-poor used in this PSA was determined by identifying which households fell below the upper ($26.68/person/month) poverty line (the lines used in the poverty assessment based on the TLSLS 2007).
Because a large number of the local population are subsistence or near-subsistence farmers, a substantial portion of household food consumption is derived directly from their private plots and does not go to markets. This means that incomes reported often do not take into consideration such consumption in monetary terms, and the figures are most likely under-estimated.

Table 5.12 shows that in Manatutu the proportion of poor derived from the household survey is higher than that identified during the TLSLS, while for Laclubar, Soibada and Natarbora the proportion of poor fell within 5% of the proportion of poor as defined in the TLSLS.
Food insecurity is a good proxy for poverty incidence because rather than looking at cash income and expenditure, it is based on the ability of a household to provide sufficient food for its needs and includes home production and subsistence. The table also shows that the levels of food insecurity derived through the household survey match very well those obtained through the TLSLS, and as such serves as a reasonable verification of the identification of those households defined as poor in this assessment.
The following analysis provides description of the characteristics of hardship and poverty, as derived from the household survey undertaken for the PPTA. It includes three groups of households, as the basis of the analysis; (i) the poor i.e. those households that are on, or fall below, the poverty line; (ii) the marginal i.e. those households that are not defined as poor, but are within 15% of the poverty line and therefore remain vulnerable to economic shocks and risks; and, (iii) the non-poor i.e. those households that earn more than 15% above the poverty line.

Table 5.12 – Comparison of Poverty Incidence and Food Insecurity

Sub-District	Poor (%) HH Survey 2013	Poor (%) TLSLS 2007	Food insecurity (%) HH survey	Food insecurity (%) TLSLS
Manatutu Vila	65.6	50.5	67.0	65.3
Laclubar	49.8	41.6	51.3	48.3
Soibada	45.4	42.3.9	50.1	54.3
Natarbora	50.2	45.1	49.8	51.4
Total	59.6	50.3	57.8	65.3

Source: Project Consultant Household Survey and TLSLS 2007

5.7.1 Demographic Characteristics of household

Gender

According to census and socio economic survey the population of direct stakeholders living along the project road are dominated by male. The survey team conducted on families/households living along the project road area. Table 5.13 shows the division of population by gender, and Table 5.14 by age groups.

Table 5.13: Household Population by Gender

Sl no.	Description	No. of individuals	Percent (%)
1	Male	167	51
2	Female	158	49
Total		325	100 %

Source: Project Consultant Household Survey

Age

Majority of the affected population are within age 18 to 50. The significant portions based on the socio-economic survey are minor, i.e. under age 18.

Table 5.14: Age distribution of Households

Age features of HH	No of individuals	% of Individuals
< 5 years of age	36	11.10
<18 years of age	98	30.17
Between 18 and 50	129	39.71
Between 51 and 70	59	18.18
> 70 years of age	3	0.02
Total	**325**	**100%**

Marital Status

Table 5.15 shows the marital status of the households.

Table 5.15: Marital Status of individuals

Marital Status	Male		Female		Total	
	No.	%	No.	%	No.	%
Minor	63	38	73	46	136	42
Unmarried	65	39	41	26.51	106	33
Married	36	23	43	27.49	79	24
Divorce/Separated	1		-	-	1	
Widow	2		1	0.01	3	
Total	**167**	**100**	**158**	**100**	**325**	**100%**

Source: Project Consultant Household Survey February 2013

Education

The educational status of households by is shown in Table 5.16. 26.77% of the individual surveyed were illiterate. Apart from them the majority of the surveyed population (29.54%) have junior high school, more than 20% can read and write and 20.62 % are senior high school or equivalent education attainment.

Table 5.16: Education of individuals

Level of Education	No. of Individuals	% of
Illiterate	87	26.77
Able to read and write	65	20.10
Junior High School Equivalent	96	29.54
Senior High School Equivalent	67	20.62
University Graduate Equivalent/Upper	10	3.0
Total	325	100%

Ethnic/Religion

No major ethnic diversity or indigenous characteristics were observed among the surveyed HHs. All the surveyed HHs can be termed as mainstream Timor-Leste citizens. All of the surveyed individuals were found to be followers of Christianity. All the surveyed HHs were found to be using Tetum as the primary language.

Table 5.17: Religion of HH

Religion	No of Individuals	% of Ind.
Christianity	325	100 %
Islam	-	-
Buddhism	-	-
Hinduism	-	-
Total	325	100 %

Source: Project Consultant Household Survey (Feb 2013)

Family Structure and Composition

Table 5.18 shows family structure. The majority of the households surveyed are nuclear family households (98 out of 150 surveyed HH). Maximum family member was found to be 11 and minimum was 6. In an average, each AH has more than 7 members.

Table 5.18: Family Structure and Composition

Family Structure and Composition	Number of HH
Nuclear family households	98
Extended family households	9
Maximum number of people in HH	11
Minimum number of people in HH	6

Source: Project Consultant Household Survey (Feb 2013)

5.7.2 Household Income and Occupation

Table 5.19 shows annual income of the households included in the survey. The majority has an annual income between USD 300 and below (48%). Only 36 % have annual income above 300 USD but below 500.

More than 50% of the HH depend on farming and other agricultural activities such as cattle raising and vegetable farming; and about 42 % depend on business as source of income and about 8% are engaged in service.

Table 5.19: Annual Income of HH

Amount (USD)	Number of HH/Families	Percent (%)	Average Income/HH
Up to 300	72	48	100/month
Above 300 and below 500	54	36	120/month
Above 500 and Below 2000	24	16	
Above 2000 and Below 5000	9	0.6	650/month
Above 5000 and Below 10000	-	-	-
Above 10000	-	-	
Total	150	100 %	

Source: Project Consultant Household Survey (Feb 2013)

Table 5.20: Main Occupation of Affected Families

Type of Occupation	Number of Families	Percent (%)
Business & Agriculture	126	84
Commercial/Business	14	10
Professional/Business	10	6
Service Holder	-	-
Total	150	100 %

Source: Project Consultant Household Survey (Feb 2013)

5.7.3 Housing, Electricity and Water

The quality of life indicator shows that the majority (68%) of the HH have electricity supply, and only about 32 % lack electricity supply. Observation indicates that electrical lines have already been provided by the government, but some of them do not have power yet.
About 84 %of the HH are having piped water supply, and 10 % are having supply from protected well. About 6% of the HH were having supply from-un-protected sources. All HH had the year round accessibility of road.

Table 5.21: Housing, Electricity and Water

Electricity	Percent (%)
HH having electricity supply	68
HH having no electricity supply	31.4
HH using solar	0.60
Total	100
Water supply	
AH having piped water supply	84
AH having water supply from protected well	10
AH having water supply from un-protected sources	6
Total	100
Accessibility	
Year-round accessibility	100%

5.7.4 Poverty and Hardship

Three groups of households have been identified; (i) the poor i.e. those households that are on, or fall below, the poverty line; (ii) the marginal i.e. those households that are not defined as poor, but are within 15% of the poverty line and therefore remain vulnerable to economic shocks and risks; and, (iii) the non-poor i.e. those households that earn more than 15% above the poverty line. Identifying households in the marginal income group is important because while these households are not poor

in terms of the officially defined poverty line, they suffer hardship in other ways, most commonly this is a form of basic needs poverty, which manifests in households having to make compromises and sacrifices as they struggle to meet daily or weekly living expenses, particularly those that require cash payments. These households, as well as poor households, are vulnerable in a socio-economic sense.

Table 5.22 shows the distribution of households across the three income groups. Overall, more than half of the respondents (54%) are from poor households and some 16% are from marginal households. There is a larger proportion of poor and marginal households within the project area.

Table 5.22 – Poverty in Subproject Areas

Sub-District	Income group (%)		
	Poor	Marginal	Non-poor
Manatutu Vila	61.2	17.9	29.1
Lacrobar	49.8	14.5	21.2
Soibada	50.3	15.5	20.1
Natarbora	54.7	18.2	22.5
Total	54.00	16.52	23.2

Source: Project Consultant Household Survey (Feb 2013)

Even non-poor households may suffer different degrees of hardship or basic needs poverty (as opposed to income poverty), including experiencing one or many of the following; (i) constantly having to make choices between the competing demands for household expenditure and the limited availability of cash income to meet that expenditure; (ii) having to make trade-offs between one bill and another, food or school fees, utilities or bus-fares; (iii) borrowing regularly from "loan-sharks", who charge very high interest rates, for small unsecured loans in order to meet family commitments and community obligations; and, (iv) being frequently, or occasionally, in constant debt.

Households deemed to be experiencing basic poverty are facing hardship on a daily basis. They struggle to cover expenses and purchase adequate and suitably nutritious food. About three-quarters of respondents (77%) stated their household had lacked sufficient staple food in the past 12 months. Respondents were then asked to quantify the number of months their household lacked food, more than half (56%) were from households lacking food for between one and three months, with in the order of a third (36%) lacking food for between four and six months. A small proportion of respondents (9%) were from households that lacked food for seven or more months.

Nearly half of the respondents (48%) stated their household had been unable to provide for its basic non-food needs, such as fuel, clothes, education or medical expenses, in the past 12 months. Respondents were asked how many times their household had not been able to provide for its basic needs in the last 12 months. This varied, on average, from once (for a third of households), nearly half of respondents (49%) stating their household had not been able to provide for its basic needs two or three times, 12% of household had not been able to provide basic needs between four and six times, and through to a number of times per month with as many as four times per month for some 5% of households.

Respondents were asked what coping mechanisms they had had to employ to alleviate hardship in the last six months, a very large proportion of respondents (over 90%) stated that their household had made changes in respect of the food consumed with 96% of households eating fewer meals per day, 93% eating smaller meals, 99% eating less meat or vegetables, and 98% shifting to cheaper (and less nutritional) foods.

Other coping mechanisms are shown in Table 5.23. A common strategy to cope with hardship is to sell livestock or other household assets (65%). Over half of households (46%) borrow money, and about half (50%) ask additional household members to work for cash. Some 40% of households needed to accept gifts of food or money from relatives or seek food aid. More than a third of

households (39%) stated they would keep children home from school (due to either lack of financial resources for books or clothes/shoes) and a fifth of households sent children away to love with better-off relatives.

Table 5.23 – Strategies to Cope with Hardship and Poverty

Sub-District	Coping mechanism (%)						
	Borrow money	Sell livestock or HH assets	Ask more HH members to work	Keep chn from school	Accept gifts/food aid	Migrate	Send chn away to relatives
Manatutu	52.0	62.2	48.0	40.3	38.0	6.5	19.6
Laclubar	55.2	68.5	54.4	33.9	41.3	8.2	14.1
Soibada	50.1	69.5	50.5	41.3	40.8	9.5	12.5
Natarbora	57.2	60.3	48.6	38.7	38.7	7.4	11.7
Total	46.13	65.12	50.37	38.55	39.7	7.9	14.55

Source: Project Consultant Household Survey (Feb 2013)

5.7.5 Ownership and Means of Transportation

Very few respondents captured in the survey stated that they or anyone in their household earned money from driving vehicles. In all some 15 respondents noted there were people hired as drivers in their households, including six motorbike drivers, three pick-up car and five van or truck drivers and one person only drove people from their household.

A larger proportion of poor (60%) and marginal (67%) households own non-motorized transport (NMT), including bicycle and animal drawn cart, compared with ownership of NMT by non-poor (54%) households. The non-poor households demonstrate much greater ownership of cars/4WDs (8%) and vans or trucks (13%), being nearly twice the ownership by poor households of these transport modes.

5.7.6 Difficulties with Access

The survey included a number of questions concerned with with ease and reliability of access. Results are shown in Table 5.24. Respondents were asked to describe the condition of the closest main road. Nearly a third (30%) stated the road was in poor condition with cracks and small potholes, 21% stated the road was in very bad condition (large cracks, ruts and/or potholes) and another 12% stated it was very difficult to drive along the road and at times it was impassable. Only 11% of respondents stated that the nearest main road was in good condition and was regularly maintained. A quarter of respondents stated the road was not regularly maintained but was in average condition (passable for most of the time). The type of road provided to most facilities is sealed or paved, for between 63% and 77% of respondents, foot tracks were the main form of access to the five main facilities for between 3% and 10% of respondents while earth roads accounted for the access for between 11% and 20% of respondents.

Table 5.24 – Type of Access to Facilities

Facility	Type of road (%)			
	Foot track	Earth	Gravel	Sealed
Market	9.5	16.9	10.9	62.8
Health centre	9.0	20.1	12.4	58.5
Primary school	5.0	19.2	11.5	64.3
Secondary school	2.3	11.2	13.5	73.0

Source: Project Consultant Household Survey (Feb 2013)

5.8 Poverty and Social Impact Assessment (PSA)

5.8.1 Poverty Assessment

The impact of improved access through road rehabilitation and maintenance on poverty reduction can be derived through (but not necessarily measured by) the (i) increased access of rural communities to basic social services such as education, health care, and local markets; (ii) increased employment opportunities for unskilled workers in the project area; (iii) indirect and induced economic growth in the project-affected regions and the nation as a whole; and (iv) anticipated reductions in transportation costs to road passengers, freight users, and vehicle operators.

5.8.2 Benefits to Agricultural Sector

The agricultural sector is important to the formal and informal economy of Timor-Leste. The household survey demonstrates that both the poor and non-poor are engaged in farming. Table 5.25 shows that agriculture is the subsistence livelihood for 48.7% of the poor and 45.3% of the marginal households, and is the main source of income for 62% of poor households, 53.4% of marginal households and 55.6% of non-poor households.

Table 5.25 – Reliance on Agriculture by Poor and Non-Poor

Income group	Livelihood Source (%)		Income Source (%)	
	Primary	Secondary	Primary	Secondary
Poor	41.6	7.1	41.2	20.8
Marginal	39.8	5.5	45.1	8.3
Non-poor	6.2	54.5	24.9	30.7

Source: Project Consultant Household Survey (Feb 2013)

A number of poverty assessments and studies have concluded that improving roads will, not in and of themselves, reduce poverty or increase agricultural production, but rather that roads are a necessary pre-requisite for development and better roads equals better access which will in turn facilitate development and contribute to poverty reduction. In the context of agricultural production in Timor-Leste, which for both livestock and crop production is the lowest in the region, contingent actions and investments are required before significant improvements in poverty reduction will be manifest. Consultation with a World Bank agricultural advisor to Ministry of Agriculture and Forestry indicates that until agricultural productivity is increased there will not be substantial reductions in poverty. Hence, benefits to the agricultural sector from road improvements are expected to be longer-term, rather than, immediate.

As noted, in the PSA for the RSIP, coffee is one of the most important cash crops in Timor-Leste and presents a great potential for economic growth and poverty alleviation. Yet its potential is currently hampered by poor road conditions that makes it difficult, or impossible, for people to transport their crops. This was confirmed by consultations undertaken for the preparation of a rural development project in Manatutu (to be funded by JFPR/ADB) concluded that infrastructure is very weak, and is the first priority for investment and development. The District Development Office indicated that the top priority is roads, which are seen as critically important for people in rural areas to access the market, followed by water, electricity, education, and then agricultural productivity.

In general, there is large variability among Sucos. The most part, the Sucos' population varies between about 500 and 2,500 (with few exceptions) and the densities are low. There is a definite difference between characteristics of semi-urban Manatuto Town (better) and the rural Sucos (worst). These data reinforces the notion that for the most part (with the exception of Manatuto Town) this District includes poor rural population, making its living on subsistence farming. About 90% of the adult population (age 15-64) in the rural Sucos is involved in crop production; however participation in the labor force averages only in the 50 percentiles (probably because there is not enough work to go around).

The Rice, which is expected to be the "expanded crop" in Timor Leste (see SDP), is not a major crop in most of the Sucos, for the simple reason that it is largely a steep mountainous area. Thus, rice is not expected to increase demand for traffic here.

About two-thirds of households are engaged in subsistence production; 61% cassava, 57% coconut, and 62% grow maize. Around a third of households are involved in production of higher-value crops such as rice (which at 54% makes Manatuto the third largest rice producing district), some 56% grow various fruits and 51% grow vegetables, but only a third grow coffee. There are in the order of 20,100 head of large livestock (cattle, buffalo and horse) in the district, giving an average of 2.4 head per household, and the third highest large livestock ownership in the country.

5.8.3 Creation of Employment & Impacts on the Local Economy

During the construction and maintenance stages of the Project, there will be a need for skilled (engineers) and unskilled workers (labourers). To realize the maximum benefits of job creation during the Project, it is important that a proportion of jobs be set aside for people from poor and vulnerable households in the villages along the roads.
With the exception of involvement in maintenance, new jobs are temporary, and while a number of unemployed poor laborers will benefit, the degree to which they will benefit is small.

Information from the consultant's engineer and labour-based specialist provided estimates of the likely requirements for total number of workers over the project period. According to the proposed Calculation of the potential job creation and wages generation were based on these two stages:

a. Feasibility and detailed engineering design works undertaken from 2013 to 2014.

b. Civil works (Road, Bridge and Drainage) associated with upgrading and rehabilitation undertaken over the period 2014-2016

5.8.4 Project Pre-Construction Works

During feasibility study and detailed engineering design, the activities to be undertaken will need some local assistance. This will create temporary job to locals like enumerator/surveyor, skilled and unskilled laborer, interpreter and have a better change of employment.
Labor based activities are as follows;

a. Enumerators for the survey on social analysis of the influenced area to determine numbers of beneficiaries and socio-economic profiles. Preparation of resettlement plan (RP).
b. Local assistance in the survey work for the preliminary assessment of the road which includes; pavement, drainage, structures and slope stability. Preliminary topographic surveys, undertake traffic survey, and identification of materials sources.
c. Local engineers' assistance in the preparation of program of the topographic survey and geotechnical investigation for the detailed design. Determine cost effective options for upgrading considering route terrain and minimum serviceability standards.
d. Local hire personnel as assistance for the clerical work on the activities to undertake the environmental assessment of the project in accordance with the EARF established for this project. Preparation of Initial Environmental Examination (IEE).
e. Surveyor, local assistance and enumerators to conduct the detailed topographic and hydrological surveys, geotechnical investigations and review of traffic analysis prepared in the FS.
f. Assistance to the engineer like CAD operator on the designing the pavement structure with asphalt surfacing for 20 years design life. Review and update the IEE and RP.
g. Assistance to the engineer like CAD operator to undertake geometric design of horizontal and vertical alignment of the road based on national standards and guidelines, and other accepted design criteria such as the ASSHTO 2004.

h. Assistance to the engineer, staff to undertake hydraulic analysis, and engineering design of bridges, drainage structures and slope protection works.
i. Local hire engineers in preparation of unit price analysis and quantity calculations, and cost estimates including implementation schedules. With draft bidding documents for review by MPW and ADB, and incorporate comments as required.

5.8.5 Project Civil Works

Improvement and rehabilitation works are most likely to be divided into two contracts packages. Contractors are likely to recruit people with skills or experience along with their permanent employees. The types of activities that can be undertaken by local labor include: vegetation clearance, construction of structures like bridges, roads, drainage, and construction of masonry walls; therefore it is likely that between 15% and 20% of crew positions can be taken up by local unskilled labor.

Using the formula and methodology of the previous feasibility studies (TA-7100, in 2009) as well as data from consultant and contractors' approximation, a total of 2,425 person-months will be created by the Project. Using the above proportions of local labor, this would equate to between 243 (10% local) and 485 (20% local) person-months' work.

If a set aside for the poor, to the same proportion as within the population can be required, this would mean 46% of the local labor component work can be set aside for people from poor and vulnerable households. See Table 5.26.

Discussion with supervisors on engineering construction projects indicate the range of wages for unskilled laborers for the types of activities discussed above would be in the order of US$115/month (for a 20-day/ month based on Law No 4 of 2012 Labour Code of Timor-Leste). In terms of wages generated, a total of between US$28,290 (10% local) and US$55,775 (20% local) will be earned, and provide poor households with wages in the order of US$13,013 (10% local) and US$25,657 (20% local) based on the wage rates discussed above. Actual rates may vary but this is indicative of the considerable benefits that the project will provide poor households within the Project Area.

Table 5.26 - Unskilled Employment & Wages

Skilled jobs and wages created	Year				Total
	2013	2014	2015	2016	
Total person-months	115	686	842	782	2,425
20% local	23	137.2	168.4	156.4	485
15% local	17.25	102.9	126.3	117.3	364
10% local	11.5	68.6	84.2	78.2	246
Wages 20% local (US$)	2,645	15,778	19,366	17,986	55,775
Wages 15% local (US$)	1,984	11,833.5	14,524.5	13,489.5	41,860
Wages 10% local (US$)	1,322.5	7,889	9,683	8,993	28,290
Wages for poor (20%) – US$	1,216.7	7,257.9	8,908.4	8,273.6	25,657
Wages for poor (15%) – US$	912.64	5,443.5	6,681.3	6,205.2	19,256
Wages for poor (10%) – US$	608.35	3,628.9	4,454.2	4,136.8	13,013

In addition to the direct unskilled construction jobs, a substantial number of unskilled jobs will be created by the industries that supply materials for the Project (excluding specialized equipment). Major quantities of sand, rock, brick, gravel, ballast, and cement will be used.

Using the formula of the previous feasibility studies, for estimating the skilled wage generating potential of the Project the assumptions include; (i) 5% of the total labor will be experienced and senior engineers who will be engaged in supervisory roles; (ii) the supervisors will receive in the

order of US$10,000/month while skilled workers (including a small contingent of junior engineers) will receive monthly wages in the order of between US$550 – US$1,250 (depending on number of years of experience); (iii) while the NCB contracts will likely have a higher proportion of Timorese workers than ICB, for the purposes of this assessment some 15% of senior engineers and two-thirds of the skilled workers are assumed to be Timorese; and (iv) the skilled workers are non-poor.

Table 5.27 shows skilled jobs (person-months) and wages generated over the Project time-frame. The table shows that in the order of US$2.1 million in total can be generated in wages for senior engineers and skilled workers, and that in the order of almost $1 million could be wages for Timorese labor. If a higher proportion of the total skilled labor could be drawn from Timorese engineers, then the wages generated for Timorese over the Project period would be higher.

Table 5.27 - Skilled Employment & Wages

Skilled Jobs and Wages Created	2013	2014	2015	2016	Total
Total skilled person-months*	187	395	488	574	1,599
Senior engineers (p-mth)	9.5	19.75	24.4	28.7	83
Skilled workers (p-mth)	123	325	412	498	1,358
Senior engineers wages	95,000	197,500	244,000	287,000	830,000
Skilled workers' wages	110,700	292,500	370,800	448,200	1,222,200
Local - senior engineers (p-mth)	2	3	4	5	14
Local - skilled workers (p-mth)	82	215	272	328	897
Local - senior engineers wages	14,250	29,625	36,600	43,050	123,525
Local - skilled workers' wages	73,800	193,500	244,800	295,200	807,300

An additional benefit of construction employment is the training that comes with it. Each worker will be able to seek other construction work based on the experience and skills acquired on the airport improvement project, another reason that these benefits should be retained in the region, if not the immediate project area, rather than an influx of foreign workers who will not leave any built capacity behind after project completion.
Combining the unskilled and skilled jobs, indicates that the Project will generate between 1,157 (10% local unskilled labor) to 1,406 (20% local unskilled labor) person-months' employment in total. While a set aside for the poor cannot be achieved for skilled labor, allocating nearly half of unskilled local work to the poor will provide a significant opportunity for unskilled poor and low-income workers in the project area to increase their household incomes.

Provision of food and other necessities to the construction work crews is another job-creating benefit in the project area. Construction benefits include both income during construction and assets that remain after the construction work is completed. The district governments can authorize female-headed and poor households to organize the food services to the construction camp. This ensures that a measure of this impact will be both pro-women and pro-poor.

Generally in the vicinity of construction camp, restaurants, hotels and bars are built to accommodate contractor staff. Many of the jobs associated with these can also be provided to women and the poor. In addition, the demand creates an opportunity for local small business enterprises and micro-credit organizations which have become increasingly involved in assisting women in starting small businesses through providing advice and small loan funds to capture both job and business opportunities for women.

5.8.6 Distributional Analysis

The general distribution of project beneficiaries can be determined using the data derived from the socio-economic survey conducted in the project influence area (See Table 5.28). The table shows among the direct or primary beneficiaries are the owners and users of non-motorized transport (NMT) and motorized transport.

Table 5.28 – Distribution of Project Beneficiaries

Beneficiaries	Income group (%)			
	Poor	Marginal	Non-poor	Total
NMT owners	51.0	48.7	44.2	48.8
Motorbike owners	28.6	25.3	20.0	23.9
Other motorised transport (MT) owners	11.4	0.0	20.8	13.2
NMT user - travel to health centre	38.1	10.2	15.0	63.3
MT user - travel to health centre	27.2	5.4	4.1	36.7
NMT user - travel to reg. place of work	30.8	10.6	10.6	41.4
MT user - travel to reg. place of work	43.9	7.6	7.1	58.6
NMT user - transport goods to sell	21.0	7.0	9.0	37.0
MT user - transport goods to sell	37.5	7.4	17.9	62.9

5.8.7 Improve Access and Mobility

Nationally, the average walking time to the nearest motorable road is 14.9 minutes, however it is significantly longer in the influence are of Manatutu to Natarbora road.

The Project will improve access to key facilities and services by undertaking works to upgrading and rehabilitating the roads, these benefits will be enhanced in the four districts that will participate in the economic activities and income generation, improving up to 90km of rural and feeder roads linking with upgraded and maintained roads.

5.8.8 Improved Access to Health and Education

The survey results also show the use of roads and the mode of transportation commonly used to reach primary and secondary schools. The beneficiary profile showed that overall the main mode of transport for children travelling to primary and secondary school was very low. About 70 percent of children going to school will walk 3 to 7 kilometers almost every day.

The average distance and travelling times to secondary schools in the districts are amongst the longest across all districts. The average travel time for the country is 58 minutes, in the other sub-districts it ranges from 70 minutes in Natarbora to Laclubar and about 95 minutes in Laclubar to Manatutu. Overall, the average distance to secondary school is 5.6 km while the average distance for the four sub-districts of Manatutu is 45 km. Survey data shows that for between a fifth and 46% of respondents, schools are located within 1.5 km from the household while for between a third and half of respondents children must travel between 2-3 kilometers to either primary or secondary school. Table 5.28 shows that in most cases the children from poor and marginal households have farther to travel to school than children form non-poor households

The poor and those in rural areas have lower school enrolment rates (for every level of school). The net enrolment rates (NER) for primary school is 73% for non-poor and 60% for the poor and the NER for secondary school is 44% for the non-poor and 27% for the poor.

Table 5.28 – Distance to Schools by Income Group

Facility	Income group	Distance to school in km (%)			
		< 0.5	1 to 3	3.5 to 9	> 10
Primary school	Poor	38.8	47.6	10.9	2.7
	Marginal	43.9	38.3	10.5	7.3
	Non-poor	45.8	46.7	4.2	3.3
Secondary school	Poor	9.0	49.7	26.1	15.2
	Marginal	18.5	22.8	38.6	20.1
	Non-poor	20.8	34.6	26.4	18.2

Source: Project Consultant Household Survey (Feb 2013)

5.8.9 Improving Access to Health Services

The distances from household to clinic locations of survey respondents interviewed passengers vary to a large extent for poor and non-poor. Table 5.5.6 shows that a smaller proportion of poor (15%) than non-poor (27%) are locate within 0.5km of a health clinic while some 43% of the poor compared with 23% of non-poor must travel between 3.5km and 9km to reach a health clinic.

Table 5.29 – Distance to Health Centre by Income Group

Facility	Income group	Distance to clinic in km (%)			
		< 0.5	1 to 3	3.5 to 9	> 10
Health centre	Poor	15.2	37.0	43.1	4.7
	Marginal	11.8	35.1	44.8	8.3
	Non-poor	27.9	46.1	23.0	2.9

Source: Project Consultant Household Survey (Feb 2013)

In Timor-Leste, hospital/clinic services are provided free of charge, and there is no disincentive for people not to go to hospitals/clinics when in need. Thus, this difference in the proportions of those who go to hospitals/clinics for routine checkups among the non-poor, poor, and very poor implies that there are reasons other than hospital fees, such as the lack of affordable transportation, poor or inadequate health facilities and staff. Nationally some 42% of people did not seek treatment because the health center was too far and 3% because they lacked transportation.

Table 5.30 shows that there is little difference in reasons for not seeking treatment between males and females, but study of this survey data shows that health treatment seeking behavior is highly correlated with access difficulties. The health problem not being serious enough accounts for the main reason for over half of those not seeking treatment, while bad roads account for 11%-15% and lack of transportation accounts for 15% - 18% of reasons for not seeking treatment.

Table 5.30 – Main Reasons for Not Seeking Treatment for Illness

Gender of H'hold member	Reason for not seeking treatment (%)							
	Hlth problem not serious enough	Too difficult to get there - bad roads	Too difficult to get there - lack trans.	No time off work	Too expensive	Service not good quality	No cure for hlth problem	Other
Males	50.3	11.1	14.8	9.8	1.0	0.8	5.2	12.7
Females	51.9	15.2	17.6	8.8	0	1.1	4.5	11.9

Source: Project Consultant Household Survey (Feb 2013)

The cost of disrupted economic activities resulting from treatment not sought due to access difficulties has been calculated by taking data from TLSLS in respect of number of days disrupted, and the proportion of those with ailments not seeking treatment due to transportation and/or access difficulties. In terms of a district breakdown, the most recent health data available is that reported for 2005 and is based on outpatient and admitted cases for the population aged five years and older. The

proportion of these that would be members of the labor force was determined using the TLSLS figures.

According to TLSLS figures 2009 data, a total of 274,991 days are disrupted as a result of sick people not seeking treatment due to bad roads and lack of transportation. Using an average of US$1.50 day as a proxy for average minimum wage, this means the minimum cost of people not seeking treatment as a direct result of difficult access is in the order of US$412,487/year.

While improving roads is critical to facilitating easy and all-year access to key facilities and services, improving passenger transport services would also contribute to a reduction in the costs associated with disrupted economic activities.

5.8.10 Improving Passenger Transport Services

As part of the studies undertaken during Phase 1 of the PPTA, a passenger transport assessment was completed. The assessment included in the Phase 1 report noted that there is a consensus that inter-urban and rural transport services are constrained by the poor road infrastructure. Some rural routes are impassable and others are very expensive in terms of operating costs. Improving and maintaining the roads is the most important requirement for extending road transport services.

The main factor that limits the access and impedes mobility (quality and quantity of road transport services) is inadequate and poorly maintained roads and river crossings. Therefore there is need to; (i) maintain existing infrastructure; (ii) ensure funds availability for future maintenance; (iii) prioritize spots needing most urgent attention; and (iv) replace failed river crossings.

Given the free market in transport services, the present economic transport demand can be considered to be matched by the existing transport supply. The demand might be higher if the roads were better, but given the current state of the roads, transport entrepreneurs are unable to operate additional services and make sufficient profit to justify the investment and operating costs.

However, there is unmet transport demand. Women and men in rural areas would like better transport services to allow them to reach medical centers, educational establishments, markets and economic centers. They would also like to travel more for family visits and leisure, if there were transport services that were available and affordable. This latent demand may be met if transport services become locally available at prices people can afford. On some roads there are no regular motorized services, due to the poor condition of the road. If the road is repaired sufficiently to allow motorized services to operate, some of this latent demand will be met, depending on the cost of the service and its reliability.

Even on routes where transport operators complain there is not enough existing demand, passengers can be encouraged to travel through improved timetabling, predictability, and service quality. It may be presumed that with road improvements, there could be a rapid increase in rural passenger numbers as the latent demand is met. Thereafter, transport demand can be said to increase in line with predictions for population and economic growth. Since most urban traffic routes are already passable by public transport vehicles, there is much less unfulfilled latent demand. Therefore urban transport demand is likely to follow predictions for urban population growth.

The assessment noted that the development of transport terminal infrastructure is not an urgent priority but that the appropriate location of transport terminals is much more important than the infrastructure itself. Record shows that transport operators and their passengers are opting for roadside stands and/or patches of bare ground, in preference to built terminals.

Well-built and well-located transport terminals benefit passengers, transport operators and supporting services (including retailers). Terminals should provide (depending on local circumstances): (i) sheltered area and seating for passengers; (ii) safe temporary parking for public transport vehicles (including buses, mikrolets, buses, trucks and taxis and/or motorcycle taxis); (iii)

water points and toilets; (iv) designated areas for traders and service suppliers that do not encroach the roadways, sidewalks or passenger facilities; (v) secure parking for bicycles; and, (vi) parking/waiting areas for private cars.

5.8.11 Perceived Benefits and Impacts

After the review and evaluation of the gathered data, the beneficiaries perceive the benefits, risks and opportunities associated with the possible upgrading and rehabilitation of the road, drainage, shoulders and bridges will shows that this will be significant on the development at the influence area.

The main benefits can be grouped into a number of themes, as presented in Table 5.31. Between 50% and three-quarters of respondents considered the project would create benefits in terms of improving transportation and travel. Making travel safer and more comfortable, and providing opportunities for improved bus services, were identified as benefits by 60% of respondents. Benefits for economic activities were considered as potential Project outcomes by between 35% and 70% of respondents, including improving market access, increased opportunities for trade and marketing, increased opportunities for a wider range of goods to be available locally. Social benefits were identified by between 60% and 80% of respondents including improvement in access to important facilities and services (70%), improving the communication between sucos (60%), and improving access to Dili capital. In the order of three-quarters of respondents identified benefits derived during the works period of the Project in terms of construction employment opportunities (72%) and opportunities to sell goods (food etc) to construction workers (68%).

Table 5.31 – Range of Project Benefits Identified

Benefit group and specifics	%
Transportation and Travel	
Reduced travel costs	50
Reduced travel time/faster travel	54
Reduced accidents	57
Increased pedestrian safety	60
Bus services will improve and become more reliable	75
Safer and more comfortable travel	70
Benefits for economic activities	
More goods available locally	68
Increased production/reduction in damage to agri. goods	35
Increased trade opportunities and marketing	40
Improved access to markets	65
Improved access to employment opportunities	70
Social benefits	
Improved access to important services and facilities	70
Communications between sucos will improve	80
Increased and improved access to Dili	60
Project-related benefits	
Employment during civil and maintenance works	72
Opportunities to sell goods to construction workers	68

Source: Project Consultant Household Survey (Feb 2013)

Negative impacts were also identified, however the proportion of respondents indicating that there would be negative impacts as a result of the project were small and insignificant.

A larger proportion of respondents were willing to rank anticipated impacts in terms of high or low impact, with a number of respondents who had previously indicated there would not be negative impacts, answering the questions on the degree of impact that could be caused.

5.9 Gender Assessment

5.9.1 Gender Impact Analysis

A brief social analysis of the project area was undertaken with particular reference to the gender dimension. The conduct of this analysis in line with the ADB's objective to conform to the growing recognition of gender as a development priority and the encouragement of donor agencies to include "gender mainstreaming" in a developing country's policy framework on the context of equal sharing of development benefits.

The study team conducted a rapid social assessment to identify social and gender issues of the project area and the potential impact of project intervention of these gender issues. This analysis attempts to identify the intended social benefits and development outcomes and risks of the project implantation and to provide recommendations in order that the proposed project may strengthen or modify existing social structures to increase gender equity that would contribute to the full realization of project benefits and attainment of sustainability.

5.9.2 Significance of Gender Analysis in Social Development

Men and Women constitute two potentially different categories of stakeholders, with varying needs, capabilities, resources and preference. In specific instances, male and female interests may coincide, but it is important to consider the social norms and expectations pertaining to men and women in any given society, and they matter for development purposes, in particular, gender difference and inequity affect development outcomes.

The Asian Development Bank, as a donor agency, has made a substantial start in defining sector-specific issues in gender for the transport sector. The ADB's Strategy on Gender makes a compelling case for integrating gender into all of its practices, emphasizing that gender inequity impedes economic growth, poverty reduction and the effectiveness of Bank-supported programs.

5.9.3 Evaluation of Road Project Outcomes and Social Impacts

This section involves a brief analysis of probable negative and positive impacts of road infrastructure on gender.

Initial assessment of the gender impact project road was undertaken based on several case studies undertaken by Asian Development Bank and World Bank in selected developing countries.

Based on initial analysis, the following were the identified probable positive and negative impacts of road infrastructure projects on gender:

a. Potential Positive Impacts on Gender
   i. Increase in transport services providing more convenient and faster travel enabling women and girls to travel safely further from home;
   ii. Greater affordability of transport;
   iii. Improvement of rural health, education and other services such as agricultural extension;
   iv. Urban health education, financial and other services become more accessible to rural women;
   v. Girls have more chance to attend high schools and colleges;
   vi. Markets are easier to reach and trading opportunities for women increase;
   vii. More customers during civil works come to the locality and improvement of opportunities to expand small enterprise operated by women;
   viii. Women are able to enjoy greater social travel to maintain family ties;
   ix. Employment opportunities generated for local labor including women, especially rural roads with labor-intensive construction, and sometimes national highways, providing much needed cash income for women and the poor;
   x. Poor women, especially female headed households are benefited through provisions for local contracting labor recruitment, and local maintenance contracts;
   xi. Health and safety problems for women are minimized since the project avoided the use of large contingents of outsider labor.

xii. At the local level, contractors and laborers were engaged for constructions and subsequent maintenance;
xiii. Labor-intensive construction methods, small-scale local contracting and decentralized implementation arrangements provide employment for women and men using small contractors to build roads, markets and other civil works;
xiv. Pro-poor approach to improve the road network demonstrated that labor-based construction method can be technically and economically efficient and can be applied to large-scale investment projects.

b. Potential Negative Impacts on Gender
i. Opening up of previously remote or isolated inhabited regions increases the spread of HIV/AIDS;
ii. Trafficking of girls and women increases, especially in localities near national highways and cross-border corridors. The risk is greatest in areas where women have low status and where there is widespread poverty;
iii. In gender-segregated societies, women are unable to travel or trade unless they are women only sections and facilities in buses, trucks , boats waiting rooms and at markets;
iv. Opening up of remote rural areas may have negative influence on the culture, property rights and way of life of already disadvantaged ethnic minorities. Indigenous/elder women are often exploited to promote tourism;
v. Increased volume of commercial and private traffic may disproportionately affect the health, security and safety of women and children;
vi. Resettlement has disproportionately negative effects on women and there are least likely to benefit from compensation;
vii. Increased rural-to-urban and labor migration may have negative impacts on rural women, for example, major poor, disadvantaged, female-headed households;
viii. Labor migration increases the risk that returning male workers will transmit HIV/AIDS to rural women and children;
ix. Road way traffic accident phobias may divide a community impacting on kin and social networks and areas to services and economic activities;
x. Establishment of constructions – and influx of outside or migrant workers can lead to cultural influences, new diseases and negative social impact;
xi. Rise in crime caused degradation in security;
xii. Loss of lives due to poor working conditions that led to less security
xiii. Loss of customers to businesses in towns meant fewer opportunities for small businesses in rural areas;
xiv. Accidents due to vehicles which are not road-worthy caused degradation in security;
xv. In the provision of connectivity to major cities, communities are highly vulnerable making junctions and surrounding areas exposed to the following risk:
- Gender discrimination.
- Drought affected.
- Loss of traditional livelihoods;
- Child labor and engaging in women;
- The high-risk groups are: truck drivers, women and children especially from scheduled tribes and poor households, migrant laborer and construction workers.

5.9.4 Gender-responsive Actions to be taken

To address the various identified potential negative impacts of road projects on gender and to enhance equal gender participation in order to attain the full realization of the benefits and sustainability of the project, various interventions with specific focus on gender are recommended to be taken, based on experiences in selected developing countries, such as:

a. Institutional Strengthening
b. Proposing appropriate and effective gender mechanisms within the institutions and provide support for taking gender concerns into account in all aspects of planning and programming.
c. Provide training on gender considerations for both central and local government level;

d. Increasing the number of women in local, district and regional decision-making assemblies by setting minimum levels of women representatives;
e. Giving emphasis on social impacts on transport sector development and integration of gender issues across all policy areas;
f. Redressing the imbalances in staffing and maintaining an equitable representation of women at all levels within the organization;
g. Women's Associations represented in the bodies in charge of planning and implementation.
h. Strengthening women's participation in decision-making on district, urban and community roads.
i. Incorporation of the transport needs of both women and men in district and sub-country development plans; and
j. Encourage participation of women in planning transport interventions.

5.9.5 Capacity Building

The implementation of institutional strengthening and capacity building must be introduced by the implementing agency for the project. The following are some recommendation to effectively monitor the gender sensitiveness of the project.

a. Ensuring that women have employment opportunities in the transport sector, either as contractors or workers;
b. Introduction of labor-based road construction methods wherein the labor construction team consisted of about 30 percent women members;
c. Informing women of potential employment opportunities in road works;
d. Involving of women in both routine and periodic maintenance of road such as excavating to level, ditching, spreading of gravel including earthen embankments and planting of trees;
e. Encouraging women to set up small construction businesses through training and networking;
f. Formation of labor contracts with landless or destitute women for routine maintenance and tree treatment of women at work;
g. Taking special care in the treatment of women and men in labor-based road works;
h. Equal recruitment opportunities for women and men in labor-based road works;
i. Ensuring equal rights of men and women as laborers in working hours and income;
j. Ensuring that women are represented in the worker's welfare committees;
k. Visitation to sites to observe the working environment ; and
l. Providing family planning support and HIV/AIDS protection to many female workers and proper gender education through conferences, consultations with psychologist and the distribution of condoms.

5.9.6 Infrastructure Support Facilities

The gender sensitive facilities should be considered in all stages of the project cycle in order to ideal the needs of the vulnerable genders. The following are some recommendation that the gender development will be visible in the project area.

a. Construction of a number of facilities such as toilets and sheds at strategic places along the road;
b. Construction of road camps during construction with separate facilities for men and women providing shelters for breastfeeding mothers; and
c. Construction of ramps within urban areas at intersections in front of building structures for easy and safe access of women, children and disabled.
d. Construction of sidewalk and street lights on community built up or urban areas to avoid accident on the children and elderly citizens.

5.10 Social Action Plan

For addressing social impacts, the SAP is effectively the equivalent of the environmental management plan. The SAP sets out the measures required mitigating the adverse social impacts and a risk identified in the assessment, and also includes the measures to increase or enhance Project benefits. Enhancing the expected benefits form the Project will largely be through the civil works implementation until the completion of the road.

5.10.1 Risk Management

The overall level of negative social impacts will be minor. The majority of impacts will occur during the civil works (upgrading and rehabilitation) phase, and will be temporary, localized, and readily controlled. A numbers of these impacts are also identified in the Project's IEE and will be addressed through the EMP.

The spread of STIs and HIV during civil works phase through the presence of ICB and NCB contractors has been identified as a potential risk. This can be addressed through implementation of the STIs and HIV/AIDS awareness and prevention campaign aimed at (i) contractor's employees, and (ii) villages along the roads.

A second social risk of the Project is potential conflicts between contractors and residents, if workers abuse the rights of local people, which may include sexual harassment of women, or seduction of young girls looking for fun and money, damage to property, theft, drunkenness and fights between local men and outsiders. The contractors will be required to establish camps for the foreigners and Timorese workers who do not live locally. Foreigners and Timorese from other districts could be considered as an 'opportunity' for young people to access money and goods which would normally be out of their reach. Concern was expressed about children and teenagers spending time at camps, and particularly teenage girls.

The feasibility study up to detailed engineering design stage will include a training component on local engineers and skilled worker. During construction there will be seminar and training awareness about transmission and prevention of HIV/AIDS and STIs, therefore selected communities in the sub-districts will benefit from training on prevention of communicable sexual infections. Other communities will be reached through the delivery of the Project's STIs and HIV awareness and prevention program. Trafficking has not been identified as a significant risk, but it is a risk nonetheless and anti-trafficking measures should be incorporated into the implementation of road projects as a matter of good practice.

The Tables 5.32 sets out the measures for the management of social risks (also this will address in the IEE report).

Table 5.32 - Measures for Management of Social Risks

Risk 1: Spread of STIs/HIV/AIDS and Human Trafficking/Child Exploitation		
Sub-project Activity	**Risk Management activity**	**Expected outcome**
Contract negotiations and award	Contract clauses requiring contractor to engage a qualified NGO to provide HIV/AIDS and STIs training (education and information) and make condoms accessible to all employers paid by the contactor	Increased awareness; No unprotected sexual activity will occur during civil works phase
Immediate pre-construction	STIs and HIV/AIDS training team contracted to provide community awareness program	Communities in vicinity of re-instated roads will be fully informed about the risks of STIs and HIV/AIDs
Detailed Engineering and Civil works	Awareness campaign through public consultation ; Monitoring by PMU and safeguards specialist	STIs and HIV/AIDS training prevention program will be shared during consultations.
Risk 2: Conflict between workers and residents		
Subproject Activity	**Risk Management activity**	**Expected outcome**
Contract negotiations and award	Contract clauses requiring contractor to set (i) targets for employment of local labor (including targets for women); (ii) village protocols (requiring workers to treat landowners/villages with respect); (iii) a code of behaviour towards girls and women; and, (iv) no employment of child or trafficked labor	Workers will maintain acceptable codes of conduct on threat of dismissal; Compliance with labor code
Immediate pre-construction	Contractor visits all villages to explain and negotiate construction activities accompanied by PMU and safeguards specialist.	All households in the subproject area will be fully informed about road works; Negotiations will be conflict-free
Detailed Engineering and Civil works	Consultations undertaken to ensure that communities are aware of opportunities for employment in re-instatement activities, maintenance works and CEC, as well as for provision of food etc to workers; Monitoring by PMU and safeguards specialist; Implementation of communications plan assisted and facilitated by PMU and safeguards specialist	Timely and informative consultations with communities and leaders, free and frank exchange about activities and requirements; No conflict during construction
Gender equity measures	Construction activities planned in manner that accommodates women's existing work/time burden; i) adopting task rates rather than daily rates; ii) flexibility in starting time; iii) undertake most works during the off-peak agricultural seasons; Awareness creation about the significance of women controlling cash; Awareness creation, targeting women, about the risks associated with exposure to public life; Women's income is likely to be spent on improving household welfare, payment of school fees and purchase of productive assets; Participation in CEC construction and skills-building activities	Women have opportunity to participate in Project works and have opportunities for employment over four-year period; Livelihood and socio-economic status of women improves
During preparation of RP and Detailed Engineering	Ensuring most local laborers are residents of aldeias/sucos along the road;	Increased community-based involvement with infrastructure management;

5.10.2 Enhancing Project Benefits

In addition to mitigating social impacts (or managing the social risks), there are measures that can be included in the project to maximize benefits. There should be a Livelihood training program be provided to the community in the influence area.

This proposed livelihood program will give the local community the opportunity employed during civil works or put up some small scale business within the project area. This will enhance and support skills development for rural poor and vulnerable groups (including poor household, disadvantaged women, unemployed youth) through literacy, numeracy, basic business skills (agriculture and horticulture) training, and raising community awareness through life skills program on road safety, primary health and gender. Selected NGOs will design and provide several skills development and community awareness programs to community workers and their family members.

On the community to be actively engaged in upgrading and rehabilitation of this rural feeder road, these will have a fully benefit from improved roads for market opportunities and access to social services, it is essential for them to have basic skills training such as literacy and numeracy. As rural roads connectivity and traffic flow increase, it is also important to raise communitywide awareness regarding road safety, gender and health issues including STI/HIV/AIDS prevention. This component is aimed at developing human resource capacities of the poor and vulnerable population in rural communities, in order to ensure the sustainability of community-based road maintenance and to maximize socioeconomic benefits from improved rural roads. The following activities will be carried out.

The Gender development should take it to consideration by given the prevalence of key gender issues in rural local community workers, the project will organize workshops where participants—men as well as women—can learn about women's rights and broader human rights, risks of gender-based violence, and managing gender relations in the household and in work sites.

5.11 Indicators for Monitoring

The social assessment undertaken for the RSIP identified the following indicators/measures for the monitoring and evaluation of that project:

a. Reduced average travel time to market in project areas by 10%;
b. Reduced average travel time to health facilities and schools in project areas by 10%;
c. Increased frequency of road transport service by 5%;
d. Increase in job opportunities in the road corridor areas by 5%; and
e. Increased economic and agricultural trade by 5%.

Identifying such specific targets can be difficult to measure and quantify and will require monitoring to utilize highly prescriptive methodologies (survey) rather than approaches that can provide and supplement an understanding of more subtle improvements and changes over time. Furthermore, targets specified in such a way can lead to an incomplete understanding of benefits accruing from the Project, for example, if cross-border trade increased by 3.5% and did not meet the target of 5% would that mean the Project was not successful? If average travel time to health facilities had not been reduced by 10% but several emergency trips had been made more easily, an indicator that is not picked up in the above targets, would that mean the Project was not successful?

It should also be noted that the targets specified above cannot be linked solely with road upgrading and access improvements. While it is important to set targets for monitoring, any improvements over an identified base-case should be considered to be benefits accruing to communities.

The poverty social impact and benefit monitoring approach recommended for the Project is a combination of quantitative (survey) and qualitative (most significant change) data gathering. Prior to completion of the works for the road project, a baseline survey will be undertaken. A monitoring plan covering a number of performance indicators will be further developed to measure and monitor benefits as well as anticipated risks and possible negative impacts from the road projects. In order to undertake this work, DRFCB's PMU with the assistance of the safeguards specialist (part of the Project Supervision Consultant), with the assistance of an independent poverty/social monitoring specialist, will establish and implement a project performance management system (PPMS). The socio-economic indicators can be incorporated into the overall PPMS to show that the social risks associated with the Project are being avoided or adequately mitigated and whether the benefits are accruing as expected.

The monitoring plan for social benefits and risks is provided in Table 5.33 The evaluation and measurement was based on the indicators derived from the survey data that acquired in the project influence area.

Table 5.33 – Poverty and Social Impact Monitoring Framework

Direct Social Benefits	Indicator	Measurement Means
Poverty reduction	Number of households/population below/above poverty line; Increase in people engaged in regular waged work; Reduced household hardship and improved food security and household well-being; Increase in number of improved houses (tin roof/water tanks), permanent materials etc	Baseline survey data (incl. existing sources such as TLSLS); RRA for participatory poverty study and assessment; Focus group discussions (FGDs) and most significant change (MSC) reporting; Project reports
Employment during construction and maintenance	Legal wages paid to workers; No use of trafficked or child labor for construction and maintenance activities; Employment targets set for women and the poor; No differential wages paid between men and women for work of equal value; A specific clause placed in bidding documents that compliance will be strictly monitored during project implementation;	No. of LBES contracts let; Construction contract wage bills; Project monitoring reports esp. to identify if targets being met; FGDs and MSC reporting
Increased passenger transport services	Increases in local vehicle passenger transport fleet; Increased number of bus stops; At least one passenger/transport vehicles will call at xx villages on the stretch daily; Increased investment in provision transport services in the subproject location	Vehicle numbers viz-a-viz passenger transport vehicle numbers; No. of pax and cargo trips per day; RRA, FGDs and MSC reporting
Increased volume of production for cash sale	Long-term increase in overall agricultural production, especially cash crops such as coffee and fruits; Improved access to local markets and Dili	Records of production in area Consultations with cooperatives etc
Increased role of women in village decision making; empowerment of women	No. of women on village authorities/committees No. of women engaged in construction and maintenance activities No. of women accessing existing credit schemes and successfully paying back loans	No. of women to be specified in terms of % of village population and viz-a-viz men; RRA, FGDs and MSC reporting Project reports
Indirect Social Benefits	**Indicator**	**Measurement Means**
Promotion of socio-economic development in the area	Increased literacy in official and working languages Increased waged and off-farm employment Increased household incomes Reduced seasonal and out migration	Survey data Household census data in longer term
District and sub-district link and access	Open a potential development/tourism in the area Generate National and local income Access to Relative and family	Survey Data Socio-economic assessment Domestic Violence report Household census data
Educational access and progress Family/household educational attainment	Generates professional people in the area District band sub-district area will become renowned Better opportunity to develop the area	Survey Data Socio-economic assessment Domestic Violence report Household census data
Potential Negative Impacts	**Indicator**	**Measurement Means**
Increase in HIV/AIDS & STIs resulting from construction phase activities	Increase in STD and HIV/AIDS rates; NGO engaged to implement A&P program	District health statistics; Survey data; Records of A&P program implemented
Land and/or resource acquisition	Compliance with RP; Satisfaction of APs with process and compensation	As identified in RP prepared for the road project
Exclusion of poor and marginalized groups	Poor and marginalized households affected by project (compared with proportion of non-poor)	RRA, MSC and baseline data
Other Interventions	**Indicator**	**Measurement Means**
Enhanced social awareness for prevention of HIV/AIDS and trafficking	HIV/AIDS awareness & prevention program implemented prior to construction Inclusion of trafficking awareness and prevention component	Project reports Independent monitoring report
Public participation, consultation & awareness	Public awareness programs to beneficiaries and communities living in subproject areas	Project reports Independent monitoring report

5.12 Resettlement Framework

The RP is based on ADB's Safeguards Policy Statement of 2009 (SPS 2009) as well as the Timor-Leste's applicable/domestic policy instruments and laws. The RP fits with the provisions of the Resettlement Framework (RF) that has been formulated to provide the basis of preparing the RP to mitigate adverse impacts under the subproject. The following section deals with these policies with a comparison of two policies and subsequently deals with the entitlements and eligibility for compensation and other resettlement entitlements.

The government proposes the Road Network Upgrading Project" (RNUP), and to promote quality and safety and ensure greater economic and social benefits to the people. It will be designed taking into account social safeguard policies of ADB that include avoiding and/or minimizing resettlement impacts. However, this road improvement includes widening and realignment and hence it is likely to have some unavoidable impacts on assets of non-titleholders. However, as a result of an extensive exercise in minimizing adverse resettlement impacts, the Project reduced impacts to a small number of families.

5.12.1 Existing Policy and Legal Framework for Resettlement

The Section 141 of the Constitution states that the ownership, use and development of land as one of the factors for economic production shall be regulated by law. Section 54 of the Constitution covers the right to private property and provides for:

a. Every individual has the right to private property and can transfer it during his or her lifetime or on death, in accordance with the law.
b. Private property should not be used to the detriment of its social purpose.
c. Requisitioning and expropriation of property for public purposes shall only take place following fair compensation in accordance with the law.
d. Only national citizens have the right to ownership of land.

The first land law of Timor-Leste was promulgated in March 2003 and was designed to serve as an umbrella law for the rest of the land and property regime. The law defined State property of private domain, established the Directorate of Land, Property and Cadastral Services (DLPCS) as a legal entity and defined its jurisdiction, and articulated general rules concerning land tenure and property rights to be further developed by ensuing legislation. Moreover, this law established a one-year period for both nationals and non-nationals to register their land claims. Effectively Law No. 1/2003 vests all land that belonged to the Portuguese state, and all state property acquired or built by the Indonesian regime, in the new state of Timor-Leste.
A decree issued by the Government in February 2011 provides for granting compensation to relocate unlawful occupants of State property based on humanitarian considerations. The Ministry of Justice (MOJ) through Ministerial Statute establishes the basis for calculating compensation. Another decree promulgated in July 2011 passed in June 2011 provides for the granting of title certificates to landowners/persons in areas where cadastral surveys have been completed (following registration and verification of claims by the government) and confirmed that the claims to land are undisputed. Among the claims registered so far under the Ita Nia Rai program, some 92 per cent of claims are undisputed.

There are no specific laws on involuntary land acquisition and compensation. The legal basis for declaring the right of way outside the current road footprints has not been established. When road works required land in the past, the Government negotiated with the owners or users (including squatters) on a case by case basis. According to past practice, when land was required for project development, concerned parties under the direction of local authorities (district and sub- district Land and Property Units and village) negotiated and reached agreement on compensation rates, total compensation amount, and the procedures or mechanism for compensation and transfer.

5.12.2 ADB Safeguard Policies

The ADB's Safeguard Policy Statement (2009) provides comprehensive guidance on complying with the requirements for environmental and social safeguards (involuntary resettlement and Indigenous Peoples) in Projects. It aims to avoid or minimize the impacts on people affected by a project, and to provide support and assistance for those who lose their land and property, as well as for others whose livelihoods are affected by the acquisition of land or restriction on land use. Resettlement planning is designed to provide APs with a standard of living equal to, if not better than, that which they had before the project. The policy is guided by the following principles:

a. Involuntary resettlement is to be avoided or at least minimized;
b. Compensation must ensure the maintenance or improvement of the APs' pre-project living standards;
c. APs should be fully informed and consulted on compensation options;
d. APs' socio-cultural institutions should be supported/used as much as possible;
e. Compensation will be carried out with equal consideration of women and men;
f. Lack of formal legal land title should not be a hindrance to assistance/rehabilitation;
g. Particular attention should be paid to households headed by women and vulnerable groups, such as indigenous people and ethnic minorities, and appropriate assistance should be provided to help them improve their status;
h. Land acquisition and resettlement should be conceived and executed as a part of the Project, and the full costs of compensation should be included in project costs;
i. Compensation/rehabilitation assistance will be paid prior to ground leveling and demolition, and in any case, before an impact occurs.

The policy comprises three important elements. The first is the compensation to replace lost assets, livelihood, and income second; assistance for relocation, including provision of relocation sites with appropriate facilities and services; and the third is the assistance for rehabilitation to improve or achieve at least the same level of wellbeing with the project as without it.

A project's involuntary resettlement category is determined by the category of its most sensitive component in terms of involuntary resettlement impacts. The involuntary resettlement impacts of an ADB-supported project are considered significant if 200 or more persons will experience major impacts, which are defined as (i) being physically displaced from housing, or (ii) losing 10% or more of their productive assets (income generating). The level of detail and comprehensiveness of the resettlement plan are commensurate with the significance of the potential impacts and risks.

5.12.3 Policy Framework and Entitlements

The legal and policy framework on resettlement in Timor-Leste has been compared with the requirements of ADB and some gaps have been identified. The gap filling measures and resettlement policy principles for the project are as follows:

a. The Constitution gives the power to the state to expropriate land for public purposes paying due compensation in accordance with the law. While there are some laws on ownership of state land and claims to private land (undisputed parcels), no law is in place that regulates how that expropriation can take place or compensation measures. The draft Expropriation Law is awaiting Parliament's approval. When the expropriation law is enacted, the Government will be able to acquire land for road improvement under "eminent domain" or involuntarily. Until an expropriation mechanism is in place, the project will follow the approach of negotiated settlement/purchase of land.
b. A substantive amount of land in Timor is not registered. The Government has started issuing land title certificates in urban areas, which will help in identifying land owners. In rural areas where most of the road sections will be improved, the DLPCS will identify and establish ownership claims for the land parcels required for the project roads.

c. The absence of an active land market in rural areas poses a challenge to determine the market or replacement value of the affected land. Professional valuation expertise under the Project Management Unit (PMU) supported by ADB will be requested to assist the DLPCS for valuation of affected assets to determine fair compensation at replacement cost to APs;

d. (iv) Resettlement impacts will be minimized through careful engineering design;

e. APs will be systematically informed and consulted during the entire process of resettlement planning and implementation, including assessment of possible impacts on their livelihoods, purchase of land/assets, determining compensation/resettlement options, and socio-economic rehabilitation measures. They will be informed of their rights and options and be invited to participate actively in the identification of mitigation and rehabilitation measures;

f. The APs will be identified and recorded as early as possible in order to establish their eligibility through a population record or census that serves as an eligibility cut-off date, usually around the time of initial consultations, at the subproject identification stage, to prevent a subsequent influx of encroachers or others who wish to take advantage of such benefits;

g. Consistent with donor policies, eligible APs are those that: a) have formal legal rights to land (including customary and traditional rights recognized under the laws of the country); b) do not have formal legal rights to land at the time the census begins but have a claim to such land or assets--provided that such claims are recognized under the laws of the country or become recognized through a process identified in the resettlement plan; and c.) have no recognizable legal right or claim to the land they are occupying, before the cut-off date;

h. Eligible APs are entitled to compensation and livelihood rehabilitation measures sufficient to assist them to improve or at least maintain their pre-subproject living standards, income earning capacity and production levels;

i. In the consultation process, representatives of local governments, village chiefs, other community leaders and civil society organizations such as non-government organizations (NGOs) from the operational areas will be included. The customs and traditions, as well as the religious practices of all APs, will be respected and protected;

j. The institutions of APs, and, where relevant of their hosts, are to be protected and supported. Physically displaced APs will be assisted to integrate economically and socially into host communities so that adverse impacts on the host communities are minimized and social harmony is promoted;

k. Lack of formal legal rights to assets lost will not deprive any AP from receiving compensation and payments for non-land assets and entitlements;

l. Particular attention will be paid to the needs of vulnerable APs. This group of APs may include those without legal or recognizable title to the land or other assets, households headed by females, the elderly or disabled, and other vulnerable groups, such as people living in extreme hardship, and indigenous people that may be a minority in specific locations. Appropriate assistance will be provided to help them improve their socio-economic status;

m. The concerns of women will be identified based on gender disaggregated socio-economic data, separate discussions on women's concerns, and ensuring adequate measures and budgetary allocations in the resettlement plan to compensate and resettle

them in a manner that does not disadvantage them. In this effort the assistance of national NGOs currently engaged in women's welfare will be sought;

n. Since there are no significant differences in cultural and socio-economic identity among the different language groups, no specific adverse impacts are anticipated to warrant separate indigenous peoples' plans. To ensure that the different language groups fully participate in planning and implementing resettlement, discussions and reports will be prepared and disclosed appropriately in the relevant languages. RPs will also include provision for any special measures that may be required;

o. Resettlement planning decisions will be preceded by a social preparation phase where consultations will be held with APs, community leaders, local administrators, and NGOs to enhance the participation of these APs in negotiation, planning, and implementation;

p. A Valuation Specialist will be provided under the PMU to assist the DLPCS to have appropriate rates in place. Payment for physical assets, i.e. houses, buildings and other structures, and non-physical assets such as lost income from productive assets or jobs, will be calculated at replacement cost and included in the RP;

q. APs losing only part of their physical assets will not be left with a proportion inadequate to sustain their current standard of living. Such a minimum size will be identified and agreed upon during the resettlement planning process;

r. Land for land or asset for asset compensation is always the preferred method. However, if insufficient land or assets are available, or if the affected people have a preference and the resettlement impacts are considered to be minor and do not undermine the livelihoods of APs, cash payment at replacement costs will be provided based on negotiation with APs. For those experiencing severe impacts (more than 10% of productive land severely affected people (i.e. those APs experiencing significant impacts) assistance will be given to identify and purchase alternative land. Efforts will also be made to provide sustainable livelihood restoration measures so that affected people can improve or at least restore their standard of living to pre-project levels;

s. A grievance redress mechanism, linked with existing traditional formal and informal systems and cognizant of cultural requirements, will be established to solve resettlement related disputes and complaints from APs;

t. The full cost of land purchase and resettlement will be included by the government in the project cost and adequate budgetary provision shall be made available during implementation;

u. All land purchase, compensation, resettlement activities will be satisfactorily completed and the subproject areas cleared of all obstructions before the commencement of civil works; and

v. No works with resettlement impacts will be implemented before a RP has been prepared and approved in line with the RF. The general process for preparing RPs includes:

   i. Consultation – with APs relevant stakeholders, and whenever necessary, assistance of relevant institutions to ensure effective consultations;
   ii. Undertaking of a participatory inventory of losses (IOL), which will be updated during a detailed measurement survey (DMS) following the detailed design;
   iii. Determination of replacement cost – for APs losing assets (land, physical assets, means of livelihood, or social support systems) will be compensated and assisted, through adequate and satisfactory to the AP, replacement land, housing, infrastructure, resources, income sources, and services, in cash or in

kind, so that their economic and social circumstances will be improved or at least restored to the pre-project level. All compensation will be based on the principle of replacement cost at current market value. When necessary, livelihood restoration programs acceptable to the local community will be put in place to help people improve, or at least restore, incomes to pre-project levels;

iv. Preparing a cost estimate and budget – including the costs of compensation, relocation and rehabilitation, social preparation and livelihood programs. The budget will also include the costs for planning, management, supervision, monitoring and evaluation, land taxes, land fees, physical and price contingencies, and implementation of the RP;

v. Inclusion of a grievance mechanism based on cultural practices and agreeable to APs.

vi. Inclusion of a monitoring system - appropriate reporting and monitoring and evaluation will be established as part of the resettlement management system, this will be set out in the RP.

5.12.4 Eligibility and Entitlements

This RP will apply to the Road Network Upgrading Sector Project for implementing the Dili-Tibar-Liquica subproject. This will ensure that all persons affected by losing of any fixed or mobile assets, will get appropriate compensation and rehabilitation assistance.

Cut-off Date under the Project is the date after which people will not be considered eligible for compensation, i.e. they are not included in the list of APs as defined by the census. Normally, the cut-off-date is the date of the detailed measurement survey. People who move into the area after this date will not be entitled to any compensation. In case of the present subproject, the RP recognizes the affected persons (also known as squatters) eligible to receive compensation for their losses although they have no formal title but have a claim to the assets. Compensation at replacement cost for affected assets (houses, other structures) crops and trees will be adequate to replace losses. See Table 5.9.1 of this report.

Table 5.34 Entitlement Matrix

Type of Impact	Entitled Person(s)	Entitlements
Temporary use of land	Legal/ customary landowners	It will be done only with agreement of landowners/APs. Affected landowners/APs will be paid rent on terms negotiated with them based on replacement value. The land will be returned to respective landowners/APs after its restoration.
Permanent acquisition of land.	Legal owner(s)/customary landowners Informal settlers with no recognizable rights	Landowners will be provided equivalent size and quality of land, or cash compensation at replacement cost. All APs will be provided compensation at replacement cost for damaged non-land assets (e.g. crops, trees,) on project-affected land.
Loss of crops and trees	All APs irrespective of their legal status	APs will be given notice to harvest crops and trees before site clearance. If APs are not able to harvest, they will be paid cash compensation at replacement cost. In case of perennial crops and trees, the compensation will also include loss of income.
Loss of structures	All APs (whether having legal land title or not)	APs will be provided replacement structure or compensation at replacement cost (if APs preferred so) without deductions for depreciation or salvaged materials. It will be ensured that replacement structures are ready to move before relocation of existing structures. In case business activities are disrupted, APs will be provided disruption allowance for the duration of business disruption.
Displacement of community structure	Community representatives as identified by the social impact assessment	Affected structures will be restored in consultation with community or the affected community will be provided with cash compensation at replacement value without deductions for any materials salvaged. Community will be assisted in dismantling and relocating structure/property.
Impacts on vulnerable APs	Vulnerable AP households identified by social assessment.	Vulnerable households will receive (i) additional support, (ii) priority employment in project construction and maintenance works; and (iii) income support for the period of disruption. Amount to be confirmed in the RP for each road/bridge.
Unforeseen impacts	Concerned APs	These will be determined as per the principles of the RF and safeguard policies of funding agencies.

5.12.5 Consultation, Assessment of Impacts and Preparation of RP

The APs will be informed and consulted on compensation and/or resettlement options, including relocation options/sites, and socio-economic rehabilitation measures, the acquisition of lands, assets and possible impacts on their livelihoods. They will be informed of their rights and options and be invited to participate actively in the identification of compensation and rehabilitation measures. Representatives of local governments, village chiefs, other community leaders and non-government organizations (NGOs) from the operational areas will be included. The customs and traditions, as well as the religious practices of all APs, will be respected and protected.

The MoPW/PMU will undertake an assessment of social impacts (census of APs, cadastral survey/ inventory of losses, and socioeconomic survey) and prepare the RP. The RP will summarize scope of land acquisition/purchase and resettlement; socio-economic information; consultation process; entitlements; and implementation arrangements. It will also include an implementation schedule ensuring that civil works will not commence until compensation and/or assistance has been paid to APs. The RP will be prepared in consultation with and disclosed to relevant stakeholders and submitted to ADB for approval and posting on their websites.

5.12.6 Land Acquisition

The Land required for the Project will be obtained according to the provisions of the Expropriations Law. The law requires land acquisition through private negotiation in the first instance. The Ministry of Justice, the agency empowered to acquire land involuntarily, will only entertain applications for compulsory acquisition after it receives documentary evidence that all attempts to obtain land under private acquisition have failed. To conform to ADB social safeguards requirements, the compensation paid to affected persons will be based on replacement value. Where statutory compensation under the Expropriation Law is less than replacement value, the project will provide

additional funding to ensure that donor compensation standards are met. A grievance redress mechanism, linked with existing traditional formal and informal systems and cognizant of cultural requirements, will be established to solve disputes and complaints from APs. For disputes arising on land issues, grievances will be resolved under the provisions of the Land Law.

5.12.7 Compensation and Income Restoration

The MoPW/PMU will coordinate with local governments to disburse or pay compensation to APs in according to the Entitlement Matrix. The Expropriation Law prescribes detailed processes for payment of compensation for land, structures, businesses, tenants, usufructs and easements. Compensation will be paid and affected structures relocated before taking possession of land/properties, and prior to the start of civil works. Government staff, working in association with independent entities like NGOs and Church leaders, will assist in identifying entitled persons and delivering the compensation amounts as required under Law. Besides direct compensation, implementation of other measures for APs such as employment in project construction, skills training, assistance to vulnerable groups will be specified in the RP

5.12.8 Grievance Redress Mechanism

The Project manager for each subproject will be the grievance focal point to receive and address concerns regarding compensation. Matters arising from ownership disputes and other land related issues will be resolved according to the provisions of the Land Law in coordination with local authorities, MOJ/DLPCS and MoPW/PMU. The grievance redress mechanism described in the RF will be further elaborated in RPs for each sub-project, to suit prevailing local conditions. MoPW/PMU will assist APs to access this mechanism. Most grievances related to resettlement benefits, relocation of structures, and other assistance will be resolved at subproject level.

5.12.9 Institutional Arrangements and Financing

The PMU under the MOI will have overall responsibility for implementing the sub-projects. A Working Group comprising senior officials from MOJ, MOF, MoPW, DLPCS, PMU, and a representative of the relevant donor agency ADB will ensure coordination of project activities and guide the PMU. The PMU will be supported by international and national safeguard specialists to plan and implement land acquisition and resettlement and monitor the activities. To this end an Environmental and Social Unit (ESU) will be established, staffed by national counterpart staff and assisted by international specialists.

The MOF/MoPW will be responsible for ensuring that adequate funds are available for land acquisition and resettlement according to budgets prepared for each sub-project. Financing of land acquisition and all associated costs will be borne by the Government. The actual costs for such activities under each subproject will be prepared during detailed design and included in the RPs. The budget will be based on estimates made from the inventory of losses, and assessment of impacts

5.12.10 Monitoring

MoPW/PMU with the assistance from the design/supervision project consultants will monitor all activities associated with resettlement. Internal monitoring will include reporting on progress of activities in the implementation schedule with particular focus on public consultations, land acquisition, financial disbursements, and level of satisfaction among APs. MoPW/PMU will prepare and submit semi-annual progress reports to ADB as part of project performance monitoring. In addition, external monitoring experts (e.g. NGOs) will be engaged to monitor category A subprojects, if any.

5.13 Conclusions

The project intends to support upgrading the Timor-Leste's infrastructure development on the National Road Network to accommodate rapid economic and social growth. It focuses on financing strategic Road Links identified by the "Medium-Term Road Network Development Program," prepared under ADB's TA.

The principal beneficiaries of the Project are the people living and working in communities within District of Manatutu and the four adjacent district including Dili with all the sub-district along the influence area. The current population within the District and the sub-district is approximately 63,000 and is projected to be in the order of 75,000 at the tentative completion of the project, i.e. 2016 (based on continued growth at the current rate of 1.06% per annum).

The conclusions of this PSA are that the communities and road transport sector will benefit directly, with significant increase expected in the level of passenger transport services; and, growth in the transport of goods by roads by small-scale transporters (e.g., Motorbike, "Angunna" trucks and ojeks) and other private car.

In the longer-term the agricultural and local/community business sector will grow, with new micro, small and medium enterprises being established that will take advantage of better transport services and lower transport costs to operate and provide services. The businesses will raise cash incomes and create more wage employment opportunities at the same time that they rely on a larger customer base and higher household incomes.

The public sector will be better able to provide services to the population. This includes health and education services for which current access is insufficient and inadequate. It also includes services that are presently not available such as access to government services and infrastructure like electricity/water supply and veterinary extension services.

The survey results indicate that the Project is welcomed and will have an overall beneficial impact; improving access and connectivity, reducing travel time and travel costs, while improving livelihoods and socio-economic conditions. A range of benefits is expected to arise from upgrading and maintaining the road links including increased accessibility to markets, improved opportunities for livelihood development, and local poverty reduction.

The overall level of negative social impacts will be minor. The majority of impacts will occur during the civil works phase, and will be temporary, localized, and readily controlled. A numbers of these impacts are also identified in the Project's IEE and will be addressed through the EMP. The spread of STIs and HIV during civil works phase through the presence of ICB and NCB contractors has been identified as the most significant social risk. This will be addressed through implementation of the STIs and HIV/AIDS awareness and prevention campaign aimed at (i) contractor's employees, and (ii) villages along the roads.

5.14 Social Appendices

Appendix 5.1 - Involuntary Resettlement Screening Form 300609
Appendix 5.2 – Indigenous People (IP) Form & Categorization Form
Appendix 5.3 - Resettlement Due Diligence
Appendix 5.4 - Revised-Resettlement Framework-RF
Appendix 5.5 - Summary Resettlement Framework
Appendix 5.6 - Summary of poverty reduction and social strategy

CHAPTER 7: ENVIRONMENTAL ASSESSMENT REVIEW PROCEDURE (EARP)

7.1 Introduction

The environmental assessment and review procedure was formulated to serve as guide on what to consider and how to undertake the evaluation of the environmental aspects of a core road subproject for it to comply with the requirements set by the Government of Timor Leste and the concerned funding agency. Review process is undertaken to determine the completeness of the document prepared, if issues and concerns are well addressed and the prescribed presentation of the required information are satisfied.

The core road subproject covered by the Timor Leste Road Network Upgrading Project is the stretch of Manatuto – Natarbura which is 81 km and the Laclubar Junction to Laclubar which is approximately 10.5 km. This is one of the undertakings of the Ministry of Public Works under the Strategic Development Plan (2011 – 2013). It will serve as link from north to south which is essential for national development. All north-south links are currently in very poor condition which causes delay in the development of the south coast. The GoTL is considering the improvement of the road to all weather, asphalt surfaced standard that will enable it to carry 20-foot container trucks as a minimum. It traverses a flat to rolling terrain in the north before sharply ascending the mountainous spine of Timor-Leste. It then passes through mountainous terrain before descending to the coastal plain in the south. The route is sparsely populated.

The civil works will be jointly financed by ADB and GoTL. The Ministry of Public Works is the Executing Agency (EA) with the PMU as the Implementing Agency (IA). The approval of a subproject highly depends on the eligibility criteria concerning the technical, economic, social and environment components of the subproject. Due to the fact that the core road subproject and those that will be selected for upgrading are all existing roads, the most significant adverse effects associated with the location, design and operation of the road have already been occurred. It is expected that the environmental impacts will be generally minor to moderate as the works only involve rehabilitation and reconstruction of existing alignment.

Structure of the EARP is organized into following Sections:

7.1 Introduction
7.2 Assessment of Legal Framework and Institutional Capacity
7.3 Anticipated Environmental Impacts
7.4 Environmental Assessment for Subprojects and/or Components
7.5 Consultation, Information Disclosure, and Grievance Redress Mechanism
7.6 Institutional Arrangement and Responsibilities
7.7 Monitoring and Reporting

7.2 Assessment of Legal Framework and Institutional Capacity

The EARP was developed based on the stipulations in the Environmental Laws and Policies of the Government of Timor Leste, ADB SPS 2009 and ADB Environmental Guidelines and Policy of 2003.

Environmental Laws and Policies of the Government of Timor Leste

For sustainable development of the economy of the country, the Constitution of Timor Leste recognizes the need for preservation and enhancement of natural resources and the need to determine actions to promote and protect the environment. Thus, Decree Law No 5/2011 or the environmental licensing was enacted as published in the Official Gazette Series I, No. 5, 9 February 2011. The law contains among others the following provisions:

1. The procedure for scoping, the conduct of the environmental assessment, the review of application for environmental license, issuance and renewal of license.
2. Categorization of the project according to severity of the environmental impacts (i.e. Category A, B and C)

3. Procedures and information requirement for Category A projects (Environmental Impact Assessment) and Category B projects (Initial Environmental Examination)
4. The review process for EIA and IEE documents, application for environmental license and the organization and composition of the review committee and its duties and responsibilities;
5. Specific provisions for public consultation and the protection of the traditional customs and cultural practices, specifically the Impacts and Bargain Agreements (IBA) for projects required to submit EIA;
6. The issuance of the decision by the Environment Authority on the review of the application and the rights of the project owner to appeal the decision;
7. Classifications of environmental license, its duration and renewal; change of conditions of the license;
8. The requirement for projects issued environmental license prior to the enactment of this decree-law to register with the Environmental Authority;
9. The requirement for environmental monitoring, reporting obligations and duties of the license holder;
10. The law also contains sanctions and penalties for violation of this decree.

Project Categorization

Under the Decree-law No 5/2011, projects are classified according to three (3) categories as follows:
Category A - includes projects that may potentially cause significant environmental impacts, and are subject to the procedure of Environmental Impact Assessment (EIA), this based on Impact Analysis and Environmental Management Plan (EMP) in accordance with the provisions in this law.
Category B - includes projects that may cause environmental impacts, and are subject to the procedure of Initial Environmental Examination (IEE), this based on the Environmental Management Plan in accordance with the provisions of the Decree Law.
Category C - includes projects where environmental impacts are negligible or non-existent, and not subject to any procedure for Environmental Assessment in accordance with the provisions of this law
For categorization of road rehabilitation subproject, Guideline No. 6 of the Decree-law states that upgrade of national road, regardless of the scale, belongs to Category B which requires the submission of an IEE and Environmental Management Plan (EMP). Based on this guideline, the upgrading of the road from Manatuto to Natarbora and Laclubar Junction to Laclubar is Category B. The GoTL's environmental classifications for environmental permitting requirements for road projects are listed in Table 7.1.

Table 7.1 Environmental Classification of Road Projects in Timor-Leste

TYPE OF PROJECT	SCALE OF PROJECT	CATEGORY	DOCUMENTATION
Construction of national highways	All	A	EIA
Construction of rural roads (>15 km)	All	A	EIA
Upgrade of National Roads	All	B	EMP
Upgrade of rural roads	All	B	EMP
Construction of bridges	All	B	EMP

Preparation of Initial Environmental Examination (IEE) and Securing of Environmental License

Projects classified as Category B are subject to Initial Environmental Examination (IEE) which is a pre-requisite in securing the Environmental License. Decree Law No 5/2011 provides the list of requirements and procedures.

Procedural Steps

1. Project Presentation and Request for Environmental License;
2. Technical analysis and opinion from the Environmental Authority;
3. Decision on the Initial Environmental Examination and Environmental Grant of License;

Project Presentation

1. The proponent of a project classified as Category B initiates the procedure for Initial Environmental Examination and application for granting an environmental license with the submission to the Environmental Authority, the following documents and information:
   a. Name of the applicant, and their identifying information and contact details;
   b. The location and scale of the project;
   c. The plans and technical drawings of the project;
   d. Technical study on the feasibility of the project;
   e. Opinions or other documents on the project issued by other entities.
   f. Environmental Management Plan (EMP);
   g. Application for grant of license Environmental.
2. The information and documentation referred to in the preceding paragraph are presented in proper form and manner prescribed in secondary legislation.
3. The proponent must instruct the EMP in accordance with the provisions of paragraph 2 of Article 4 and in accordance with relevant legislation.
4. In tabling the documents, the proponent must settle the rate of the phase of the Environmental Assessment In the event that the Environmental Authority requires a public consultation for a proponent, which shall be held to discuss issues about the project.

Technical Analysis by the Environmental Authority

1. Initial Environmental Examination is the technical assessment and an opinion on the EMP from the Environmental Authority within 30 days from the filing date of the project.
2. For purposes of analysis and technical evaluation, the Environmental Authority may, whenever necessary, contact the proponent, as well as the ministries related to the project, to obtain additional information and clarifications regarding the same.
3. The Environmental Authority may ask the bidder once the redesign of all or part of the EMP, based on technical analysis. The period defined in paragraph 1 of this Article shall be suspended until the delivery by the proponent of the new EMP.
4. The Environmental Authority has at least a period of 10 days to review the new documents or the corresponding number of days remaining until the completion period of 30 days, provided that the number of days remaining is not less than 10.
5. If the applicant disagrees with the request of the Environmental Authority, as provided in paragraph 3 of this article, it must justify its reasons and submit them in writing to the Environmental Authority.

Endorsed by the Environmental Authority

1. The Environmental Authority is responsible for providing technical advice to Higher Environmental Authority, based on documentary evidence submitted by the proponent and the conclusions of the technical review of Environmental Assessment, and proposes that:
   a. that the EMP is recommended for approval, or
   b. that the EMP is not recommended because of the negative environmental impacts outweigh the benefits.
2. If the Initial Environmental Examination concluded that negative impacts cannot be mitigated, based on existing sciences and technologies, or that mitigation costs are higher than the positive impacts, the Environmental Authority should recommend actions specified in paragraph (b) No 1 of this article.

Type of Environmental License

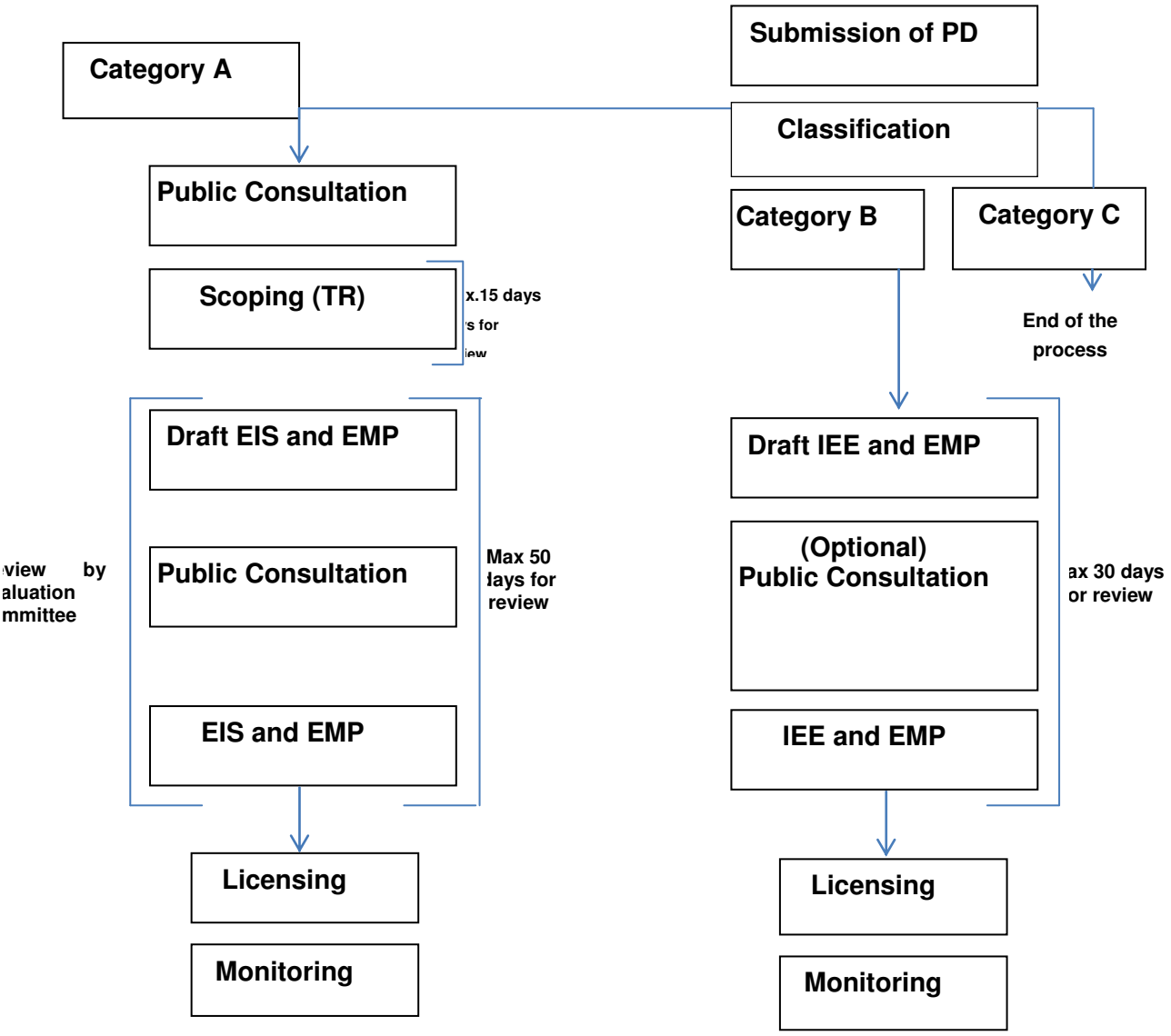
1. As a result of the order in favor of Superior Environmental Authority are two types of licenses issued under the category of project, including the Environmental License for Category A and Category B.

2. Depending on the type of license, are an integral part thereof, the following documents:
   a. Category A - Environmental Impact Statement and Environmental Management Plan;
   b. Category B- Initial Environmental Examination and Environmental Management Plan.
3. The format and content of the environmental license in Category A and B will be defined in a diploma supplement.
4. The Environmental License is not transferable to another project belonging to the same proponent or a different proponent.
5. For projects of category C the Environment Authority supports the tenderer to maintain environmental management.

Issuance of Environmental License

1. The Environmental Authority is the entity responsible for issuing the environmental license.
2. The deadline for issuing a license is 10 days after the order of the authority referred to in paragraph 1 of the preceding article.
3. The tenderer/bidder shall be notified thereof in writing within 5 days after the deadline set in the previous paragraph.
4. The proponent must pay the fee for environmental license in accordance with the provisions of relevant legislation and within 10 days after receipt of the notification. However, project officers are exempt from environmental license fees. Unofficial translation by La'o Hamutuk of Decree-Law 5/2011 on Environmental Licensing.
5. No project can proceed to implementation without having the final decision of the evaluation procedure adopted, the issue of environmental license and payment of the environmental license, in accordance with the provisions of this Decree-law.

The simplified process of securing the Environmental License is shown in the flow diagram below:



Source: National Directorate for Environment

Figure 7.1 - Flow Diagram of the EIA Process

Note:
The timeframe above is for technical review by NDE, and does not include time for the activities of the proponent.

7.3 ADB SPS 2009 and ADB Environmental Guidelines and Policy of 2003

GoTL's Environmental Assessment and Review Procedure is consistent with the ADBs SPS 2009 and Environmental Guidelines and Policy of 2003. Outlined below is the summary of ADB's procedure that shall be adopted for this core subproject :

1. Use a screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks. Appendix 7.1 - the Rapid Environmental Assessment Checklist for use as guide in the screening process.

ADB uses a classification system to reflect the significance of a project's potential environmental impacts. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. Each proposed project is scrutinized as to its type, location, scale, and sensitivity and the magnitude of its potential environmental impacts. Projects are assigned to one of the following four categories:

(i) Category A. A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required.

(ii) Category B. A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required.

(iii) Category C. A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.

(iv) Category FI. A proposed project is classified as category FI if it involves investment of ADB funds to or through a FI (paras. 65-67).

2. Conduct an environmental assessment for each proposed project to identify potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential transboundary and global impacts, including climate change. Use strategic environmental assessment where appropriate.

3. Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative.

4. Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. Prepare an environmental management plan (EMP) that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators. Key considerations for EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle.

5. Carry out meaningful consultation with affected people and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders, including affected people and concerned nongovernment organizations, early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project

implementation as necessary to address issues related to environmental assessment. Establish a grievance redress mechanism to receive and facilitate resolution of the affected people's concerns and grievances regarding the project's environmental performance.

6. Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders.

7. Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports.

8. Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources.

9. Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials subject to international bans or phase outs. Purchase, use, and manage pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides.

10. Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities.

11. Conserve physical cultural resources and avoid destroying or damaging them by using field-based surveys that employ qualified and experienced experts during environmental assessment. Provide for the use of "chance find" procedures that include a pre-approved management and conservation approach for materials that may be discovered during project implementation.

Performing the above tasks requires trained personnel particularly on the part of the proponent and regulatory agencies like the NDE. With the simultaneous implementation of various development projects in Timor Leste, the Institutional Capacity of concerned agencies particularly of MPW should be enhanced. Efficiency-wise, an Environmental Unit for MPW with trained members should be organized who will take charge of all environmental works required for each subproject.

7.4 Anticipated Environmental Impacts

Typical roads will be improved from poor/bad condition of the asphalt pavement to ACP reconstruction and AC overlay with replacement of some bridges. Construction activities will involve:

- Clearing and Grubbing
- Removal of Structures and Obstruction
- Pavement
- Drainage
- Earthwork Cut and Fill
- Retaining Structures
- Other drainage structures
- Bioengineering
- Road Safety

Based on preliminary engineering inventory of the proposed subproject sites, none will have major alignment deviations. Construction materials such as sand, gravel, and quarry/borrow material will be sourced from approved locations and brought to the site. Adherence to best engineering practices during rehabilitation/reconstruction, and implementation of the EMP, will avoid or adequately mitigate all of the rehabilitation/ reconstruction-related impacts, namely:

- Soil erosion
- Loss of vegetation/fauna
- Sedimentation
- Flooding cause by the project
- Generation of wastes
- Air Pollution
- Noise generation
- Extraction of construction materials
- Health and Safety Concerns
- Social or Community Concerns

Post-construction impacts that have been identified for the subproject are associated with improved access such as:

- Reduced dust and noise
- Reduced erosion where bioengineering and drainage structures are constructed
- Reduced travel costs
- Reduced travel time/faster travel
- Reduced accidents
- Increased pedestrian safety
- Bus services will improve and become more reliable, safer and more comfortable
- More goods will be available locally
- Increased production of agricultural-based products
- Reduction in spoilage of perishable goods
- Increased trade opportunities and marketing

7.5 Environmental Assessment for Subprojects and/or Components

Each subproject will undergo categorization and only subproject with environmental category B or with less sensitive environment will be included in the Project. The IEE will be prepared following ADB's prescribed format (Appendix 7.2). Where a subproject requires an IEE, at least one public consultation during the IEE preparation will be conducted with local community, stakeholders such as the developers, small businesses, the local and national government, other concerned groups and potentially affected people. Any subprojects that are classified as environmental category A will not be included under this sector project.

On behalf of the MPW, the PMU including the Project Implementation Support Consultants will be responsible for ensuring that environmental assessments are prepared and EMPs for subprojects as outlined in this EARP are properly implemented. The environmental assessment reports are submitted to ADB for review and approval prior to finalization of contracts or commencement of work. The PMU will monitor the progress of the environmental work stream to ensure that all environmental assessments and clearances are submitted to ADB prior to the implementation of future subprojects.

Due Diligence and Review

For projects proposed for financing, ADB will conduct safeguard reviews, including reviews of the borrower's/client's safeguard documents, as part of its overall due diligence. ADB's safeguard due diligence and review emphasizes environmental and social impact assessments and the planning process, in addition to safeguard documentation. Due diligence and review involves field visits as well as desk reviews. Through such due diligence and review, ADB will confirm (i) that all key potential social and environmental impacts and risks of a project are identified; (ii) that effective measures to avoid, minimize, mitigate, or compensate for the adverse impacts are incorporated into the safeguard plans and project design; (iii) that the borrower/client understands ADB's safeguard policy principles and requirements as laid out in Safeguard Requirements and has the necessary commitment and capacity to manage social and environmental impacts and/or risks adequately; (iv) that the role of third parties is appropriately defined in the safeguard plans; and (v) that consultations with affected people are conducted in accordance with ADB's requirements. In cases where the assessment and planning process, or the safeguard documents, do not meet ADB's safeguard requirements, the borrower/client will be required to undertake additional assessment and/or improve the safeguard plans. When the borrower/client has inadequate capacity to carry out safeguard plans for a proposed project, the project will include component(s) to strengthen that capacity. For projects that are deemed by ADB to be highly complex and sensitive, ADB will require the borrower/client to engage an independent advisory panel during project preparation and implementation.

Unanticipated Environmental Impacts

Where unanticipated environmental impacts become apparent during project implementation, the borrower/client will update the environmental assessment and EMP or prepare a new environmental assessment and EMP to assess the potential impacts, evaluate the alternatives, and outline mitigation measures and resources to address those impacts.

7.6 Consultation, Information Disclosure, and Grievance Redress Mechanism

In disclosing the environmental document to the public, (i) MPW is responsible for ensuring that all environmental assessment documentation, including the environmental due diligence and monitoring reports, are properly and systematically kept as part of MPW project record; (ii) all environmental documents are subject to public disclosure, and therefore may be made available to the public, on request; and (iii) MPW will consult the public, particularly with project affected persons and local NGOs, in accordance with ADB's SPS 2009, ADB's Environmental Assessment Guidelines (2003) and the ADB's Public Communications Policy (PCP) (2005).

34. Disclosure of environmental assessment documents will follow ADB and government procedures. Appropriate form, manner and language will be used to make it understandable by the affected people and local NGOs. It should be made accessible to the public. A complaints focal person in MPW offices will be set up to address all concerns and grievances of the local communities and affected parties.

7.7 Institutional Arrangement

Responsibilities of MPW

The MPW as the Executing Agency will be the main agency responsible in coordinating the implementation of the environmental assessment and review procedures (EARP). MPW ensures the EARP are strictly adhered to, and that preparation of IEE/SIEE is carried out in a timely and adequate manner, environmental mitigation and monitoring and institutional requirements are fully met while meaningful public consultations are carried out satisfactorily. MPW will submit IEE/SIEEs and monitoring reports to ADB for review in a timely manner.

During IEE preparation MPW will be responsible for the following:

i. Prepare and submit application for the proposed subproject to the National Directorate for Environment (NDE), under the Secretariat for the Environment in the Ministry of Commerce, Industry and Environment.
ii. Prepare environmental assessments (IEE/SIEE), including EMP for each subproject (assisted by International and National Environmental Consultants under the PMU/Project Implementation Support Consultants).
iii. Ensure that adequate public consultation has been undertaken with affected groups, local stakeholders, and NGOs.
iv. Review the completeness and adequacy of the environmental assessment documents particularly the mitigation measures in accordance with the ADB guidelines and NDE requirements.
v. Ensure timely submission of the IEE/SIEE to NDE and ADB to allow necessary disclosure by ADB.
vi. Undertake the necessary actions, as necessary, to ensure subproject environmental compliance with the Government's and ADB's requirements.

Prior to the commencement of civil works for subsequent subprojects MPW will:

i. Submit any of the environmental assessment reports (i.e EMP) required by NDE, and obtain approval from NDE, or other permits from another statutory authorities as required by the Government.
ii. Ensure that all regulatory clearances for the subproject obtained from the relevant Government authorities are submitted promptly to ADB.
iii. Ensure that the required mitigation measures during construction as specified in the IEE and EMP are included in the bidding document of the subproject and that all bidding contractors have access to the IEE and EMP.
iv. Ensure that the EMP and all required mitigation measures during construction, including conditions stipulated in the NDE's clearance or environmental/pollution control permit, are included in all the contracts signed by the Contractor(s) with requirements to update the EMP in response to any unexpected impacts and/or project scope changes and that all selected contractors have agreed to implement environmental mitigation and monitoring measures prescribed in the EMP.
v. Receive environmental safeguard clearance on subproject(s)

During the implementation of civil works for future subprojects the MPW, through PMU, will:

i. Ensure that EMP (including proposed mitigation measures and monitoring programs) is updated as required, and is properly implemented by the contractors.
ii. Monitor the implementation of EMP and prepare and forward the monitoring reports on quarterly basis to NDE and ADB.
iii. In case unpredicted environmental impacts occur during project implementation, inform ADB, review the EMP with the contractor, and implement alternative environmental mitigation program.
iv. In case a Subproject changes in scope, inform ADB and reconfirm the environmental classification (through preparation of rapid environmental assessment), and prepare a supplementary IEE, when required, including public consultation.
v. Ensure that ADB be given access to undertake environmental due diligence for all Subprojects. However, the MPW shall have the main responsibility for undertaking environmental due diligence and monitoring of all the Subprojects. The due diligence report as well as monitoring reports on EMP implementation, as required, will be systematically prepared and be made available to the public, if requested.

Responsibilities of ADB

ADB will be responsible for regular review and timely clearance of Subprojects' IEE/SIEE. Technical guidance will be provided by ADB to MPW as needed. ADB will also be responsible for reviewing monitoring reports.

i. During implementation of the Sector Project, ADB will:
ii. Review and clear IEE reports as a basis for Subproject approval.
iii. Monitor the EMP implementation, as required, and conduct due diligence as part of the Sector Project reviews.
iv. Provide assistance to MPW, if required, in carrying out its responsibilities and for building capacity for safeguard compliance.
v. Ensure that MPW will conduct the required consultations with project affected groups, local NGOs and other concerned stakeholders, and that MPW as project sponsor disclose form, manner, and language(s) accessible to those being consulted. Information disclosure with affected people will be guided by the Public Communications Policy or PCP (2005).

Responsibilities of NDE

NDE is the government authority responsible for conducting environmental screening of development proposals, advising on the requirements to conduct environmental impact assessments, develop environmental management plans and obtaining environmental licenses. It is also responsible for monitoring compliance, provide recommendations and ensures that the implementing agencies meet Government of Timor Leste's environmental standards.

Staffing and Budget

There will be immediate cost in securing the services of the environmental consultants and training of MPW staff on environmental management of projects, focusing on preparation of IEE and the inclusion of environmental clauses and the IEE and EMP in bidding documents. At a later stage contractors will be familiarized with the environmental aspects of the bidding and later selected contractors will receive training on environmental requirements. Environmental consultants will be included in the PMU during Subproject implementation. The PMU will have EEOs (Regional Engineers/District Supervisors) part time, dealing with the environmental management placed under the PMU during the Subproject implementation, and will be an integral part of MPW. The environmental consultants will be assigned on an intermittent basis to undertake training and capacity building for environmental management in MPW and NDE and to guide the EEOs of MPW in monitoring and reporting. The environmental consultants will be jointly responsible for overall environmental matters for MPW.

The budget needed for the environmental management of the Sector Project has been included in the project costs. Multiple field visits will be required to each Subproject route, plus at least one public consultation for each Subproject IEE in the subsequent Subprojects at which project information needs to be distributed. A presentation for other government agencies and other stakeholders will

also be included. Therefore adequate travel, accommodation and per diem budgets will be provided under administrative costs.

7.8 Monitoring and Reporting

Both the borrower/client and ADB have their own separate monitoring responsibilities. The extent of monitoring activities, including their scope and frequency, will commensurate with the project's risks and impacts. Borrowers/clients are required to implement safeguard measures and relevant safeguard plans, as provided in the legal agreements, and to submit periodic monitoring reports on their implementation performance. ADB will require borrowers/clients to:

i. establish and maintain procedures to monitor the progress of implementation of safeguard plans,
ii. verify the compliance with safeguard measures and their progress toward
iii. intended outcomes,
iv. document and disclose monitoring results and identify necessary corrective and preventive actions in the periodic monitoring reports,
v. follow up on these actions to ensure progress toward the desired outcomes,
vi. retain qualified and experienced external experts or qualified NGOs to verify monitoring information for projects with significant impacts and risks,
vii. use independent advisory panels to monitor project implementation for highly complex and sensitive projects, and
viii. submit periodic monitoring reports on safeguard measures as agreed with ADB.

Monthly progress reports will be prepared by the environmental specialist of the Project Implementation Support Consultant. The documents will be submitted to PMU and quarterly reports to NDE. The reports will contain progress made in EMP implementation with particular attention to compliance with the principles and matrix set out in the EMP for each subproject. A section on compliance with the EMP will be included in the twice yearly (semi-annual) report that is prepared for ADB as a requirement for the Project. The MPW will submit semi-annual monitoring reports to ADB. General good practice requires that an EMP monitoring report will be completed according to the following schedule:

- a report at the end of project design. Prepared by the PMU
- a report prepared every 1 month during construction, by the contractor
- a report prepared every 3 months by the PMU for the MPW and NDE
- a report prepared every 6 months by the PMU for the ADB and,
- a yearly report that is prepared by PMU during operation for as long as the monitoring is specified in the EMP.

Appendix 7.1 -Rapid Environmental Assessment Checklist Form

Screening Questions	Yes	No	Remarks
A. PROJECT SITING **IS THE PROJECT AREA ADJACENT TO OR WITHIN ANY OF THE FOLLOWING ENVIRONMENTALLY SENSITIVE AREAS?**			
• **CULTURAL HERITAGE SITE**			
▪ **PROTECTED AREA**			
• **WETLAND**			
• **MANGROVE**			
• **ESTUARINE**			
• **BUFFER ZONE OF PROTECTED AREA**			
• **SPECIAL AREA FOR PROTECTING BIODIVERSITY**			
B. POTENTIAL ENVIRONMENTAL IMPACTS **WILL THE PROJECT CAUSE…**			
• **encroachment on historical/cultural areas; disfiguration of landscape by road embankments, cuts, fills, and quarries?**			
• **encroachment on precious ecology (e.g. sensitive or protected areas)?**			
• **alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction site?**			
• **deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?**			
• **increased local air pollution due to rock crushing, cutting and filling works, and chemicals from asphalt processing?**			
• **risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation during project construction and operation?**			

Screening Questions	Yes	No	Remarks
• **noise and vibration due to blasting and other civil works?**			
• **dislocation or involuntary resettlement of people?**			
• **dislocation and compulsory resettlement of people living in right-of-way?**			
• **disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?**			
• **Other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?**			
• **hazardous driving conditions where construction interferes with pre-existing roads?**			.
• **poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as STI's and HIV/AIDS) from workers to local populations?**			
• **creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents?**			
• **accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials?**			
• **increased noise and air pollution resulting from traffic volume?**			
• **increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road?**			
• **social conflicts if workers from other regions or countries are hired?**			

Screening Questions	Yes	No	Remarks
• **large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?**			
• **risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?**			
• **community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning.**			
C. CLIMATE CHANGE AND DISASTER RISK QUESTIONS **THE FOLLOWING QUESTIONS ARE NOT FOR ENVIRONMENTAL CATEGORIZATION. THEY ARE INCLUDED IN THIS CHECKLIST TO HELP IDENTIFY POTENTIAL CLIMATE AND DISASTER RISKS.**			
• **Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes**			
• **Could changes in temperature, precipitation, or extreme events patterns over the Project lifespan affect technical or financial sustainability (eg., increased erosion or landslides could increase maintenance costs, permafrost melting or increased soil moisture content could affect sub0-grade).**			
• **Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (eg., high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?**			

Screening Questions	Yes	No	Remarks
• **Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., by encouraging settlement in areas that will be more affected by floods in the future, or encouraging settlement in earthquake zones)?**			

Appendix 7.2 - Outline of an Environmental Impact Assessment Report

This outline is part of the Safeguard Requirements. An environmental assessment report is required for all environment category A and B projects. Its level of detail and comprehensiveness is commensurate with the significance of potential environmental impacts and risks.
A typical EIA report contains the following major elements, and an IEE may have a narrower scope depending on the nature of the project. The substantive aspects of this outline will guide the preparation of environmental impact assessment reports, although not necessarily in the order shown.

A. Executive Summary
This section describes concisely the critical facts, significant findings, and recommended actions.

B. Policy, Legal, and Administrative Framework
This section discusses the national and local legal and institutional framework within which the environmental assessment is carried out. It also identifies project-relevant international environmental agreements to which the country is a party.

C. Description of the Project
This section describes the proposed project; its major components; and its geographic, ecological, social, and temporal context, including any associated facility required by and for the project (for example, access roads, power plants, water supply, quarries and borrow pits, and spoil disposal). It normally includes drawings and maps showing the project's layout and components, the project site, and the project's area of influence.

D. Description of the Environment (Baseline Data)
This section describes relevant physical, biological, and socioeconomic conditions within the study area. It also looks at current and proposed development activities within the project's area of influence, including those not directly connected to the project. It indicates the accuracy, reliability, and sources of the data.

E. Anticipated Environmental Impacts and Mitigation Measures
This section predicts and assesses the project's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic (including occupational health and safety, community health and safety, vulnerable groups and gender issues, and impacts on livelihoods through environmental media and physical cultural resources in the project's area of influence, in quantitative terms to the extent possible; identifies mitigation measures and any residual negative impacts that cannot be mitigated; explores opportunities for enhancement; identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics that do not require further attention; and examines global, transboundary, and cumulative impacts as appropriate.

F. Analysis of Alternatives
This section examines alternatives to the proposed project site, technology, design, and operation—including the no project alternative—in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. It also states the basis for selecting the particular project design proposed and, justifies recommended emission levels and approaches to pollution prevention and abatement.

G. Information Disclosure, Consultation, and Participation
This section:
i. describes the process undertaken during project design and preparation for engaging stakeholders, including information disclosure and consultation with affected people and other stakeholders;

ii. summarizes comments and concerns received from affected people and other stakeholders and how these comments have been addressed in project design and mitigation measures, with special attention paid to the needs and concerns of vulnerable groups, including women, the poor, and Indigenous Peoples; and
iii. describes the planned information disclosure measures (including the type of information to be disseminated and the method of dissemination) and the process for carrying out consultation with affected people and facilitating their participation during project implementation.

H. Grievance Redress Mechanism

This section describes the grievance redress framework (both informal and formal channels), setting out the time frame and mechanisms for resolving complaints about environmental performance.

I. Environmental Management Plan

This section deals with the set of mitigation and management measures to be taken during project implementation to avoid, reduce, mitigate, or compensate for adverse environmental impacts (in that order of priority). It may include multiple management plans and actions. It includes the following key components (with the level of detail commensurate with the project's impacts and risks):

(i) Mitigation:

(a) identifies and summarizes anticipated significant adverse environmental impacts and risks;
(b) describes each mitigation measure with technical details, including the type of impact to which it relates and the conditions under which it is required (for instance, continuously or in the event of contingencies), together with designs, equipment descriptions, and operating procedures, as appropriate; and
(c) provides links to any other mitigation plans (for example, for involuntary resettlement, Indigenous Peoples, or emergency response) required for the project.

(ii) Monitoring:

(a) describes monitoring measures with technical details, including parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits and definition of thresholds that will signal the need for corrective actions; and
(b) describes monitoring and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures and document the progress and results of mitigation.

(iii) Implementation arrangements:

(a) specifies the implementation schedule showing phasing and coordination with overall project implementation;
(b) describes institutional or organizational arrangements, namely, who is responsible for carrying out the mitigation and monitoring measures, which may include one or more of the following additional topics to strengthen environmental management capability: technical assistance programs, training programs, procurement of equipment and supplies related to environmental management and monitoring, and organizational changes; and
(c) estimates capital and recurrent costs and describes sources of funds for implementing the environmental management plan.

(iv) Performance indicators:

describes the desired outcomes as measurable events to the extent possible, such as performance indicators, targets, or acceptance criteria that can be tracked over defined time periods.

J. Conclusion and Recommendation

This section provides the conclusions drawn from the assessment and provides recommendations.

CHAPTER 8 – CLIMATE CHANGE ADAPTATION

8.1 Climate Change

Based on the analysis of Cardno Acil on the climate projections and information they gathered from recent literature, the temperature in Timor-Leste is expected to increase over the next decades. Despite a very wide range of possible climate conditions, mean annual precipitation is also expected to increase slightly (especially over the wet season) while tropical cyclones and accompanied extreme rainfall events could be less frequent but more intense. Sea level is also expected to rise in the 21st century and the probability of occurrence and intensity of extreme wave heights will likely increase.

Water is a critical resource in East Timor. As explained in the same assessment, climate change could result in a drier dry season, rainfall maybe lessened but more intense events, and El Niño events, which result in delayed rain and less rain, may become more severe. These changes may exacerbate East Timor's existing problems with drought, floods, and water quality" (Barnett et al., 2007).

East Timor is prone to flooding, especially on the southern side of the country. In Manatuto Vila where the alignment passes through, people experience flooding every rainy season with floodwater level up to one (1) meter and subsides after 2 to 3 hours. Heavier precipitation associated with climate change may threaten the infrastructure even over the project region. These conditions may be exacerbated by soil instability associated with farming practices and deforestation. All together, these conditions could lead to an increase in soil erosion and landslides.

Sea-level rise is expected to aggravate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihood of island communities. Part of Manatuto is located in the coastline and sea level rise may affect the level of water and salinity within the downstream of major rivers like Laclo River. Quality of groundwater will be eventually affected due to salt intrusion.

Landslides and erosion are one of the most common environmental risks, resulting from interactions between water flow and soil. Very wet conditions in part of the country (2,500mm) can trigger slope failures and in many areas road construction is feasible only during the dry season. The steep topography and heavy rains result in thin and unstable soils, with low water holding capacity.

The main findings on climate change assessment by Cardno Acil for the Road Network Development project are indicated below:

- Observations from the last century show an increase in temperature and a slight decrease in precipitation for Indonesia (as indicated, information not available for Timor-Leste).
- GCMs expect for Timor-Leste (from 136 climate projections) the following:

  Horizon 2020:
  - mean annual temperature increase: +0.8 °C (varying between +0.4 °C and +1.5 °C)
  - mean annual precipitation difference: +2% (varying between -12 % and +15%)

  Horizon 2050:
  - mean annual temperature increase: +1.5 °C (varying between +0.7 °C and +2.8 °C)
  - mean annual precipitation difference: +4% (varying from -25% and +15%)

  Horizon 2080:
  - mean annual temperature increase: +2.2 °C (varying between +0.8 °C and +4.0 °C)
  - mean annual precipitation difference: +6% (varying from -21 % and +32 %)

- Intra annual patterns of temperature at time horizons 2020 and 2050 would not vary significantly from the actual conditions.

- Hot days and heat waves are expected to be more frequent in the future.

- Differences in the precipitation would be positive from September to June for both 2020 and2050 time horizons and winter months show the most important increase.

- Future conditions may bring fewer extreme rainfall events but their intensity would be more important.

- Tropical cyclone patterns and occurrence are not expected to change that much in a warming world, while the intensity of these cyclones and the accompanied precipitations volumes may increase over the next decades.

- The combined effects of temperature increase and no significant difference in rainfall over the dry season would have considerable effect on the runoff volume during the drought period (runoff volume could be most significantly reduced).

- Flood intensity and frequency are expected to increase significantly for the region of interest.

- Projected sea level rise at the end of the 21st Century relative to the reference 1980-1999period for the six SRES scenarios ranges from 1.9 mm/year to 5.8 mm/year.

- Studies realized worldwide have shown that the extreme wave height probability of occurrence and intensity associated with climate change along coastal regions are likely to increase.

8.2 Identified Environmental Risks and Climate Change Vulnerability

On the same assessment, communities that were consulted identified the following key existing and potential environmental risks and climate change vulnerability:

- Inappropriate farming methods such as slash-and-burn farming is putting road infrastructure at risk from erosion, landslide and degradation.

- Forest and grasses fires along the roadsides are worsening the effect on road conditions and has contributed to a decrease in soil quality, loss of water resources, loss of biodiversity and contributed to variability in microclimate.

- The increasing sedimentation during rainy seasons has affected road drainage and caused road blockage. The areas worse hit and at the highest risk are those with the poorest vegetation and/or food crop cover;

- Heavy rainfall causing flooding during the rainy season has at times led to changing river patterns which has caused damage to bridges, other infrastructures and community natural resources.

8.3 Climate Change as a Development Challenge

It was reported that 80% of the people are directly dependent on local forests, arable land and healthy rivers for their survival. The following key development issues have been identified:

- Development of adaptable farming systems
- Forest preservation and restoration
- Developing an integrated approach to vegetation management and road rehabilitation
- Developing National Meteorological Service and climate early warning system
- Enhancing healthcare and access to potable water

8.4 Road Rehabilitation

Assessment of the options against risks was based on “Adaptation Assessment Matrix" used in the study conducted by Cardno Acil. Hazard impacts with medium to high likelihood of occurrence in project site with the proposed preventive measures are presented in Table 8.1.

Table 8.1 Hazard Impact Adaptation Measures

Hazard Impact	Consequence	Proposed Preventive/Adaptation Measures
Drought and its consequence		
Lowering of water table	Settlement of road sub-grade(compressible soils) leading to distortion of the road surface	• Use flexible pavement structures • Increase maintenance budgets (responsive measure) • Increase water retention capacity and slow infiltration through environmental measures and bio-retention systems to recharge aquifers and reduce surface flow run off
Insufficient moisture to sustain the vegetative cover	Erosion	• Re-vegetation with drought tolerant species • Mulching • Matting/erosion control blankets • Granular protection
Forest and bush fires	Increased erosion due to reduced ground cover	• Re-forestation, replanting with fire tolerant tree species
Presence of Large Amount of Water		
More runoff water	Gully erosion More severe floods Water build-up Overflow and mud /debris deposits making roads impassable	• Apply a safety factor • Reduce the gradients of slopes • Take account of the materials used • Increase size and number of engineering structures (hydraulic structures, high river crossings) • Increase water retention capacity and slow infiltration through natural or bioengineered systems • Increase land cover • Raise pavement and add drainage
	Landslides and slips of the slopes of fill or cut slopes	• Increase land cover • Surface drainage and its maintenance • Modify the frequency of checks
Sub-surface flooding		
Raising of water tables and of penetration of greater volumes of water infiltration affecting the subsurface moisture content	Reduced pavement failure and increased risk of pavement failure due to water saturation.	• Improved longitudinal and transverse drainage system • Water capture and storage systems • Improvements of water courses • Increase water retention capacity and slow infiltration through re-vegetation

	Subsidence and collapse caused by natural or man-made underground cavities	• Identify and treat the risk-prone zones
	Penetration of water in to fill	• Enclose the materials • Use materials that are unaffected by water or treat them to make them so • Raise level of road
	Collapse of fill	• Check the condition of slopes regularly • Check regularly the condition and functioning of the drainage system and hydraulic structures • Improve the implementation of alternative routes in the event of a road closure

CHAPTER 9: TRAFFIC: EXISTING STUDIES – REVIEW

9.1 Background and Data Sources

Traffic & Transport Assessment, on the Manatuto-Natarbora Road are based on two main sources:

1. Traffic Counts and O-D Surveys conducted in February 2013, as part of this Study (ADB 2857-TIM), and of the parallel study in North-East TL (ADB TA 8146-TIM)[*1]. They are described and assessed in the following chapter, Chapter 10.
2. "Preparing the Road Network Development Project – ADB TA 7100, 2009[*2]". It is commonly known as the "2009 The Timor Leste "National Road Master Plan"[2].

In addition, this Feasibility Study made an attempt to assess "Induced Traffic" from the Petroleum Facility Development on the South Coast:

3. TL Ministry of Finance, Petroleum Infrastructure Development "Traffic Report,": "Chapter 4 - Existing Traffic Condition," and "Chapter 5 - Transport Demand Model"; prepared by PT. Virama Karya-Multi Arch.LDA.

The 2009 National Road Master Plan (TA 7100-TIM), set the foundations for all other traffic studies conducted afterwards. All following studies adopted, almost entirely, the traffic counts and traffic projections, as well as all other inputs to the RED Model for Economic Assessment[*3].

Thus, this Chapter 9 concentrates on review of TA 7100-TIM. In addition, it lists other studies, since 2009 which benefited from the 2009 Road Master Plan, and reviewed by the Study Team. Finally, this chapter also reviews the Timor GAP Traffic Studies, for the Petroleum development on the South Cost, which a-priori, expected to induce traffic into the Manatuto-Natarbora Rd.

The following chapter, Chapter 10, focuses on traffic assessment of the 2013 traffic studies; to be used later in Chapter 11 as Input to the RED Model.

9.2 Preparing the Road Network Development Project - TA 7100, 2009

9.2.1 Background

The Project "Preparing the Road Network Development Project – ADB TA 7100, 2009," more commonly known as the "2009 National Road Master Plan," provides the most comprehensive traffic and transport data; transport projections; and traffic analyses available up till now.

TA 7100 reports are used as background foundations for developing this project, TA 2857. Thus, this section highlights content and input of TA 7100 of significant value to TA 2857, in particularly with respect to the Manatuto-Natrabora Road. For more details see TA 7100 reports.

The road network under TA 7100 is comprises of 63 road links, of which 48 are National Road links, and 15 are selected District Road links, pre-selected by the GoTL. The total length of network under that study is about 1,675 km, of which about 1,410 km are National Roads and 265 km are District Roads. Table 9.1 lists the 63 road links, and their length (km).

Among others, the list includes the four National road links A09-01, A09-2, A09-3 and A09-4 of the Manatuto –Natarabora Road; as well as District road link C15, Laclubar – Laclubar Junction. As such, they were included in all the analyses and assessments, conducted by TA 7100.

[*1] A Feasibility Study for the North Eastern Coastal Road and braches, TA 8146-TIM, "Road Network Upgrading (Sector) Project" is currently carried by the ADB, in parallel to the Manatuto-Natarbora Feasibility Study. The Teams for these two studies collaborated closely, to ensure compatibility in methodology, in particularly of Traffic Surveys, and input to RED Model for Economic Analysis.

[*]2 "Preparing the Road Network Development Project –ADB TA 7100," September 2009; Prepared by Cardno Acil (with KWK Consulting), for the Timor Leste Ministry of Infrastructure (MOI); Financed by the Asian Development Bank (ADB).

[*]3 The Team TL/Transport Economists for this Feasibility Study, 2857-TIM, as well as for TA 8146-TIM, have acted in past as the TL/Transport Economist for TA 7100, and have developed its methodology and findings. The current, 2013 methodology is a collaborated update of their work for TA 7100.

Table 9.1: TA 7100– Timor Leste, National Road Network

Link				Link Length (km)	Road Length (km)
No.	From	To	Link ID		
1	Dili (Mota Ulum)	Manatuto (A09 Jct)	A01-01	58.7	
2	Manatuto (A09 Jct)	Baucau (By-pass)	A01-02	57.3	
3	Baucau (By-pass)	Lautem	A01-03	59.8	
4	Lautem	Com	A01-04	20.3	196.1
5	Dili (Taibesi Rd)	Aileu	A02-01	43.7	
6	Aileu	Maubisse	A02-02	25.0	
7	Maubisse	Aituto (A05 Jct)	A02-03	13.1	
8	Aituto (A05 Jct)	Ainaro	A02-04	26.3	
9	Ainaro	Cassa	A02-05	21.1	
10	Cassa	Zumulai	A02-06	17.0	
11	Zumulai	Suai	A02-07	29.8	176.0
12	Dili (Airport Jct)	Tibar	A03-01	7.2	
13	Tibar	Liquica	A03-02	26.3	
14	Liquica	Batugade	A03-03	74.3	
15	Batugade	Mota Ain	A03-04	1.0	
16	Batugade	Maliana	A03-05	41.3	150.1
17	Tibar	Gleno	A04-01	33.3	
18	Gleno	Ermera	A04-02	11.5	44.8
19	Aituto (A02 Jct)	Betulala	A05-01	10.8	
20	Betulala	Same	A05-02	20.0	
21	Same	Betano	A05-03	24.7	55.5
22	Baucau (By-pass)	Venilale	A06-01	23.9	
23	Venilale	Viqueque	A06-02	34.1	58.0
24	Viqueque	Natarbora	A07-01	43.0	43.0
25	Viqueque	Uatucarbau (Jct C8)	A08-01	55.8	
26	Uatucarbau Jct	Iliomar	A08-02	25.0	
27	Iliomar	Los Palos	A08-03	45.0	
28	Los Palos	Lautem	A08-04	27.9	153.7
29	Manatuto	Cribas	A09-01	22.3	
30	Cribas	Laclubar Jct	A09-02	13.1	
31	Laclubar Jct	Mane Hat	A09-03	34.7	
32	Mane Hat	Natarbora	A09-04	10.8	80.9
33	A04 Jct (Gleno)	Lourba (A12 Jct)	A10-01	68.5	68.5
34	A04 Jct (Ermera)	Maliana	A11-01	63.9	63.9
35	Maliana	Oeleu	A12-01	15.5	
36	Oeleu	Lourba (A10 Jct)	A12-02	9.8	
37	Lourba (A10 Jct)	Zumalai	A12-03	26.1	51.4
38	A05 Jct (Aiassa)	Hatu Udo	A13-01	16.9	
39	Hatudo	Cassa	A13-02	7.7	24.6
40	Natarbora	Alas Jct	A14-01	37.7	
41	Alas Jct	Betano	A14-02	9.1	46.8
42	Suai	Tilomar	A15-01	12.2	
43	Tilomar	Wemassa Border	A15-02	15.0	27.2
44	A12 Jct (Oeleu)	Fatululik	A16-01	28.7	
45	Fatululik	Tilomar	A16-02	48.0	76.7
46	Pante Macassar	Bobometo/Oesilo	A17-01	28.3	28.3
47	Pante Macassar	Citrana	A18-01	47.5	47.5
48	Pante Macassar	Sakato	A19-01	15.0	15.0
49	Tutuala	A08 Jct (Trisula)	C2	29.0	
50	Lacluta/Dilor	A07 Jct	C5	13.0	
51	Quelicai	A01 Jct	C6	17.8	
52	Baguia	A01 Jct	C8	37.6	
53	Km 9.5	A02 Jct	C10-01	8.0	
54	Km 9.5	A04 Jct	C10-02	9.5	
55	Lequidoe	A02 Jct	C11-01	16.9	
56	Lequidoe	A02 Jct	C11-02	10.9	
57	Ermera	Fatubessi	C13	11.4	
58	Laclubar	A09 Jct	C15	9.6	
59	Bazartete	A03 Jct (Aipelo)	C17	14.4	
60	Hatobuilico	A10 Jct (Letefoahi)	C22	18.4	
61	Hatu Udo	Ainaro	C23	26.7	
62	Turiscai	A02 Jct	C26	20.4	
63	Lolotoe Jct	Beco	C32	22.8	266.4
Total (All Links)				**1674.4**	**1674.4**

9.2.2 Phases & Content

TA 7100 was conducted in two phases:

Phase I - the initial phase, started with the mission of updating findings and results of the 2005 Report "Technical Assistance to the Democratic Republic of Timor-Leste for Transport Sector Improvement" (TA 3731-TIM), 2005. Phase I included detailed analyses and assessments -- engineering, traffic and transport, social, environmental, economic, etc., of all 63 links of the National Road Network. Based largely on engineering and economic considerations, Phase I concluded with recommendations on 32 "Priority Roads Links for Development" (see Figure 9.1), and "Proposed Improvements". From that, it derived a "Ten-Year Master Plan/Investment Plan for Timor Leste Road Sector".

Figure 9.1 shows the National Road Network, by designated link number, and the recommended 32 priority links. Note, each road section (collections of links) is marked by different colour. For instance, all links of road A01 are shown here in red. The 32 selected links, largely in the west, are marked by wider lines[*4]. The recommended links include those with IRR>12%, as well as links with IRR 11%-11% (marked in yellow). It also includes links with lower IRR (marked in blue), but which were essential for road completeness, from origin to destination.

Among others, this phase of RA 7100 included substantial work on preparing traffic and other input data to the RED Model for Economic Assessment. This Project, 2857-TIM, updates these 2009 data, and uses the updates to run current 2013 analyses.

Phase II - conducted during the second half of the Project, focuses on Project Preparation/Feasibility Studies for two selected road section from the "Ten Year National Road Master Plan/Investment Plan," recommended in Phase I.

The two Feasibility Studies, conducted during Phase II were:

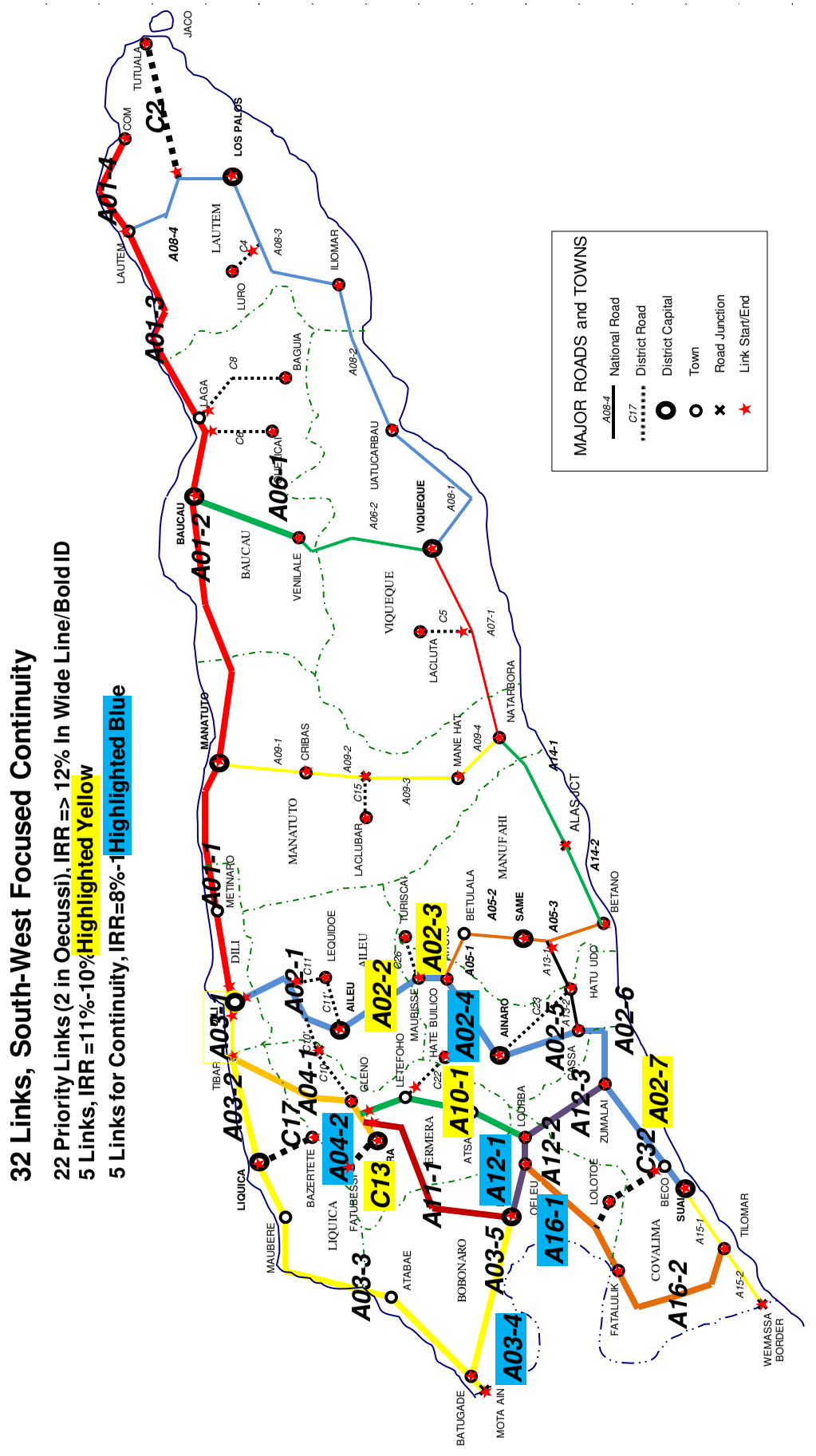
- Road A03-03-04, Liquicia – Batugade - Mota-Ain, 78.8 km[*5]
- Road A11-01, Ermera –Maliana, 63.9 km

Among others, This Project, 2857-TIM, uses the structure of these feasibility studies, accepted by ADB and the Ministry of Transport, to construct this 2013 Feasibility Study (ADB 2857-TIM).

[*4] It should be noted that Manatuto-Natarbora Rd. was not recommended, at the time, as a priority road.

[*5] This Project is currently in progress. Preparatory Study, finance d by JICA and conducted by Nippon KOEI, started in 2010. Construction is expected to start in mid 2013.

Figure 9.1 Timor Leste Road Master Plan – National Road Network, and Recommended 32 Links



9.3 Other Traffic/Economic Evaluation Studies, Adapting TA7100-TIM

The importance and comprehensiveness of the TA 7100 Report is reflected in the fact that since its release in 2009, all ensuing traffic studies, and road feasibility studies/economic analyses in Timor Leste, have based their analysis and derived much of their input data from that report.
The following studies/projects are based on, or have derived data from TA 7100:

- JICA, *"Preparatory Work, Road A03*-03-04, Liquicia – Batugade - Mota-*Ain,"* 2010. This Project, following the Feasibility Study by TA 7100 (see above), has been approved (see report below). It was financed by JICA, and prepared by Nippon KOEI. Construction is expected to start in mid 2013.
- *"Monitoring and Evaluation Report, of the Reconstruction of Road A03*-03/04, Contract 1: *Liquica to Km 49.7"* 2012; ADB Grant No. 01800-TIM; Prepared by SMEC with KWK.
- World Bank "Feasibility Study - *Timor Leste Road Climate Resilience Project, 2011"*. Since then, this Project, encompassing road links A02-1, A02-2, A02-4 and A02-4, Dili to Ainaro, has been accepted for financing by the WB. It is currently in progress. KEI is preparing the detailed design, and construction is expected to start by 2014.
- JICA, *"Preparatory Survey on Road Network Development Sector Project in The Democ*ratic Republic Of Timor – Leste, 2010". This preparatory survey applies to Road Link A01-01, Dili-Manatuto, and Road Link A01-02, Manatuto-Baucau.
- *TL, Ministry Of Finance, Petroleum Infrastructure Development and Timor GAP, "Preliminary* Engineering Design, Highway Traffic Report, Transport Demand Model, and Highway *Economic Analysis," Prepared by PT. Virama Karya*-Multi Arch.LDA, 2011.

9.4 TA 7100 Traffic Study - Highlights

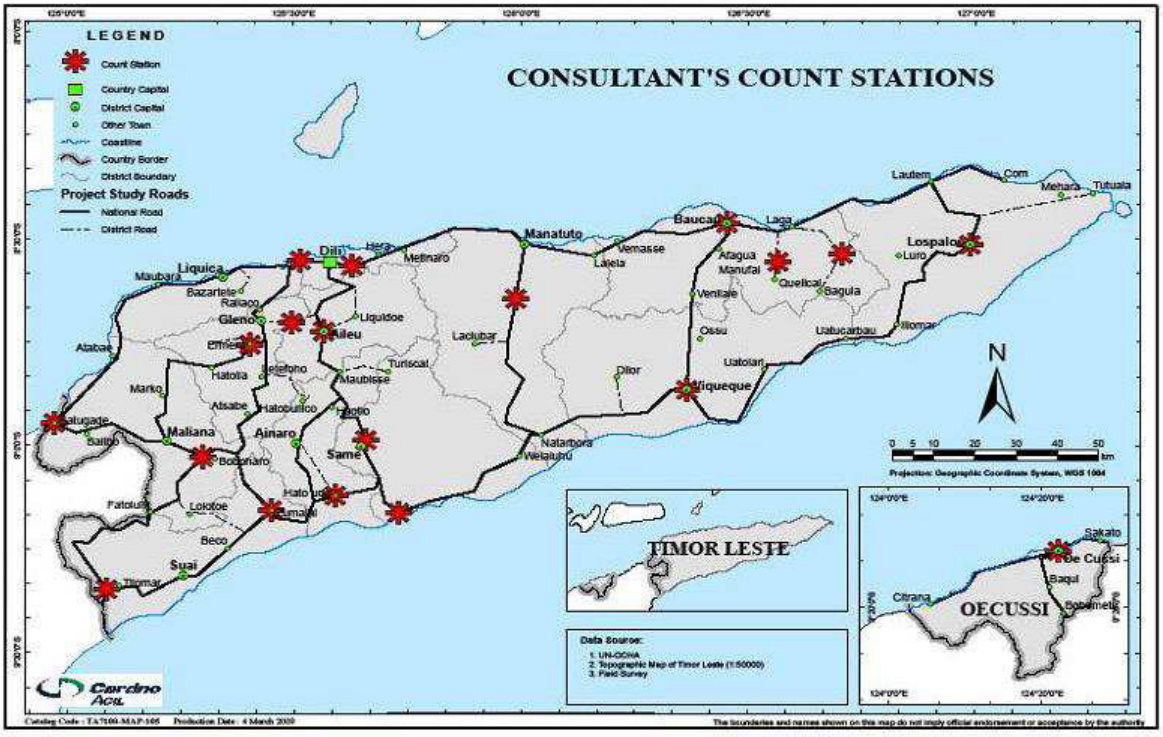
To update the 2005 traffic counts on the road network links, this study conducted "National Classified Traffic Counts". The count locations, duplicated, for the most part, the locations used by the 2005 study, to assess the classified traffic growth rate (by vehicle type) since 2005. Locations of the 2009 surveys are shown in Figure 9.2.

The 2009 survey included only one traffic count station on the Manatuto-Natarbora Road[*6] (between Manatuto Junc. and Criba), and none on the Laclubar Junc.-Laclubar road.

Average Annuaal Daily Traffic (AADT), 2005 and 2009, by vehicle type, and annual growth rates for this period, are shown in Table 1.2 (National Roads), and in Table 9.3 (District Roads). Table 9.4 focuses on specific data for the five road links on the Manatuto-Natarbora Rd.

Given that there was only actual counting station, only the data for road link A09-1 (Manatuto Junc. to Criba) is based on actual counts. AADT for the other road links is based on estimates, resulting from applying the derived average annual overall growth rates for different vehicle categories. By any account, 2009 AADT was very low. On road link A09-1 the AADT was 110, including motorcycles, and 63 without them. The rest of the links were estimated to have had even lower volumes.

Figure 9.2 Locations of Traffic Count Stations, 2009



The following chapter, Chapter 10 deals with Assessment of Traffic, based on the 2013 Traffic Surveys. The 2013 data are used to update the 2009 traffic report (TA 7100-TIM), while, basing the analysis on the foundation methodology developed in 2009.

[*6] In contrast, this 2857 TIM conducted three counting surveys on the Manatuto-Natarbora Road, A09, including District Road C15; as well as one day O-D / counting survey, 5 km west of Manatuto Junction. See results in Chapter 11.

Table 9.2: TA 7100– AADT 2005 & 2009, and Annual Growth Rate, National Road Links

National Roads | **March to April 2005** | **Dec 2008/Jan 2009**

St.	Link From	To	Road-Link	Length (km)	*Motor cycle*	Car/ taxi	Jeep/ 4WD	Pick-up/ van	Mini-bus	Large-Bus	Light Truck	Med. Truck	Heavy Truck	Total (inc M/C)	Total (exc M/C)	*Motor cycle*	Car/ taxi	Jeep/ 4WD	Pick-up/ van	Mini-Bu	Large-Bus	Light Truck	Med. Truck	Heavy Truck	Total (inc M/C)	Total (exc M/C)	Growth (%/year) (inc M/C)	Growth (%/year) (exc M/C)
1	Dili (Mota Ulum)	Manatuto (A09 Jct)	A01-1	58.7	*253*	*58*	*103*	*131*	*129*	*75*	*58*	*84*	*15*	**906**	**653**	*631*	*162*	*142*	*151*	*246*	*54*	*140*	*108*	*17*	**1651**	**1021**	**17.4%**	**12.7%**
2	Manatuto (A09 Jct)	Baucau	A01-2	57.3	*82*	*17*	*59*	*40*	*43*	*42*	*40*	*53*	*14*	**390**	**308**	*338*	*87*	*109*	*91*	*84*	*51*	*110*	*19*	*2*	**891**	**553**	**24.7%**	**16.9%**
3	Baucau	Lautem	A01-3	59.8	*71*	*2*	*34*	*33*	*73*	*60*	*44*	*53*	*1*	**371**	**300**	*310*	*44*	*56*	*47*	*166*	*17*	*55*	*2*	*2*	**699**	**389**	**18.4%**	**7.2%**
4	Lautem	Com	A01-4	20.3	*35*	*0*	*10*	*16*	*5*	*5*	*13*	*19*	*0*	**103**	**68**	***127***	***0***	***16***	***25***	***9***	***4***	***16***	***13***	***0***	**211**	**84**	**21.1%**	**5.9%**
5	Dili (Taibesi Rd)	Aileu	A02-1	43.7	*156*	*1*	*78*	*59*	*7*	*21*	*155*	*80*	*22*	**579**	**423**	*316*	*41*	*57*	*38*	*57*	*12*	*52*	*17*	*1*	**591**	**274**	**0.5%**	**-10.9%**
6	Aileu	Maubisse	A02-2	25.0	*86*	*0*	*46*	*10*	*14*	*24*	*42*	*5*	*0*	**227**	**141**	*303*	*11*	*61*	*40*	*48*	*13*	*54*	*10*	*0*	**539**	**237**	**26.0%**	**14.8%**
7	Maubisse	Aituto (A05 Jct 5)	A02-3	13.1	*86*	*0*	*46*	*10*	*14*	*24*	*42*	*0*	*0*	**222**	**136**	***313***	***0***	***75***	***16***	***26***	***21***	***50***	***0***	***0***	**501**	**188**	**24.2%**	**9.0%**
8	Aituto (A05 Jct 5)	Ainaro	A02-4	26.3	*45*	*0*	*31*	*19*	*0*	*22*	*21*	*39*	*1*	**178**	**133**	***164***	***0***	***51***	***30***	***0***	***19***	***25***	***27***	***1***	**317**	**154**	**16.6%**	**3.9%**
9	Ainaro	Cassa	A02-5	21.1	*55*	*0*	*26*	*22*	*28*	*25*	*43*	*47*	*0*	**246**	**191**	***200***	***0***	***43***	***35***	***51***	***22***	***52***	***33***	***0***	**435**	**235**	**16.4%**	**5.7%**
10	**Cassa**	**Zumalai**	**A02-6**	**17.0**	***94***	**0**	**11**	**9**	**4**	**16**	**8**	**26**	**12**	**181**	**87**	*342*	*0*	*18*	*14*	*7*	*14*	*10*	*18*	*12*	**435**	**94**	**26.4%**	**2.1%**
11	Zumalai	Suai	A02-7	29.8	*65*	*0*	*31*	*36*	*38*	*25*	*57*	*23*	*0*	**275**	**210**	*342*	*0*	*16*	*13*	*10*	*9*	*9*	*11*	*11*	**421**	**79**	**12.0%**	**-22.9%**
12	Dili (Airport Jct)	Tibar	A03-1	7.2	*702*	*278*	*338*	*215*	*240*	*50*	*185*	*192*	*45*	**2245**	**1543**	*881*	*145*	*294*	*263*	*254*	*44*	*147*	*361*	*48*	**2436**	**1555**	**2.2%**	**0.2%**
13	Tibar	Liquica	A03-2	26.3	*239*	*38*	*51*	*81*	*104*	*38*	*94*	*60*	*8*	**713**	**474**	***868***	***114***	***84***	***129***	***190***	***33***	***113***	***42***	***8***	**1581**	**712**	**23.7%**	**11.5%**
14	Liquica	Batugade	A03-3	74.3	*110*	*16*	*25*	*26*	*26*	*19*	*25*	*25*	*0*	**272**	**162**	*551*	*24*	*141*	*139*	*42*	*39*	*33*	*56*	*21*	**1045**	**494**	**43.2%**	**34.7%**
15	Batugade	Mota Ain (Border)	A03-4	1.0	*135*	*14*	*35*	*26*	*22*	*18*	*25*	*24*	*0*	**299**	**164**	*492*	*15*	*73*	*51*	*31*	*44*	*18*	*36*	*23*	**784**	**292**	**29.3%**	**16.6%**
16	Batugade	Maliana	A03-5	41.3	*135*	*14*	*28*	*24*	*26*	*19*	*23*	*25*	*0*	**294**	**159**	*588*	*6*	*54*	*78*	*19*	*43*	*18*	*37*	*12*	**856**	**268**	**33.0%**	**14.9%**
17	Tibar	Gleno	A04-01	33.3	*118*	*0*	*28*	*37*	*80*	*0*	*72*	*59*	*5*	**399**	**281**	*349*	*15*	*128*	*99*	*111*	*2*	*170*	*18*	*2*	**894**	**545**	**24.0%**	**19.3%**
18	**Gleno**	**Ermera**	**A04-02**	**11.5**	***39***	**2**	**19**	**15**	**31**	**0**	**32**	**52**	**6**	**196**	**157**	*140*	*5*	*31*	*24*	*57*	*0*	*39*	*36*	*6*	**339**	**198**	**15.7%**	**6.4%**
19	**A05 Jct (Aituto)**	**Betulala**	**A05-01**	**10.8**	***16***	**0**	**14**	**11**	**1**	**8**	**7**	**50**	**5**	**111**	**95**	*58*	*1*	*22*	*18*	*1*	*7*	*8*	*35*	*5*	**155**	**97**	**9.2%**	**0.4%**
20	**Betulala**	**Same**	**A05-02**	**20.0**	***13***	**0**	**14**	**9**	**1**	**9**	**7**	**56**	**4**	**113**	**100**	*48*	*1*	*24*	*14*	*2*	*8*	*8*	*39*	*4*	**146**	**99**	**7.1%**	**-0.3%**
21	Same	Betano	A05-03	24.7	*108*	*0*	*32*	*25*	*86*	*0*	*105*	*43*	*0*	**399**	**291**	*169*	*8*	*10*	*9*	*45*	*0*	*11*	*2*	*0*	**253**	**84**	**-11.4%**	**-28.1%**
22	Baucau (By-pass)	Venilale	A06-01	23.9	*72*	*12*	*52*	*53*	*44*	*23*	*49*	*50*	*16*	**371**	**299**	*337*	*12*	*49*	*60*	*116*	*17*	*50*	*2*	*1*	**643**	**306**	**15.8%**	**0.6%**
23	Venilale	Viqueque	A06-02	34.1	*63*	*0*	*32*	*32*	*0*	*0*	*0*	*47*	*16*	**190**	**127**	*248*	*18*	*12*	*21*	*22*	*15*	*25*	*2*	*0*	**363**	**115**	**18.9%**	**-2.6%**
24	Viqueque	Natarbaro	A07-01	43.0	*14*	*0*	*5*	*5*	*6*	*0*	*10*	*12*	*0*	**52**	**38**	*120*	*5*	*8*	*10*	*29*	*0*	*30*	*5*	*0*	**207**	**87**	**44.4%**	**24.6%**
25	Viqueque	Uatucarbau (Jct C8)	A08-01	55.8	*29*	*0*	*3*	*8*	*15*	*9*	*18*	*16*	*0*	**98**	**69**	*165*	*8*	*23*	*11*	*19*	*10*	*19*	*2*	*0*	**257**	**92**	**29.3%**	**8.0%**
26	Uatucarbau (Jct C8)	Llomar	A08-02	25.0	*14*	*0*	*1*	*4*	*7*	*4*	*9*	*8*	*0*	**47**	**33**	***51***	***0***	***2***	***6***	***13***	***3***	***11***	***6***	***0***	**92**	**41**	**19.4%**	**5.7%**
27	Llomar	Los Palos	A08-03	45.0	*14*	*0*	*1*	*4*	*7*	*4*	*9*	*8*	*0*	**47**	**33**	*122*	*6*	*11*	*9*	*20*	*0*	*25*	*0*	*0*	**192**	**71**	**45.6%**	**22.6%**
28	Los Palos	Lautem	A08-04	27.9	*86*	*6*	*32*	*40*	*12*	*19*	*27*	*32*	*0*	**254**	**168**	*455*	*38*	*33*	*37*	*169*	*5*	*49*	*9*	*1*	**797**	**341**	**35.6%**	**20.8%**
29	Manatuto	Criba	A09-01	22.3	*7*	*0*	*1*	*2*	*0*	*0*	*12*	*2*	*0*	**24**	**17**	*48*	*9*	*9*	*14*	*8*	*0*	*21*	*2*	*0*	**110**	**63**	**50.2%**	**41.5%**
30	Criba	Laclubar Jct	A09-02	13.1	*7*	*0*	*1*	*2*	*0*	*0*	*12*	*2*	*0*	**24**	**17**	*35*	*13*	*5*	*8*	*8*	*1*	*22*	*0*	*0*	**91**	**55**	**42.6%**	**37.1%**
31	Laclubar Jct	Mane Hat	A09-03	34.7	*1*	*0*	*0*	*0*	*1*	*0*	*1*	*0*	*0*	**3**	**2**	***4***	***0***	***0***	***0***	***2***	***0***	***1***	***0***	***0***	**7**	**3**	**23.7%**	**11.7%**
32	Mane Hat	Natarbora	A09-04	10.8	*6*	*0*	*1*	*2*	*4*	*0*	*4*	*3*	*0*	**20**	**14**	***22***	***0***	***2***	***3***	***7***	***0***	***5***	***2***	***0***	**41**	**19**	**21.0%**	**8.5%**
33	Gleno	A10 & A12 jct	A10-01	68.5	*28*	*0*	*0*	*6*	*4*	*0*	*62*	*41*	*0*	**141**	**113**	***102***	***0***	***0***	***10***	***7***	***0***	***74***	***29***	***0***	**222**	**120**	**12.8%**	**1.6%**
34	Ermera	Maliana	A11-01	63.9	*26*	*0*	*0*	*4*	*13*	*0*	*18*	*5*	*0*	**66**	**40**	*103*	*1*	*9*	*9*	*1*	*1*	*23*	*27*	*1*	**175**	**72**	**29.7%**	**17.0%**
35	**Maliana**	**Oeleu**	**A12-01**	**15.5**	***67***	**0**	**12**	**7**	**7**	**5**	**15**	**13**	**0**	**125**	**59**	*242*	*1*	*19*	*11*	*14*	*4*	*18*	*9*	*0*	**318**	**76**	**28.2%**	**7.0%**
36	Oeleu	Lourba (A10 Jct)	A12-02	9.8	*106*	*0*	*107*	*108*	*132*	*12*	*83*	*86*	*0*	**634**	**528**	*184*	*0*	*17*	*12*	*26*	*4*	*12*	*9*	*0*	**263**	**79**	**-20.9%**	**-39.7%**
37	**Lourba (A10 Jct)**	**Zumalai**	**A12-03**	**26.1**	***85***	**0**	**7**	**7**	**5**	**11**	**7**	**14**	**0**	**136**	**51**	*309*	*0*	*11*	*12*	*8*	*9*	*9*	*9*	*0*	**368**	**59**	**30.5%**	**4.2%**
38	**A05 Jct (Same?/Aiassa?**	**Hatu Udo**	**A13-01**	**16.9**	***22***	**1**	**2**	**1**	**15**	**0**	**7**	**0**	**0**	**47**	**25**	*80*	*2*	*3*	*1*	*27*	*0*	*9*	*0*	*0*	**122**	**42**	**28.8%**	**14.5%**
39	Hatu Udo	Cassa	A13-02	7.7	*31*	*0*	*14*	*11*	*17*	*17*	*27*	*34*	*0*	**151**	**120**	*37*	*1*	*1*	*2*	*7*	*0*	*2*	*1*	*0*	**50**	**14**	**-25.5%**	**-44.1%**
40	Natarbora	Alas Jct	A14-01	37.7	*25*	*0*	*18*	*18*	*24*	*0*	*26*	*28*	*0*	**139**	**114**	***91***	***0***	***30***	***29***	***44***	***0***	***31***	***19***	***0***	**244**	**153**	**16.1%**	**8.1%**
41	Alas Jct	Betano	A14-02	9.1	*55*	*0*	*26*	*22*	*28*	*25*	*42*	*47*	*0*	**245**	**190**	*109*	*2*	*6*	*7*	*22*	*0*	*4*	*1*	*0*	**152**	**43**	**-12.0%**	**-32.7%**
42	Suai	Tilomar	A15-01	12.2	*43*	*0*	*18*	*15*	*11*	*3*	*24*	*17*	*0*	**131**	**88**	*170*	*0*	*21*	*14*	*11*	*0*	*1*	*10*	*1*	**227**	**57**	**15.7%**	**-11.1%**
43	Tilomar	Wemassa Border	A15-02	15.0	*19*	*0*	*7*	*6*	*6*	*0*	*10*	*8*	*0*	**56**	**37**	*217*	*1*	*21*	*9*	*16*	*0*	*2*	*19*	*1*	**286**	**69**	**54.4%**	**18.1%**
44	A12 Jct (Oeleu)	Fatululik	A16-01	28.7	*10*	*0*	*9*	*13*	*0*	*0*	*11*	*7*	*0*	**50**	**40**	*116*	*0*	*1*	*3*	*0*	*0*	*4*	*4*	*0*	**129**	**12**	**28.7%**	**-26.8%**
45	Fatululik	Tilomar	A16-02	48.0	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	**1**	**1**	*127*	*0*	*18*	*14*	*14*	*0*	*4*	*8*	*2*	**188**	**60**	**303.8%**	**198.2%**
46	**Pante Macassar**	**Bobometo/Oesilo**	**A17-01**	**28.3**	***157***	**0**	**25**	**37**	**122**	**4**	**3**	**103**	**0**	**450**	**293**	*569*	*0*	*41*	*58*	*222*	*4*	*4*	*71*	*0*	**969**	**400**	**22.7%**	**8.6%**
47	**Pante Macassar**	**Citrana**	**A18-01**	**47.5**	***156***	**1**	**15**	**17**	**6**	**0**	**8**	**41**	**0**	**244**	**88**	*568*	*2*	*24*	*27*	*12*	*0*	*10*	*28*	*0*	**671**	**103**	**31.0%**	**4.4%**
48	**Pante Macassar**	**Sakalo**	**A19-01**	**15.0**	***95***	**0**	**23**	**21**	**16**	**0**	**0**	**47**	**5**	**208**	**113**	*345*	*1*	*38*	*34*	*29*	*0*	*1*	*33*	*5*	**484**	**140**	**25.3%**	**5.8%**

March/April 2005											
Million veh-kms recorded per year (1)	39.17	3.60	13.51	13.39	15.05	7.72	17.01	17.36	1.76	**128.56**	**89.40**
Percentage vehicular travel	30.5%	2.8%	10.5%	10.4%	11.7%	6.0%	13.2%	13.5%	1.4%	**100%**	
Dec 2008/Jan 2009											
Million veh-kms recorded per year (1)	142.32	10.78	22.16	21.33	27.47	6.69	20.42	12.08	1.81	**265.05**	**122.73**
Percentage vehicular travel	53.7%	4.1%	8.4%	8.0%	10.4%	2.5%	7.7%	4.6%	0.7%	**100.0%**	
Anual rate of change											
Million veh-kms recorded per year	41%	34%	14%	13%	17%	-4%	5%	-9%	1%	21%	9%

Million pass-km	1232.89		
Average trip length (km)	75		
No of trips (million)	**16.413**	Trips/person/year	15.2

Note: (1) The 2005 and/or 2008/9 volumes for roads that were not counted in one of those years have been estimated by applying the derived average annual overall growth rates for different vehicle categories - see **Appendix 2A**.46.

Source: Consultants' Surveys and TA 3731

Table 9.3: TA 7100– AADT 2005 & 2009, and Annual Growth Rate, District Road Links

District Roads

March to April 2005

St.	Link From	To	Road-Link	Length (km)	Motor cycle	Car/ Taxi	Jeep/ 4WD	Pick-up/ Van	Mini-Bus	Large-Bus	Light Truck	Med. Truck	Heavy Truck	Total (inc M/C)	Total (exc M/C)
50	Jaco (via Tutuala)	A08 Jct (Trisula)	C2	29.0	22	0	6	11	4	0	10	0	13	**66**	**44**
53	Luro	A08 Jct	C4	10.0	4	0	0	0	0	0	4	3	0	**11**	**7**
54	Lacluta/Dilor	A07 Jct	C5	13.0	16	0	10	8	13	0	17	18	0	**82**	**66**
55	Quelicai	A01 Jct	C6	17.8	7	0	13	12	13	0	14	10	0	**69**	**62**
58	Baguia	A01 Jct	C8	37.6	8	0	5	5	6	0	8	2	0	**34**	**26**
61	Km 9.5	A02 Jct	C10	8.0	22	0	8	14	8	1	15	13	2	**83**	**61**
62	Km 9.5	A04 Jct	C10'	9.5	22	0	8	14	8	1	15	13	2	**83**	**61**
63	Lequidoe	A02 Jct	C11	16.9	0	0	0	0	10	0	1	0	0	**11**	**11**
64	Lequidoe	A02 Jct (Aileu)	C11'	10.9	0	0	0	0	49	0	1	0	0	**50**	**50**
65	Laulara	A02 Jct	C12	0.4	32	0	22	9	8	0	35	0	0	**106**	**74**
66	Ermera	Fatubessi	C13	11.4	90	0	6	22	51	0	57	16	0	**242**	**152**
70	Laclubar	A09 Jct	C15	9.6	14	0	2	2	0	0	25	6	0	**49**	**35**
72	Bazartete	A03 Jct (Aipelo)	C17	14.4	70	8	6	20	17	0	37	4	0	**162**	**92**
77	Hatobuilico	A10 Jct (Letefoh)	C22	18.4	7	0	0	2	0	0	20	15	0	**44**	**37**
78	Hato Udo	Ainaro	C23	26.7	28	0	20	15	0	0	1	28	0	**92**	**64**
80	Turiscai	A02 Jct	C26	20.4	20	0	5	6	6	0	8	10	0	**55**	**35**
86	Lolotoe	Beco	C32	22.8	25	0	12	13	21	14	27	9	0	**121**	**96**

Dec 2008/Jan 2009

St.	Motor cycle	Car/ Taxi	Jeep/ 4WD	Pick-up/ Van	Mini-Bus	Large-Bus	Light Truck	Med. Truck	Heavy Truck	Total (inc M/C)	Total (exc M/C)	Growth (%/year) (inc M/C)	Growth (%/year) (exc M/C)
50	*57*	*0*	*3*	*4*	*5*	*0*	*7*	*0*	*5*	**80**	**24**	5.4%	-15.3%
53	*10*	*0*	*0*	*0*	*0*	*0*	*3*	*1*	*0*	**14**	**4**	7.4%	-13.5%
54	*41*	*0*	*5*	*3*	*16*	*0*	*12*	*7*	*0*	**85**	**43**	0.9%	-10.5%
55	49	2	1	3	35	0	9	1	0	**100**	**50**	10.3%	-5.4%
58	71	5	4	2	27	0	11	0	0	**121**	**50**	40.2%	18.9%
61	*57*	*0*	*4*	*5*	*10*	*1*	*11*	*5*	*1*	**93**	**36**	3.1%	-12.8%
62	71	3	7	5	2	0	5	0	0	**94**	**23**	3.3%	-23.1%
63	*0*	*0*	*0*	*0*	*12*	*0*	*1*	*0*	*0*	**13**	**13**	4.5%	4.5%
64	89	7	8	2	1	0	16	0	0	**123**	**34**	27.1%	-10.1%
65	*83*	*0*	*12*	*3*	*10*	*0*	*25*	*0*	*0*	**132**	**49**	6.0%	-10.3%
66	90	2	22	17	31	0	17	46	1	**226**	**136**	-1.9%	-3.0%
70	*36*	*0*	*1*	*1*	*0*	*0*	*18*	*2*	*0*	**58**	**22**	4.6%	-11.8%
72	*181*	*24*	*3*	*7*	*21*	*0*	*26*	*2*	*0*	**263**	**83**	13.8%	-2.8%
77	*18*	*0*	*0*	*1*	*0*	*0*	*14*	*6*	*0*	**39**	**21**	-3.1%	-14.0%
78	62	0	8	14	8	0	2	1	0	**95**	**33**	0.8%	-16.2%
80	*52*	*0*	*3*	*2*	*7*	*0*	*6*	*4*	*0*	**73**	**22**	8.0%	-11.8%
86	*64*	*0*	*6*	*5*	*26*	*12*	*19*	*4*	*0*	**136**	**72**	3.2%	-7.5%

	Motor cycle	Car/ Taxi	Jeep/ 4WD	Pick-up/ Van	Mini-Bus	Large-Bus	Light Truck	Med. Truck	Heavy Truck	Total (inc M/C)	Total (exc M/C)
March/April 2005											
Million veh-kms recorded per year	2.09	0.04	0.71	0.91	1.10	0.12	1.46	0.90	0.15	**7.49**	**5.40**
Percentage travel	27.9%	0.6%	9.5%	12.1%	14.7%	1.6%	19.5%	12.1%	2.0%	**100.0%**	
Dec 2008/Jan 2009											
Million veh-kms recorded per year	6.00	0.26	0.45	0.45	1.43	0.10	1.05	0.39	0.05	**10.18**	**4.18**
Percentage travel	58.9%	2.5%	4.4%	4.4%	14.0%	1.0%	10.3%	3.8%	0.5%	**100.0%**	
Anual rate of change											
Million veh-kms recorded per year	32%	62%	-12%	-17%	7%	-4%	-8%	-20%	-24%	9%	-7%

Million pass-km	46.44
Average trip length	75
No of trips (million)	**0.62**
Trips/person/year	0.6

Note: (1) The 2008/9 volumes for roads that were not counted have been estimated by applying the derived average annual overall growth rates for different vehicle categories - see **Interim Report Appendix 2A.47**.
- when growth rates for district roads could not be established (for cars and large buses - because none were recorded in 2005 - the growth rates for National roads were applied).

Source: Consultants' surveys and TA 3731

Table 9.4: TA 7100– AADT 2009, and Annual Growth Rate 2005-2009, Manatuto-Natarbora Road

Road Link				AADT by Vehicle Type, 2009											Annual Growth Rate	
Link		Road–	Length	*Motor*	Car/	Jeep/	Pick-up	Mini-	Large-	Light	Med.	Heavy	Total		Growth (%/year)	
From	To	Link	(km)	*cycle*	taxi	4WD	van	Bu	Bus	Truck	Truck	Truck	(inc M/C)	(exc M/C)	(inc M/C)	(exc M/C
															2005-2009	
Manatuto	Criba	A09-01	22.3	*48*	*9*	*9*	*14*	*8*	*0*	*21*	*2*	*0*	110	63	50.2%	41.5%
Criba	Laclubar Jct	A09-02	13.1	*35*	*13*	*5*	*8*	*8*	*1*	*22*	*0*	*0*	91	55	42.6%	37.1%
Laclubar Jct	Mane Hat	A09-03	34.7	*4*	*0*	*0*	*0*	*2*	*0*	*1*	*0*	*0*	7	3	23.7%	11.7%
Mane Hat	Natarbora	A09-04	10.8	*22*	*0*	*2*	*3*	*7*	*0*	*5*	*2*	*0*	41	19	21.0%	8.5%
Laclubar	A09 Jct	C15	9.6	*36*	*0*	*1*	*1*	*0*	*0*	*18*	*2*	*0*	58	22	4.6%	-11.8%

Source: TA 7100 Traffic Counts, and Estimates (1)
Note (1):Volumes for roads that were not counted have been estimated by applying the derived average annual overall growth rates for different vehicle categories

9.5 Timor GAP Traffic Study

9.5.1 Objective

This section focuses on implications of the Timor GAP plans to projected new "Induced Traffic" on the Manatuto-Natarbora road, due to petroleum facilities development on the South Coast. The bulk of this Chapter concentrates on assessing traffic demand and traffic projections produce by Timor GAP, as part of their development plans. In particular, on the "induced demand," on the Manatuto-Natarbora road.

Fuller review of Timor GAP land-use development plans on the South Coast, is given in Chapter 2 of this Report – Development Plans; this section provides just a reminder summary.

In summary, the Timor GAP development plans for the South Coast include three clusters: (i) Suai Supply Base (ii) Betano Refinery and Petrochemical Industry, and (iii) Beaço LNG-Plant.

Each cluster will also include construction of New Town, to house the administrative staff and the workers: (i) Nova Suai (ii) Nova Betano, and (iii) Nova Viqueque, respectively. Figure 9.3 shows the location of these clusters.

Figure 9.3 Development Clusters

To connect these three clusters and support growth of the petroleum industry, a new Double Carriage, four -lane Highway is planned, along the South Coast, from Suai to Beaço, a distance of about 155 km.

9.5.2 Data Source

Timor GAP provided the Team with three reports on Traffic, traffic demand model, and economic assessment of the road system within their vicinity. All of the reports were issued by the TL Ministry of Finance, Petroleum Infrastructure Development. They were produced by the Consultant: PT. Virama Karya-Multi Arch.LDA.

The GAP reports are:

- Traffic Report, Chapter 4, Existing Traffic Condition
- Traffic Report, Chapter 5, Transport Demand Model
- Detailed Engineering Design Final Report, Highway Economic Analysis

The sections below review selected findings, with particular relevance to traffic on the Manatuto-Natarbora road.

9.5.3 Existing Traffic Conditions – Chapter 4

Traffic Surveys

The study conducted Traffic Counts surveys during April 8-17, 2011 for 24 hours (6:00 AM to 6:00AM, next morning). Each location was surveyed for three days on weekdays and weekends. The locations were: (1) Beko Village to Suai Rd, (2) Betano Junction, (3) Viqueque to Beaco Rd, (4) Salele Juntion, (5) Zumalai Junction, (6) Natarbora Junction, (7) Viqeque Junction. In addition, they also conducted Travel Trip Surveys.

The study reports that daily traffic along the corridor Suai to Beaco, range from 648 (Beco Village – Suai) to 455 (Betano Junction); and 530 on the Viqueque to Beaco corridor.

From this Feasibility Study viewpoint, the only relevant count, for comparison with the 2013 count, is the count at Natarbora Junction. However this particular count was not included in the report[*7].

In summary, with respect to Manatuto-Natarbora Road, the traffic counts for Timor GAP do not add useful information to this Feasibility Study.

Secondary Data

All of the secondary data used by the Consultant, is derived from the 2009 Road Master Plan, TA-7100, reviewed above.

Thus, also the secondary data do not provide any relevant additional data.

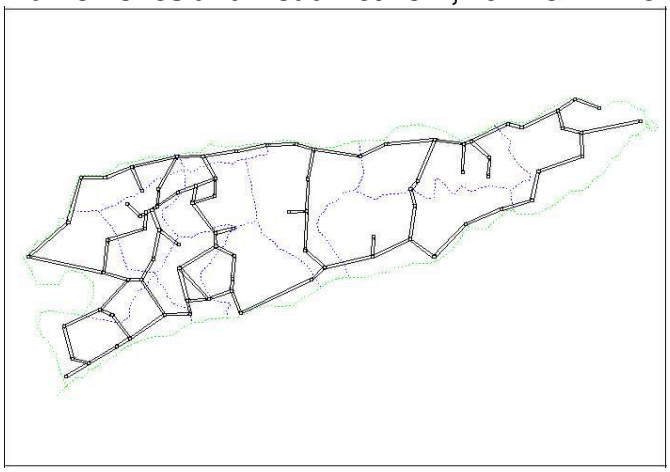
9.5.4 Transport Demand Model, Base Year 2011 – Chapter 5

The GAP study uses a "Four Step Transport Demand Model" (Trip Generation, Trip Distribution, Modal Split, and Traffic Assignment)[*8] to estimate traffic the Timor Leste National Road Network.

Basic Model Structure and Inputs

- Base year: 2011.
- 14 Traffic Zones: Thirteen (13) internal zones -- each of the 13 Districts of TL; One (1) External zone -- Indonesia (see Figure 9.4).
- Road Network: National Road System (see Figure 9.4).
- O-D Matrices: Based on O-D Matrices in the 2009 Road Master Plan, plus O-D data from the 2011 Consultant survey on the South Coast Corridor.
- Vehicle Categories: Initially, 11 Vehicle types (including Truck trailer, and Articulated truck and semi trailer; in addition to the 9 vehicle types included in the 2009 and 2013 surveys). Combined for analysis into 3 categories – (i) Cars, 4WD, and buses (ii) Medium trucks, and (iii) Heavy trucks.

Figure 9.4 Traffic Zones and Road Network, 2011 GAP Demand Study



Source: Timor GAP Report, Figure 5.2

[*7] See GAP Study, Table 4.3. Result of Traffic Count Survey.
[*8] There is no reference to the specific Software used by the Consultant

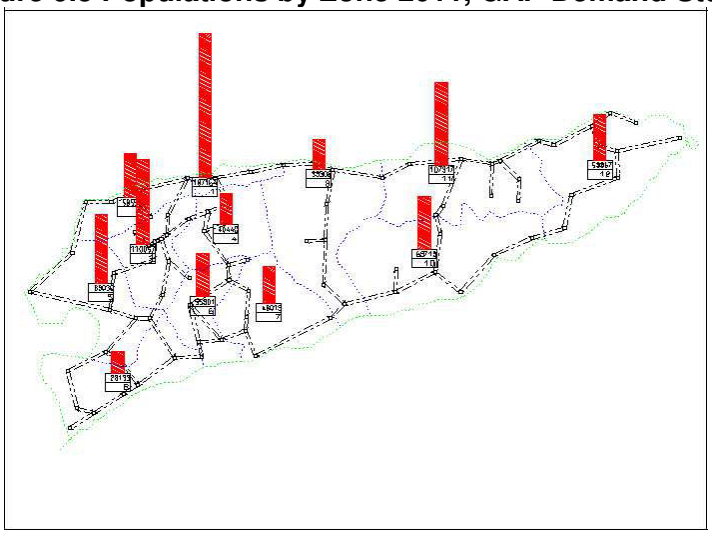
Sub-Models

(1) Trip Generation:

Trip Generation is based solely on population size in each traffic zone (see Figure 9.5)

- Trip Production: Number of Daily Vehicle-Trips = Linear function of Population in each Traffic Zone (estimated coefficients by the Consultant)
- Trip Attraction: Number of Daily Vehicle-Trips = Linear function of Population in each Traffic Zone (estimated coefficients by the Consultant)

Figure 9.5 Populations by Zone 2011, GAP Demand Study



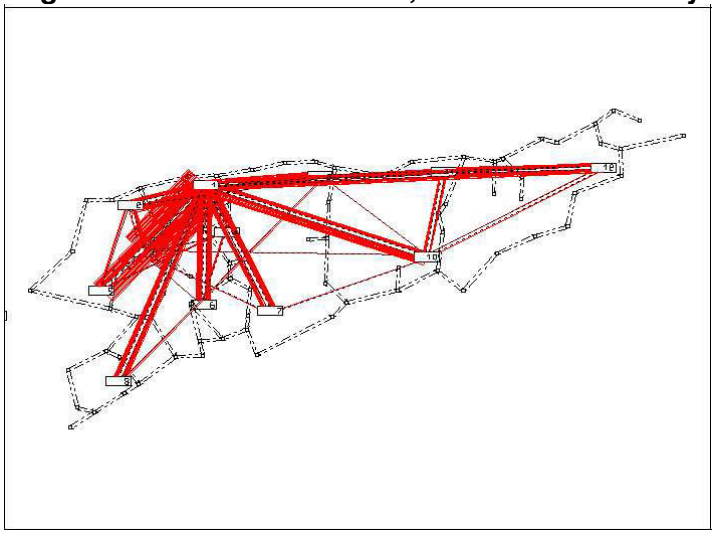
Source: Timor GAP Report, Figure 5.7

(2) Trip Distribution

Trip distribution is based on calibration of the O-D matrices, together with road network "impedance factor". The Consultant indicates, correctly, that Trip Distance, Trip Time, or Trip Cost is as used as "impedance factor" in the process of calibration model. However, it is not clear which"impedance factor" was used by the Consultant. It seems that Trip Distance was used in the 2011 Study.

The results of the Trip Distribution are shown as"desire lines" (see figure 9.6), where the width of the line shows the volumer of daily vhicle-trips. The desire lines do not project trips on the actual road network, though they take "impedance factor" of the road (probably road distance) into account. The map shows, clearly, that Dili is the most desired O-D point. It also shows significant travel between Dili and the three Petroleum Facilities.

Figure 9.6 Desire Lines 2011, GAP Demand Study



Source: Timor GAP Report, Figure 5.8

(3) Modal Split

The three O-D Matrices, by the aggregated vehicle-type categories, provide the modal-split to the model

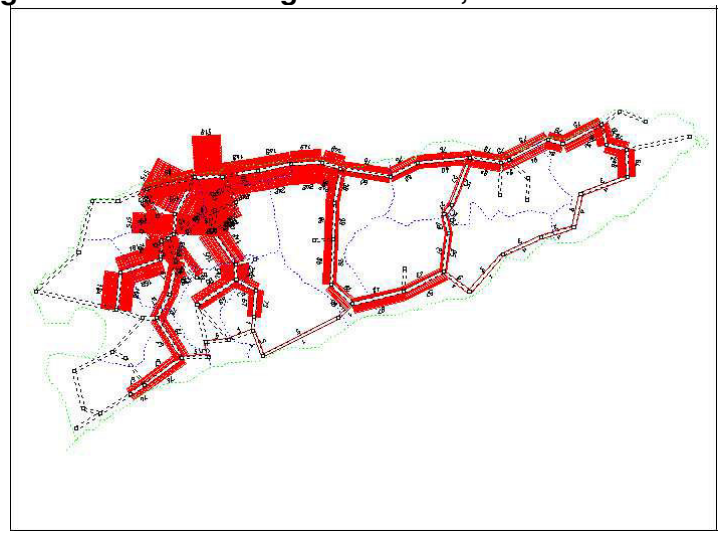
(4) Traffic Assignment

Route assignment project determines the daily vehicle-trips onto each link of the road network. The Consultant used a mathematical model, called "Equilibrium Trip Assignment" and "Capacity Restraint Method". Capacity restraint is calculated from relationship curve between volume and speed that results in "Volume Delay Function," which shows sensitivity-level of the network supply Roads) to increasing traffic volume on each link. Inputs used in the Traffic Assignment process are:

- Road Network
- Vehicle Origin-Destination Trip Matrices
- Relationship between volume and speed, for each road link type

The result of the Assignment process, for the base year 2011 is shown in Figure 9.7. The 2011 Assignment shows traffic (about 36 vehicle-trips going south, and about 20 going north[*9]) on the Manatuto-Natarbora Rd[*10] (see: in the middle of the chart), where large portion of this traffic seems to be produced and attracted to Viqueque.

Figure 9.7 Traffic Assignment 2011, GAP Demand Study



Source: Timor GAP Report, Figure 5.9

9.5.5 Traffic Demand Forecast, 2021-2031 – Chapter 5

The Consultant used traffic growth rates produced by the 2009 Road Master Plan, TA-7100, to forecast traffic for the period 2011-2031. To that growth he added "induced traffic" by the Petroleum Facilities to be constructed on the South Coast, starting at the year 2016.

In addition, the Consultant indicated that the calibrated "four steps model" for 2011, can be used to forecast traffic in later years, using appropriate matrices for the selected year. And he provided an example of Traffic Assignment results in a chart, for the year 2011. It is shown here in Figure 6.6. No specific values are shown on the chart[*11].

Results of the traffic forecast, 2011-2031, are given only for the Southern Corridor, as follows:

- Road segment Suai – Same (GAP, Table 5.18)
- Road Segment Same – Viqueque (GAP, Table 5.19)

[*9] The actual numbers of vehicle-trips on the chart is hard to read. The volumes given here are best guess. No Table was given concerning number of vehicle-trips on each link.

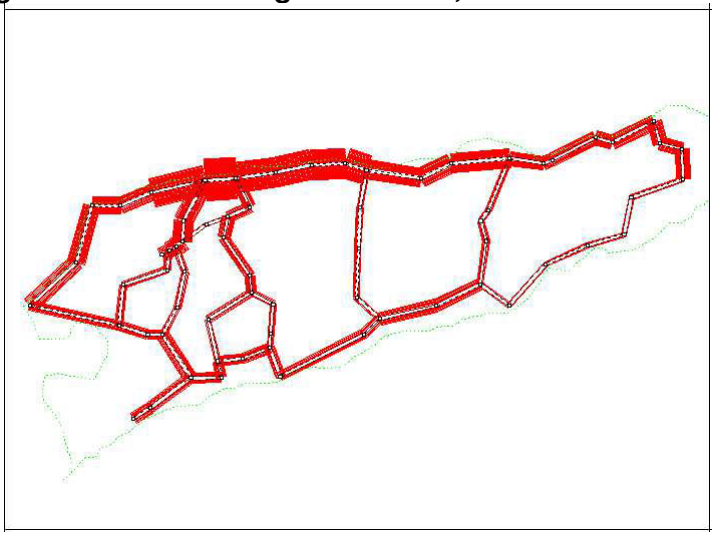
[*10] This leads us to believe that the "Impedance Factor" used by the Consultant is probably "Road Distance" (regardless of road conditions).

[*11] The original chart, in the GAP Report, does not show number of projected vehicle-trips. So, it is not possible to actually assess the traffic on each link. Note the scale (width of line for traffic volumes) in this chart for 2021, and in the previous chart for 2011 (Figure 6.5) may be different. Thus, it is not possible to simply compare between the two.

- Road Segment Viqueque – Beaco (GAP,Table 5.20)

No results are given for any other links on the National Network.
Thus, the GAP forecast does not provide any information on projected traffic over the Manatuto-Natarbora Road.

Figure 9.8 Traffic Assignment 2021, GAP Demand Study



Source: Timor GAP Report, Figure 5.12

9.5.6 Induced Traffic –Chapter 5

"Induced Traffic" onto the Manatuto-Natarbora Rd, by the planned Petroleum Industry Facilities on the South Coast, was expected, a-priori, to provide valuable traffic data, to justify the reconstruction of that road. However, as indicated above, the GAP report provides traffic forecast, 2011-2031, only for three sections on the Southern Corridor.
Th*us, the GAP forecast does not provide any information on "induced Traffic" over the Manatuto-*Natarbora Road.
Even for the South Corridor, where traffic projections are posted by the Consultant, the source of information to justify the "Induced Traffic" are not transparent. In all three tables of the GAP report (GAP, Tables 5.18-5.80), there is a substantial jump upwards in number of vehicle-trips between the year 2015 and 2016.
For example:

- Road segment Suai – Same (GAP, Table 5.18): In 2015 total daily vehicle-trips is 1,044 and it more than doubles to 2,210, in the year 2016.
- Road Segment Same – Viqueque (GAP, Table 5.19): In 2015 total daily vehicle-trips is 733 and it more than doubles to 1,870, in the year 2016.
- Road Segment Viqueque – Beaco (GAP, Table 5.20): In 2015 total daily vehicle-trips is 854 and it more than doubles to 2,002, in the year 2016.

It is presumed that this growth is attributed to execution of the development plan in the three clusters. However, it is not clear how these volumes were derived by the Consultant[*12].
In summary, even the source of "induced Traffic," from the Petroleum Facilities (even just to the South Coast Highway) is not transparent.

[*12] Repeated attempts by the 5857-TIM Team to obtain clarifications on these and other issues, from Timor GAP, were unsuccessful.

CHAPTER 10: TRAFFIC: 2013 TRAFFIC SURVEYS AND ASSESSMENT

10.1 Background and Data Sources

Traffic & Transport Assessment, on the Manatuto-Natarbora Road are based on two main sources:

1. Traffic Counts and O-D Surveys conducted in February 2013, as part of this Study (ADB 2857-TIM), and of the parallel study in North-East TL (ADB TA 8146-TIM).
2. "Preparing the Road Network Development Project – ADB TA 7100, 2009". It is commonly known as the "2009 The Timor Leste "National Road Master Plan" (see review Chapter 9).

Traffic Projections for the Manatuto-Natarbora Road are derived from:

1. Assessment of traffic growth rates and patterns, between previous traffic counts, in particularly the 2009 Road Master Plan, and 2013; and their projecting rates into the future.
2. Assessment of projected GDP per capita, and vehicle ownership, and their expected contribution to traffic growth.
3. Assessment of development plans, in particularly of Timor GAP Petroleum facilities, on the South Corridor, to produce new "Induced Traffic" onto the Manatuto-Natarbora Road.

This chapter focuses on traffic assessment of the 2013 traffic studies; to be used later in Chapter 11 as Input to the RED Model.

10.2 Survey Methodology

10.2.1 Joint Effort – ADB 2857-TIM & TA 8146-TIM

To increase the number of survey stations, increase sample size, and achieve more comprehensive results for the entire centre and north-eastern roads, the team of this feasibility study, ADB 2857-TIM, cooperated fully with the team for ADB feasibly study TA 8146-TIM. The two teams developed and utilized identical survey instruments (forms), and divided between them the execution of the surveys at the survey stations, as well as the analysis of the results, later on.

10.2.2 Dates, Time and Location

Dates and Time

Traffic counts were conducted during the second half of February 2013 (see dates in Figure 10.2). All counts were taken for 12 hours, 06:00 to 18:00. Counts were conducted during various mid-week days and/or Saturday, but not on Sunday. This is in order to capture working-days traffic. Traffic counts were taken either for two or three consecutive days in each location (site)[*1.] One traffic count station conducted a 24 hour count (06:00 to 06:00 next day), to estimate conversion factors, by vehicle type, from 12 count to 24 hrs Average Annual Daily Traffic (AADT). In addition, road side surveys (O-D) were taken for one day, at three locations.

Locations

Traffic counts by this team, ADB 2857-TIM, were conducted at three sites on the Manatuto-Natarbora Road, for two consecutive days at three locations on Roads A09/C15: One at A09-01, one at the Laclubar Junction (T Junction of A09-2, A09-3, and C15), and one at A09-04. In addition, it conducted a one-day, road side surveys (O-D), on the Dili- Manatuto Rd.,A01-01, about 5 km west of Manatuto Junction. Locations and dates of the Traffic Surveys, by both Feasibility Studies, are shown in Figure 10.1.

[*1] Traffic counts for TA 8146-TIM were conducted over three days. The difference in counting dates, between the two teams, is attributed to the fact that initial data indicated significantly less traffic on the Manatuto-Natarbora Rd. which did not necessitate a three-day count.

10.2.3 Traffic Counts - Survey Instruments (Form)

Traffic count forms allowed for counting traffic, during each hour, for 12 hours (6:00 to 18:00), by nine types of vehicles:

1. Motorcycle
2. Private car/taxi,
3. Jeep/4WD
4. Pick-up/van
5. Micro/Minibus (up to 20 seats)
6. Medium and large bus (>20 seats)
7. Light truck (<5 tonnes)
8. Medium truck (>5<10 tonnes)
9. Heavy, oil and articulated trucks (3 +axle)

For details see Appendix 10.1.

10.2.4 Road Side Surveys - Survey Instruments (Form) All Vehicles (Categories 1-9)

- Origin (by District, and Sub-District if known to the respondent)
- Destination (by District, and Sub-District if known to the respondent)
- The designated District codes (by GoTL) are:
    1. Dili
    2. Liquica
    3. Ermera
    4. Aileu
    5. Maliana
    6. Ainero
    7. Same
    8. Suai
    9. Manatuto
    10. Viqueque
    11. Bacau
    12. Losspalos
    13. Oecuse

- Vehicle type (see nine types, above)
- Driver' s sex (male or female)
- Number of passengers, excluding the driver
- Motorcycles, Private car, taxi, jeep/4WD, Pick-up, Van only (Categories 1, 2,3 or 4)
- Trip Purpose (work, leisure, tourism)
- Estimated trip time (hrs) and length (km)

Trucks only (Categories 7-9)

- Load (1/4, 1/2, 3/4 load, or full load)

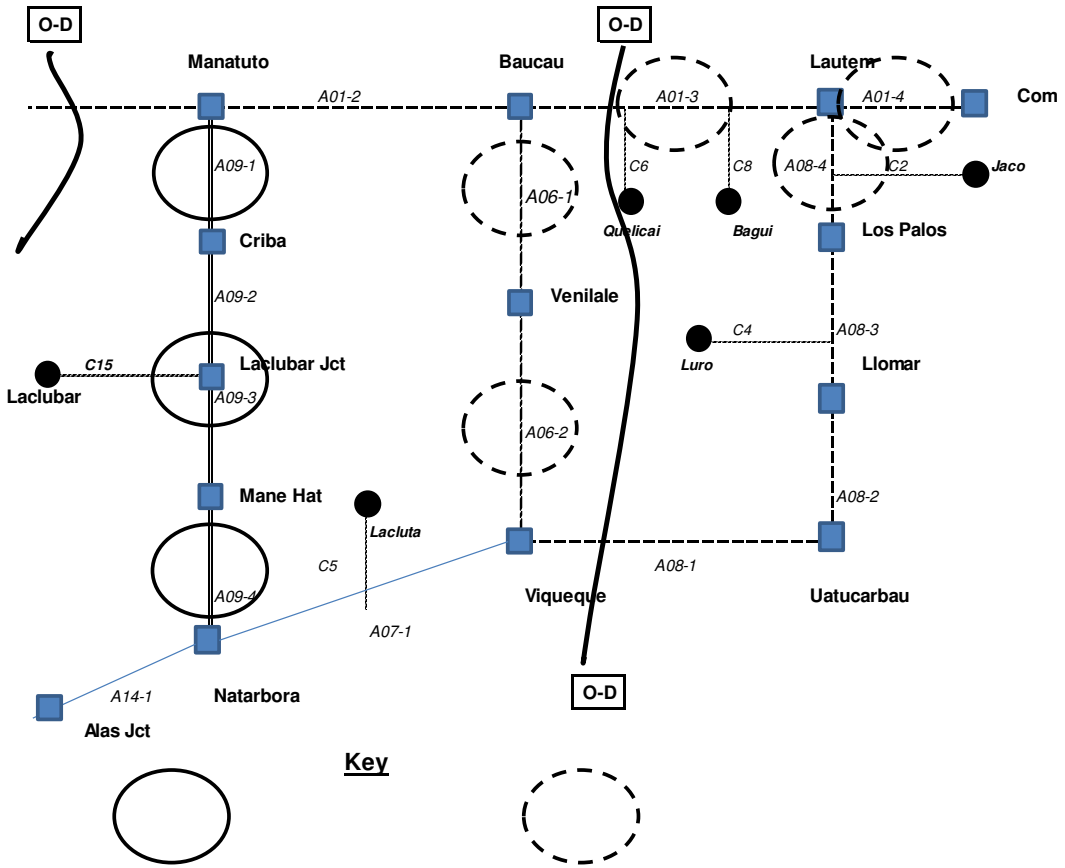
Bus Passengers (Categories 5-6)

Sample of five (5) front passengers

- Trip Purpose (work, leisure, tourism)
- Household monthly family income

For details see Appendix 10.1.

Figure 10.1 Survey Locations, and Survey Dates, February 2013



Classified count sites
12-hrs (06:00 to 18:00) x 2 days
Plus 12-hrs (18:00 to 06:00) x 1 day, O-D

Classified count sites
12-hrs (06:00 to 18:00) x 3 days
Plus 12-hrs (18:00 to 06:00) x 1 day, O-D

	February											March			
	18	19	20	21	22	23	24	25	26	27	28	1	2	3	4
KEI-KWK	m	t	w	th	f	s	s	m	t	w	th	f	s	s	m

Team 1 (KEI-KWK) — OD Dili-Manatuto Rd.

ADB

Team 1 — OD = Baucau to Lautem Rd
Count 1 Count 2 Count 3

Team 2 — OD = Viqueque to Uatucarbau Rd
Count 5 Count 6

OD =Roadside Interviews

10.3 Average Daily Traffic (ADT) & Average Annual Daily Traffic (AADT)

Table 10.1 shows Average Annual Daily Traffic (AADT), by vehicle type, and for the total (including, or excluding motorcycle) for each of the five links in the Study Area (A09-01, A09-02, A09-03, A09-04, and C15). It also shows vehicle share (%) and average annual growth rate (%) for the period 2009-2013.

The AADT was calculated in two steps:

1. Averaging the two day counts into a single Average Daily Traffic (ADT).
2. Applying to the ADTs a "Conversion Factors," by vehicle type, which converts the 12 hour ADT into 24 hour AADT. The converting factors (shown at the bottom of Table 10.1) were adopted from a 24 hour count conducted by ADB TA 8146-TIM[*2].

10.3.1 Traffic Volumes/Mode Share - Highlights

- Traffic volume (all Categories 1-9) on the Manatuto-Natarbora Rd is very low, varying between 148 AADT on A09-01, to 65 AADT on A09-04 (including Motorcycle).
- Motorcycle (Category 1) has the largest share of AADT, varying between 74.3% on A09-01, to 61.4% on A09-04. On all links (with the exception of A09-04 with 61.4%), Motorcycle accounts for about 75% of total AADT.
- Vehicle traffic Without Motorcycle, (Category 2-9) is quite extremely low, varying between 59 AADT on A09-01, to only 22 AADT on C-15.
- The most dominant vehicle type, excluding Motorcycle, is Jeep/4WD (Category 3), accounting for about 20% of total AADT on A09-01, 02, and 03, and about 12% on A09-04. On C-15 (which is an access link to Laclubar from the main road) it accounts for only about 11%.
- The second dominant mode is Light Truck (Category 7), accounting for about 15% on all links.
  It should be noted (from observation in the field) that Light Trucks (Category 7) serve not only for hauling goods, but also as "Semi-Bus". About 50% of the Light Trucks carry full passenger load, of approximately 20 people per Light Truck.
- There are very few Medium Trucks (Category 8): Only 2 on link A09-01, and none on the other links; and no Heavy Trucks, at all, on any link.
  It should be noted (from observation in the field) that the relatively large number of Medium Trucks on A09-04 (19 AADT), is a periodic anomaly. Most of these trucks are currently used for hauling material into a near-by road project in Natarbora. They are not expected to be there under "normal" circumstances.
- There were exceptionally few Buses (either Micro/Minibus, or Medium/Large). On all five links combined there were only 5 AADT buses.
  This is a corollary to the point above, indicating that Light Trucks act a "Semi-Buses" on the Manatuto-Natarbora road.
  No Private Cars (Category 2) were counted in the entire Study Area.
- A corollary to all points above is that currently only sturdy and relatively small vehicles, can operate on this steep mountainous terrain, with poor road conditions (with the exception of the lighter Motorcycles, which operate over shorter distances).
  For all practical purposes, the poor road can accommodate now only Jeep/4WD (Category 3) and Light Trucks (Category 7) to carry group of people and goods on the Manatuto-Natarbora road

[2] The 24 hour count was conducted on road A01-03, Bacau to Lautem, between 06:00 February 25 to 06:00 February 26, 2013.

10.3.2 Traffic Growth, 2009-2013, Mamatuto-Natarbora Rd.

Table 10.1 shows Average Annual Traffic Growth for the period 2009-2013. However, it should be treated with caution, for the following reason: In 2009 actual traffic counts were taken only on link A09-01(between Manatuto Junction and Cribas). AADT on the other three links of the Manatuto-Natarbora road, as well as on C-15, were only estimated. Thus, a meaningful comparison is valid only for the A09-01 link.

On that link, A09-01, average annual traffic growth; between 2009 and 2013 was 37.8% for all traffic, including Motorcycle; and 101.6% for traffic excluding Motorcycle.

Overall, the number of links on Mnatutu-Natarbora Rd. is quite limited (only 5 out of 63 National links), and one link (A09-01) has valid comparative data. Thus, these data are not sufficient to establish valid growth patterns, to be projected into the future, as input for RED.

Instead, this Study adopted the traffic growth rates developed by the parallel study, TA 8146-TIM, which conducted the 2013 traffic counts at (almost) the same five locations as in 2009 (and 2005); and established a valid growth pattern over the period 2009-2013. Details of the traffic growth rates used in RED are provided in a later section of this chapter.

Table 10.1 AADT, by Vehicle Type, Roads A09 & C15, February 2013

Vehicle Type	1	2	3	4	5	6	7	8	9	Total		Avg Annual Growth 2009-2013	
	Motorcycle	Private car / Taxi	Jeep/4WD	Picup/Van	Micro/Minibus (up to 20 seats)	Medium and largebus (>20 seats)	Light Truck (<5 tonnes)	Medium truck (>5<10 tonnes)	Heavy, oil and Art Truck (3 axle)	Inc. M-Cycle	Exc M-Cycle	Inc. M-Cycle	Exc M-Cycle
A09-01													
AADT 2013	**89**	**0**	**30**	**0**	**2**	**0**	**25**	**2**	**0**	**148**	**59**	**37.8%**	**101.6%**
AADT 2009 (exc.UN) **(1)**	35	0	1	0	0	0	1	0	1	38	3		
AADT 2005 (exc.UN)	13	0	7	0	1	2	0	0	12	35	22		
Share 2013 (%)	**60.2%**	**0.0%**	**20.2%**	**0.0%**	**1.1%**	**0.0%**	**16.9%**	**1.6%**	**0.0%**	**100.0%**	**39.8%**		
A09-02													
AADT 2013	**76**	**0**	**24**	**0**	**0**	**0**	**16**	**0**	**0**	**117**	**40**	**5.8%**	**-16.0%**
AADT 2009 (exc.UN) **(2)**	35	13	5	8	8	1	22	0	0	92	85		
AADT 2005 (exc.UN)	7	0	1	2	0	0	12	2	0	24	24		
Share 2013 (%)	**65.4%**	**0.0%**	**20.6%**	**0.0%**	**0.0%**	**0.0%**	**14.0%**	**0.0%**	**0.0%**	**74.3%**	**34.6%**		
A09-03													
AADT 2013	**54**	**0**	**17**	**0**	**0**	**1**	**10**	**0**		**82**	**28**	**103.4%**	**NA**
AADT 2009 (exc.UN) **(2)**	4	0	0	0	0	0	0	0		4	0		
AADT 2005 (exc.UN)	1	0	0	0	0	0	0	0		4	3		
Share 2013 (%)	**65.9%**	**0.0%**	**20.9%**	**0.0%**	**0.0%**	**0.9%**	**12.3%**	**0.0%**		**74.6%**	**34.1%**		
A09-04													
AADT 2013	**24**	**0**	**8**	**0**	**0**	**0**	**14**	**19**	**0**	**65**	**41**	**11.4%**	**19.7%**
AADT 2009 (exc.UN) **(2)**	22	0	2	3	7	0	5	2	0	41	19		
AADT 2005 (exc.UN)	0	7	0	1	2	0	0	12	2	24	24		
Share 2013 (%)	**37.2%**	**0.0%**	**12.7%**	**0.0%**	**0.0%**	**0.0%**	**21.2%**	**28.9%**	**0.0%**	**61.4%**	**62.8%**		
C-15													
AADT 2013	**54**	**0**	**8**	**0**	**0**	**1**	**13**	**0**	**0**	**75**	**22**	**NA**	**NA**
AADT 2009 (exc.UN) **(3)**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
AADT 2005 (exc.UN)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Share 2013 (%)	**71.5%**	**0.0%**	**10.9%**	**0.0%**	**0.0%**	**1.0%**	**16.6%**	**0.0%**	**0.0%**	**77.8%**	**28.5%**		
Notes													
Conversion Factor 12 to 24 hours	**1.12**	**1.00**	**1.18**	**1.25**	**1.10**	**1.53**	**1.25**	**1.56**	**1.43**		**1.16**		

(1) 2009, Actua traffic count on link A09-01

(2) 2009, Estimated traffic, based on A09-01 and national average per vehicle type

(3) 2009, No traffic count

10.4 Road Side Survey (O-D), Road A01-01, Dili - Manauto Rd.

This Study conducted on 1 March 2013, a one-day road side surveys (O-D), on the Dili- Manatuto Rd.,A01-01. The location was about 5 km west of Manatuto Junction. The survey included both an O-D survey, as well as a traffic count, to estimate survey sampling rates, by vehicle type. Table 10.2 shows summary finding of this survey.

10.4.1 Road Side Survey – Highlights

- The Road survey included 418 vehicles, out of total count of 868; this represents an overall sampling ratio of 48%.
- Sampling ratios for each vehicle type varied between 100% for Large & Heavy Trucks and Pickup/Van and Mini-Micro buses; 70% for Medium & Large Bus; 40% for Motorcycle, to 24% for Jeep/4WD.
  These ratios were used later, in the opposite direction, to expand the traffic survey O-D matrices into full population (of vehicle) matrices.
- The survey samples 212 bus passengers, from 75 buses surveys. The sample included the first front passengers in each bus.
- Average monthly income per household (HH) of sampled bus passengers (5 front passengers in each sampled bus), was US$103.
- Average number of passengers per vehicle varied by vehicle type, as expected. For example:
  1. Motorcycle: 1.3
  2. Car, 4WD and Pickup/Van: 3.9-3.4
  3. Small bus: 10.9
  4. Large bus: 26.5
  5. Med Truck:6.1
  6. Large & Heavy Truck:2.8-2.5

  Note, figures are also given separately in the Table for male and female.
  The average number of passengers per-vehicle (by type) are used later as input for RED, to estimate passengers' VOT savings.
- Trip purpose for motorcycle and personal vehicles (Categories 1-4) was mostly Leisure (72%-28%).
- Trip purpose for bus passengers (Categories 5-6) was about one half Work and one half Leisure (50%-50%; and 38%-62%, respectively).
  This ratio is used later as input to RED, to estimate VOT 0f passenger for work and leisure.
- Trips are quite long; average trip length is over 100km, and average travel time about 5.0 hours (see details in Table).
- Truck Load : Average truck load was:
  1. Large bus: 32%
  2. Med Truck:51%
  3. Large & Heavy Truck:65%

10.4.2 O-D Matrices, 2013

Table 1.3 shows summary O-D: All movements across partial north-south cordon west of Manatuto (AADT)
Because most of the surveyed vehicle were only between Dili (zone 1), and Manatuto (Zn 8), Viqueque(Zn10), Becau (Zn 11) and Lospalos (Zn 12), the matrices shown here are reduces matrices. They show total number of vehicle-trips (AADT) between these four zones and Dili.

10.5 Induced Traffic from the South Coast - General

This study estimated two types of "Induced Traffic" from/to the South Coast, along the Manatuto-Natarbora road:

1. **General Traffic**. This traffic estimates potential traffic linkages between The South Coast and Dili, where population sizes act as proxies for the strength of the linkages. It includes a mix of traffic vehicles (excluding motorcycles), derived from the Road Side Survey (O-D) conducted by the Consultant. This general traffic includes both people and goods movements, and is expected to grow at the same annual rates as "normal" traffic.
2. **Fuel Hauling Traffic**. This traffic is based on estimates of fuel hauling traffic, by road, between the Refineries in Betano and the North Coast. It is based on input provided by Timor Gap Management. All of this traffic is by heavy (3 axle) tanker-trucks. This traffic remains constant from year 2017 onwards, as it depends on a fixed production capacity of the refineries (30,000 PBD) in the foreseeable future.

The following sections discuss estimation methodology and calculation of vehicular traffic associated with each of these "Induced Traffics".

10.6 Induced General Traffic

10.6.1 Regression Equation

Table 1.4 shows an estimated regression equation, showing the number of all vehicle-trips to/from Dili (Y), as a function of the District population (X) from which the trips originated or destined, and the distance (D) between them.

The equation was estimated using 2013 O-D data (Collected at three locations, by both Teams; see locations in Figure 10.1), and 2013 population data, by District.

Because Dili is the major production/attraction in Timor Leste, and because most of the O-D surveyed in 2013 included Dili as such, the equation estimates trips to/from Dili (rather than to other District).

The equation was fitted with "Best Fit" equation of the form:

Y = 0.0561*X /D^0.8

Where:

Y=Vehicle-trips to/from Dili
X=Population in District (where trips originated or destined)
D = Distance between Dili and the District

R2=0.9948. The R2 is very high (maximum theoretical value of R2 is 1.0), which means that the independent variable (X) and the distance (D) to the power of 0.8 explains most of the variability.

10.7.1 Estimating Induced Gen. Traffic from Viqueque & Betano

Using this formula the Consultant estimated the total projected traffic between Viqueque -Dili, and Betano-Dili, through the upgraded Natarbora-Manatuto road. Calculations are shown in Table 10.5.

Recall, Viqueque (located east of Natarbora) is planned as a Liquefied Natural Gas (LNG) Cluster, and Betano (located west of Natarbora) as Refinery/Petro-Chemical Cluster.

Currently, traffic between Dili-Viqueque is light, as the road links between them (either through the Natarbora-Manatuto, or the Viqueque-Baucau-Manatuto road) are in poor condition. So is the traffic Betano-Dili (either through the Natarbora-Manatuto, or the Seme-Alieu road).

But with the upgrading of the Natarbora-Manatuto road, which is shorter, and thus more attractive than the alternative road via Baucau (if the later is upgraded at all), one expects traffic to flow along Road A-09, between Viqueque and Dili. Similarly, at least some of the traffic Betano-Dili is expected to be diverted to the improved road Natarbora-Manatuto.

Current (2010) population of Viqueque is 70,177, and in 2017 there will be an added population of 6,400 in the new town of Nova Viqueque. Total population by 2017 is 76,577.

Current (2010) population of Betano (Manufahi) is 48,894, and in 2017 there will be an added population of 30,000 in the new town of Nova Betano. Total population by 2017 is 78,894.

Using these populations, and the distanced to Dili, the consultant estimated Total Induced Traffic to Dili in the year 2017.

The Consultant assumed that 100% of induced trips Viqueque-Dili will flow via Natarbora-Manatutu (which is shorter than Viqueque-Baucau-Manatuto); and that 50% of the trips Betano-Dili wil go there (even though Natarbora-Manatutu is slightly longer, but will be in superior conditions to Seme-Alieu).

The Consultant assume that the vehicular mix, excluding motorcycles, which do not tend to travel such long distances, will be similar to the one observed in the Road Side Survey on road A01-01, on March 1, 2013. It also assumed that annual growth rates for this induced traffic, by vehicle type, are the identical to those of "Normal" Traffic (see Section 10.6 below).

Results of these estimates for the base-year 2017 are shown in Table 10.5, and in Table 10.6.

Table 10.2 AADT, Road Survey, Dili Manatuto Rd, A01-01, Summary Findings

	Vehicle Category	Count and Sampled Veh.			Sampled Bus Passengers (@ 5/Bus)	Avg. Passengers Per Vehicle			Trip Purpose			Trip Length, Time, Speed			Average Trucks Load (% of Tot)	Avg. Month HH Income Bus Pass. (US$)
		No. Vehicle Counted	No. Vehicle Surveyed	Sample Share (%)		Male	Female	Total	Work & Business	Leisure	Tourist	Av Trip Time (hrs)	Av Trip Length (km)	Av Speed (km/hr)		
1	Motorcycle	421	167	40%		1.2	0.1	1.3	7%	93%	0%	4.7	102.5	21.8		
2	Car	2	12	100%		2.1	1.8	3.9	0%	100%	0%	5.4	113.5	20.9		
3	Jep/4X4	229	55	24%		2.4	1.3	3.7	11%	89%	0%	4.4	120.6	27.2		
4	Pickup/Van	18	29	100%		2.6	0.8	3.4	28%	72%	0%	7.6	151.1	19.8		
5	Bus: Min-Mic	10	33	100%	10	6.6	4.3	10.9	50%	50%	0%	4.0	102.0	25.5		$ 103
6	Bus: Med-Lg	60	42	70%	197	15.3	11.1	26.5	38%	62%	0%					$ 103
7	Med Truck	112	15	13%	5	4.4	1.7	6.1	60%	40%	0%				32%	
8	Lag Truck	13	52	100%		2.3	0.5	2.8	50%	50%	0%				51%	
9	Heavy Truck	3	13	100%		2.4	0.2	2.5	50%	50%	0%				65%	
	Total	**868**	**418**	**48%**	**212**											

Table 10.3 Summary O-D Matrices - All Movements across Partial North-South Cordon West of Manatuto (AADT)

Motorcycle Local = 1% Dili (O/D) = 99%

Zn	1	2	3	4	5	6	7	8	9	10	11	12	Tot
8	3												3
9	71								3				74
10	108												108
11	30												30
12													0
Tot	212	0	0	0	0	0	0	0	3	0	0	0	215

Private car/taxi Local = 0% Dili (O/D) = N/A

Zn	1	2	3	4	5	6	7	8	9	10	11	12	Tot
8													0
9													0
10													0
11													0
12													0
Tot	0	0	0	0	0	0	0	0	0	0	0	0	0

Jeep/4WD Local = 1% Dili (O/D) = 98%

Zn	1	2	3	4	5	6	7	8	9	10	11	12	Tot
8													0
9	29								1				30
10	8												8
11	49	1											50
12	26												26
Tot	112	1	0	0	0	0	0	0	1	0	0	0	114

Pick-up/van Local = 0% Dili (O/D) = 100%

Zn	1	2	3	4	5	6	7	8	9	10	11	12	Tot
8													0
9	8												8
10	1												1
11	7												7
12	5												5
Tot	21	0	0	0	0	0	0	0	0	0	0	0	21

Micro/Minibus Local = 0% Dili (O/D) = 100%

Zn	1	2	3	4	5	6	7	8	9	10	11	12	Tot
8													0
9	13												13
10	6												6
11	12												12
12													0
Tot	31	0	0	0	0	0	0	0	0	0	0	0	31

Medium/Large Bus Local = 0% Dili (O/D) = 100%

Zn	1	2	3	4	5	6	7	8	9	10	11	12	Tot
8													0
9	13												13
10	25												25
11	16												16
12	7												7
Tot	61	0	0	0	0	0	0	0	0	0	0	0	61

Light Truck Local = 0% Dili (O/D) = 100%

Zn	1	2	3	4	5	6	7	8	9	10	11	12	Tot
8													0
9	15												15
10	8												8
11	31												31
12													0
Tot	54	0	0	0	0	0	0	0	0	0	0	0	54

Medium Truck Local = 0% Dili (O/D) = 100%

Zn	1	2	3	4	5	6	7	8	9	10	11	12	Tot
8													0
9	8												8
10	9												9
11	23												23
12	11												11
Tot	51	0	0	0	0	0	0	0	0	0	0	0	51

Heavy Truck Local = 0% Dili (O/D) = 100%

Zn	1	2	3	4	5	6	7	8	9	10	11	12	Tot
8													0
9	4												4
10	4												4
11	5												5
12													0
Tot	13	0	0	0	0	0	0	0	0	0	0	0	13

All Vehicles (exc m/c) Intraprovincial 1% Local = 0% Dili (O/D) = 99%

Zn	1	2	3	4	5	6	7	8	9	10	11	12	Tot
8	0	0	0	0	0	0	0	0	0	0	0	0	0
9	90	0	0	0	0	0	0	0	1	0	0	0	91
10	61	0	0	0	0	0	0	0	0	0	0	0	61
11	143	1	0	0	0	0	0	0	0	0	0	0	144
12	49	0	0	0	0	0	0	0	0	0	0	0	49
Tot	343	1	0	0	0	0	0	0	1	0	0	0	345

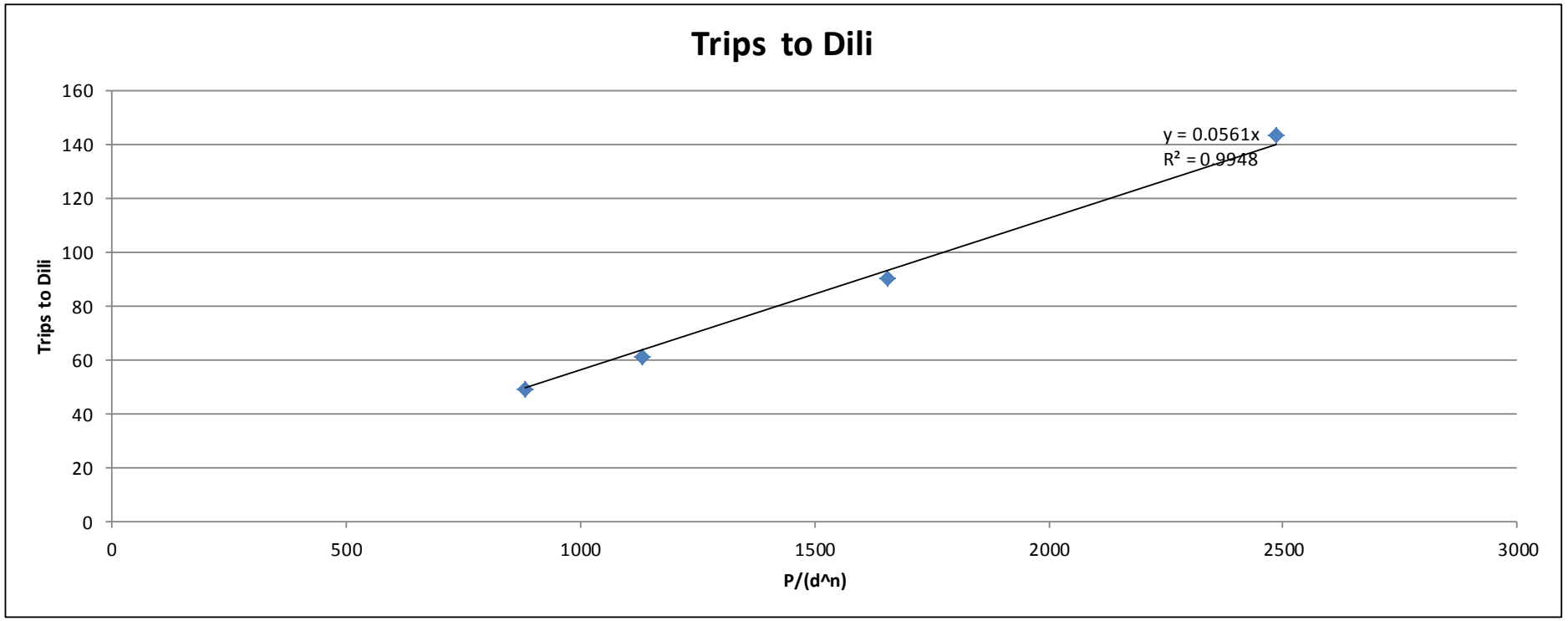
All Vehicles (inc m/c) Intraprovincial 1% Local = 1% Dili (O/D) = 99%

Zn	1	2	3	4	5	6	7	8	9	10	11	12	Tot
8	3	0	0	0	0	0	0	0	0	0	0	0	3
9	161	0	0	0	0	0	0	0	4	0	0	0	165
10	169	0	0	0	0	0	0	0	0	0	0	0	169
11	173	1	0	0	0	0	0	0	0	0	0	0	174
12	49	0	0	0	0	0	0	0	0	0	0	0	49
Tot	555	1	0	0	0	0	0	0	4	0	0	0	560

1 = Dili
2= Liquica
3= Ermera
4=Aileu
5= Bobonaro (Maliana)
6= Ainaro
7=Manufahi (Same)
8= Covalima (Suai)
9=Manatuto
10=Viqueque
11= Baucau
12= Lautem (Lospalos)

Table 10.4 Trips to Dili, as a Function of Distance to Dili and District Population, 2013 Data

	9 Mantuto	10 Viqueque	11 Baucau	12 Lautem
=P*(d^n)	1,657	1,132	2,487	883
Trips	90	61	143	49
Population = P	43246	70177	111484	60218
Distance = d	59	174	116	196



"Best Fit" Equation Trips = 0.0561*Pop/D^0.8

Table 10.5 Estimated Trips, Viqueque-Dili, Betano-Dili, 2017

A. Input Data

Population			Distance to Dili (D)	
2010	2017	2017		
	Nova	Total		
Viqueque	Viqueque	Viqueque	Via Natarb	
70,177	6,400	76,577	174	
2010	2017	2017		
	Nova	Total		
Manufahi	Butano	Manufahi	Via Natarb	Via Seme
48,894	30,000	78,894	192	176

B. Induced Trips 2017: Calculation

"Best Fit" Equation	Trips = 0.0561*Pop/D^0.8

	Coeficient	Pop 2017	D	D^0.8
Viqueque	0.0561	76,577	174	62.00681134
Trips =	69			
Manufahi	0.0561	78,894	192	67.0874034
Trips =	66			

C. Total Induced Trips, Via Natarbora, 2017

	%	Trips
Viqueque	100%	69
Manufahi (1)	50%	33
Total		102

(1) Another 50% via Seme

Table 10.6 Estimated Trips, Viqueque-Dili, Betano-Dili, by Vehicle Type, 2017

A. Road Dsurvey, A01-01, 2013

Vehicle Type	2	3	4	5
	Private Car / Taxi	Jeep / 4WD	Picup / Van	Micro/Minibus (up to 20 seats)
AADT 2013	2	269	22	11
% of Non-M-cycle	0.7%	88.5%	7.2%	3.6%

Vehicle Type	6	7	8	9	Total
	Medium and large bus (>20 seats)	Light Truck (<5 tonnes)	Medium truck (>5<10 tonnes)	Heavy, oil and Art Truck(3 axle)	Excl M-Cycle
AADT 2013	92	140	20	4	304
% of Non-M-cycle	30.3%	46.1%	6.6%	1.3%	100.0%

B. Estimated Distribution, Induced Traffic, Via Natarbora, 2017

Vehicle Type	2	3	4	5
	Private Car / Taxi	Jeep / 4WD	Picup / Van	Micro/Minibus (up to 20 seats)
Induced Vehicles	1	90	7	4

Vehicle Type	6	7	8	9	Total
	Medium and large bus (>20 seats)	Light Truck (<5 tonnes)	Medium truck (>5<10 tonnes)	Heavy, oil and Art Truck(3 axle)	Excl M-Cycle
Induced Vehicles	31	47	7	1	102

10.7 Estimating "Induced" Fuel Hauling Truck Traffic from/to Betano

Information on outputs, by type, and conceptual assessment of exports and domestic consumption of petroleum products, as well as of fuel hauling from the petroleum clusters on the South Coast, provided by Timor GAP Management, is as follows:

Liquefied Natural Gas (LNG) - All LNG output (up to 5 million tons per-annum) will be shipped, by water, from the specialized LNG Port to be constructed in Nova Viqueque. This port will handle solely LNG, and most of the LNG output will be for export.

LNG to the Refineries – If LNG will be delivered to the refineries, for production of various liquid fuels and/or fertilizers, it will be carried-out via a pipe-line.

Given these two facts, no road hauling of LNG is currently expected.

Refineries' Liquid Fuels Output - Table 10.7 shows planed output of the refineries, by product type (in Barrels Per Day, BPD), as well as estimates by Timor GAP Management for share of exports and local consumption in Timor Leste. Total daily output is about 30,000 BPD, of which the largest share is of Naphta, about 20,000 BPD, solely for export. The other 10,000 BPD products are divided, in various shares, between export and domestic consumption, as shown in the table.

Hauling Methods from Refineries - For Export, liquid fuels will be delivered via a pipe-line from the refineries in Betano to Suai Port, and from there by vessels overseas. As for domestic consumption of liquid fuels, there are no definite plans, as of now, for delivery means (coastal-water or road). However, Timor GAP agreed that a 50%-50% share between water and land hauling is reasonable.

Subsequently, these shares were used by the Consultant, to estimate number of fuel-hauling tanker-trucks over the Natarbora-Manatuto road. The estimates assumed a weight of 150 kg per barrel of oil, and 10 tons weight per truck. All fule will be delivered by large (3 axle) trucks.

This traffic from the year 2017 onwards is 91 trucks (including empties) in both directions. This traffic remains constant from year 2017 onwards (no application of annual growth rates), as it depends on a fixed production capacity of the refineries (30,000 PBD) in the foreseeable future.

Table 10.7 Refineries Output, and Estimated Number of Trucks, 2017 Onwards

Refinery	Outpot	Export/Local Share		Local Consumption & Haul by Road				Estimated Trucks/day	
Output	Per Day			BPD	Share	BPD	Tons	one-way	two-ways
Type	(BPD)	Export	Local	Total	by Road	by Road	by Road	Haul Fuel	(Inc Empty)
LPG	1,500	67%	33%	495	50%	248	37.13	4	7
Naphta	20,200	100%	0%	-	-	-	-	-	
Gasoline	900	50%	50%	450	50%	225	33.75	3	7
Jet Fuel	2,600	75%	25%	650	50%	325	48.75	5	10
Diesel	4,500	0%	100%	4,500	50%	2,250	337.50	34	68
Import Reformer	500	NA	NA						-
(Gasoline Blending)									-
Total	**30,200**			**6,095**		**3,048**	**457**	**46**	**91**
Source: Timor Gap, CEO				Source: Estimates by Consultant					
				Assumptions			150 kg/br	10 Ton/Truck	

10.8 Estimated Traffic Growth Rate for RED

10.8.1 General

Because this Study had only one link (A09-01) to compare with previous counts, it adopted, instead, the traffic growth rates established by the parallel study, TA 8146-TIM, which conducted the 2013 traffic counts at (almost) the same five locations as in 2009 (and in 2005 before); and established a valid growth pattern over the period 2009-2013 and 2005-2013.

In February 2013, TA 8146-TIM, conducted traffic counts at five locations. They are listed below; in parenthesis, AADT (with/without motorcycles):

- A01-3, Bacau-Lautem (856/383)
- A01-04, Lautem-Com (269/102)

- A06-01, Bacau-Venilale (1195, 541)
- A06-02, Venilale- Viqueque (496/235)
- A08-04, Lautem-Lospalos (644, 291)

10.8.2 Annual Growth Rates, 2009-2013 & 2005-2013

The following average annual growth rates, by vehicle types, were estimated by, TA 8146-TIM:

- Motorcycle (1)
  - 2009-13: 5.9%
  - 2005-13: 23.8%
- Cars/4WD, Van/Pickup (2-4)
  - 2009-13: 2.5%
  - 2005-13: 4.7%
- Buses (5-6)
  - 2009-13: 5.9%
  - 2005-13: 23.8%
- Trucks (7-9)
  - 2009-13: 6.0%
  - 2005-13: 11.7%

Overall, the average annual growth rates 2009-2013 have slowed, compared to 2005-2013[3]; however they remain quite significant, about 6.0% per annum for motorcycles, buses, and trucks.

10.8.3 Future Traffic Generators

Vehicle Ownership

Overall Growth - The national vehicle fleet has show a constant growth. The estimate average annual growth since 2004 is:

- 7.2% - All vehicles, including motorcycles
- 3.6% - All vehicles, excluding motorcycles

Although the National fleet is relatively small (about 27 vehicles, excluding motorcycles, per thousand population), the Timorese economy is growing rapidly, and so is its vehicle fleet.

Motorcycles - The increase in personal income, attributed to growth in the Petroleum Sector, results in increased vehicle ownership, in particularly of motorcycles, by first-time vehicle owners. Motorcycles are favored because they: (i) Can operate off-road, in areas where other vehicles cannot operate; (ii) Can travel over bad roads, in essence serving as a cheap personal substitute to 4WD; and (iii) Are relatively cheap to buy and operate.

Trucks - There has also observed quite an increase in Truck ownership and truck traffic, which seem s to be attributed to growth in construction. And iyt is expected to grow even further, as infrastructure/ cobnstruction expands, in particularly of the Petroleum Sector.

Private Cars – Growth in purchase of private cars (salon) has not materialized yet. In fact car usage, due to poor road conditions, has fallen, replaced by 4WD. However, experience shows that with further increase in personal income, and improved road conditions, some individual already owning motorcycles will shift to cars. And eventually, within the next few years (say 2015-16) private car ownership will increase as well.

Transport Growth with the GDP - Typically, in developing economies, starting from a low base, such as Timor Leste, vehicle ownership growth rate increases faster than the GDP. A "rule of thumb" sets this ratio to be 1.2-1.5 faster than the GDP.

Based on past performance, it is expected that the GDP (excluding oil) of the Timorese economy will continue to grow at about 10% per annum.

[3] This should have been expected as the base year 2005 had lowere exonomic activity and hence, also lower traffic.

10.8.4 Proposed Annual Growth Rates for RED

Table 10.8 shows the proposed annual growth rate, by vehicle type, for RED, based on the combination of determinants discussed above.
The growth rates (per each 5 years, as dictated by RED) are:

Table 10.8 Annual Growth Rates, 2013 – 2034, for RED

	2014-2018	2019-2023	2024-2028	2029-2033
Motorcycle	10.0%	7.5%	5.0%	2.5%
Cars, 4WD, Pickup/Van	7.5%	7.5%	7.5%	7.5%
Buses	7.5%	7.5%	7.5%	7.5%
Trucks	20.0%	15.0%	10.0%	10.0%

Notes:

- Annual growth rates for Motorcycles starts at 10%, and levels off from 2019 onwards –first to 7.5%, later to 5.0%, and finally to 2.5%.
- Growth rates for personal vehicles (combination of Saloon Cars, 4WD and Pickup/Vans) remains constant at 7.5% throughout the period, as one sub-type substitutes other; and more cars are bought by previous bicycle owners.
- Growth rates for Buses remains constant at 7.5% throughout the period, reflecting constant growth of the economy, associated with similar growth in demand for travel by bus passengers.
- Annual growth rates for Trucks starts at 20%, and levels off from 2019 onwards –first to 15%, and then to 10%. These largest growth rates (compared to other vehicles) reflect the ever increasing demand for hauling construction materials, particularly by the Petroleum Sector.

10.8.5 Summary Traffic, by Year, 2014 -2033

Table 10.9 shows summary traffic in each of the years 2014-2033, in each of the five links of the Study Area.
The table is divided into four types of traffic categories:

1. Normal Traffic
2. Generated Traffic
3. Induced Traffic
4. Total Traffic (sum of the three above)

Within each traffic category, there is a further division into:

1. Total Traffic, including Motorcycle (Inc-MC)
2. Traffic excluding Motorcycle (Exc-MC)

Appendix 10.2 shows the detailed traffic data: traffic by vehicle category in each of the years, for the four type of traffic categories listed above.

Highlights

- Recall, Induced Traffic does not include Motorcycle: A trip to Dili is too long for motorcycle, and thus motorcycles were excluded from the population-generated induced trips; obviously, there are no motorcycles in the induce fuel tanker-trucks traffic.
- Similarly, Generated Traffic does not include much motorcycle, as the reduced travel cost by motorcycle is too small to generate significant new motorcycle traffic.
- The result, as shown below, is an increasing share of non-motorcycle traffic over time, which generates higher road-based benefits (VOC and VOC). For example:
    - On Road A09-01, base-line traffic (including generated and induced traffic) in 2014 is 152 vehicles, and excluding motorcycles is 63 (40% of total). Total traffic grows in 2033 to 1,323 AADT, and excluding motorcycles it is 925 (80% of total).

- On Road A09-02, base-line traffic (including generated and induced traffic) in 2014 is 122 vehicles, and excluding motorcycles is 46 (40% of total). Total traffic grows in 2033 to 1,147 AADT, and excluding motorcycles it is 855 (70% of total).
- On Road A09-03 and A09-04, base-line traffic (including generated and induced traffic) in 2014 is 87 vehicles, and excluding motorcycles is 33 (40% of total). Total traffic grows in 2033 to 988 AADT, and excluding motorcycles it is 761 (80% of total).
- On Road C-15, base-line traffic (including generated and induced traffic) in 2014 is 74 vehicles, and excluding motorcycles is 20 (30% of total). Total traffic grows in 2033 to 490 AADT, and excluding motorcycles it is 258 (50% of total).

Table 10.9 Traffic by Year, 2014 – 2033 by Link; Normal, Generated and Induces; Include/Exclude Motorcycle (MC)

Year		A09-01								A09-02							
		Normal		Genert		Induced		All Traff		Normal		Genert		Induced		All Traff	
		Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC
1	2014	152	63	0	0	0	0	**152**	**63**	122	46	0	0	0	0	**122**	**46**
2	2015	169	71	0	0	0	0	**169**	**71**	135	52	0	0	0	0	**135**	**52**
3	2016	188	81	34	15	0	0	**223**	**95**	150	58	34	13	0	0	**185**	**72**
4	2017	210	92	39	17	193	193	**442**	**302**	167	66	39	15	193	193	**399**	**274**
5	2018	235	105	43	19	202	202	**480**	**326**	186	75	43	17	202	202	**431**	**294**
6	2019	257	117	48	22	211	211	**516**	**350**	203	83	48	20	211	211	**462**	**314**
7	2020	281	131	53	24	221	221	**555**	**377**	221	93	53	22	221	221	**495**	**336**
8	2021	308	146	58	28	232	232	**599**	**406**	241	103	58	25	232	232	**532**	**360**
9	2022	338	164	64	31	244	244	**646**	**439**	264	115	64	28	244	244	**572**	**388**
10	2023	371	184	71	35	257	257	**699**	**476**	289	129	71	32	257	257	**617**	**418**
11	2024	397	201	76	38	272	272	**745**	**511**	308	140	76	35	272	272	**656**	**446**
12	2025	425	219	82	42	287	287	**794**	**548**	329	153	82	38	287	287	**698**	**478**
13	2026	455	239	88	46	304	304	**847**	**589**	352	167	88	42	304	304	**743**	**512**
14	2027	488	261	95	51	322	322	**904**	**633**	376	182	95	46	322	322	**792**	**549**
15	2028	523	284	102	56	341	341	**967**	**681**	402	198	102	50	341	341	**845**	**590**
16	2029	555	310	109	61	362	362	**1027**	**734**	425	216	109	55	362	362	**897**	**634**
17	2030	590	339	117	67	386	386	**1092**	**792**	450	235	117	61	386	386	**952**	**682**
18	2031	627	370	125	74	411	411	**1163**	**854**	476	257	125	67	411	411	**1012**	**735**
19	2032	668	404	134	81	438	438	**1240**	**923**	505	280	134	74	438	438	**1077**	**792**
20	2033	711	441	144	89	467	467	**1323**	**998**	536	305	144	82	467	467	**1147**	**855**

Year		A09-03								A09-04							
		Normal		Genert		Induced		All Traff		Normal		Genert		Induced		All Traff	
		Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC
1	2014	87	33	0	0	0	0	**87**	**33**	87	33	0	0	0	0	**87**	**33**
2	2015	96	37	0	0	0	0	**96**	**37**	96	37	0	0	0	0	**96**	**37**
3	2016	107	42	34	13	0	0	**141**	**55**	107	42	34	13	0	0	**141**	**55**
4	2017	119	47	39	15	193	193	**350**	**255**	119	47	39	15	193	193	**350**	**255**
5	2018	132	53	43	17	202	202	**377**	**272**	132	53	43	17	202	202	**377**	**272**
6	2019	144	59	48	20	211	211	**403**	**289**	144	59	48	20	211	211	**403**	**289**
7	2020	157	65	53	22	221	221	**431**	**309**	157	65	53	22	221	221	**431**	**309**
8	2021	171	73	58	25	232	232	**461**	**330**	171	73	58	25	232	232	**461**	**330**
9	2022	187	81	64	28	244	244	**495**	**353**	187	81	64	28	244	244	**495**	**353**
10	2023	204	90	71	31	257	257	**532**	**379**	204	90	71	31	257	257	**532**	**379**
11	2024	218	98	76	34	272	272	**565**	**404**	218	98	76	34	272	272	**565**	**404**
12	2025	232	107	82	38	287	287	**601**	**432**	232	107	82	38	287	287	**601**	**432**
13	2026	248	117	88	41	304	304	**640**	**462**	248	117	88	41	304	304	**640**	**462**
14	2027	265	127	95	45	322	322	**681**	**494**	265	127	95	45	322	322	**681**	**494**
15	2028	283	138	102	50	341	341	**727**	**530**	283	138	102	50	341	341	**727**	**530**
16	2029	299	151	109	55	362	362	**771**	**568**	299	151	109	55	362	362	**771**	**568**
17	2030	317	164	117	61	386	386	**819**	**611**	317	164	117	61	386	386	**819**	**611**
18	2031	335	179	125	67	411	411	**871**	**657**	335	179	125	67	411	411	**871**	**657**
19	2032	355	195	134	74	438	438	**927**	**707**	355	195	134	74	438	438	**927**	**707**
20	2033	377	213	144	81	467	467	**988**	**761**	377	213	144	81	467	467	**988**	**761**

Year		C-15							
		Normal		Genert		Induced		All Traff	
		Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC
1	2014	74	20	0	0	0	0	**74**	**20**
2	2015	83	23	0	0	0	0	**83**	**23**
3	2016	93	27	34	10	0	0	**127**	**38**
4	2017	104	32	39	12	0	0	**143**	**44**
5	2018	117	38	43	14	0	0	**160**	**52**
6	2019	128	43	48	16	0	0	**176**	**59**
7	2020	140	49	53	18	0	0	**193**	**67**
8	2021	154	56	58	21	0	0	**212**	**77**
9	2022	169	63	64	24	0	0	**233**	**87**
10	2023	186	72	71	27	0	0	**256**	**100**
11	2024	198	79	76	30	0	0	**274**	**109**
12	2025	212	87	82	33	0	0	**294**	**120**
13	2026	227	95	88	37	0	0	**315**	**132**
14	2027	242	104	95	41	0	0	**337**	**145**
15	2028	259	115	102	45	0	0	**362**	**160**
16	2029	274	126	109	50	0	0	**383**	**176**
17	2030	290	138	117	56	0	0	**407**	**193**
18	2031	307	151	125	62	0	0	**432**	**213**
19	2032	326	166	134	68	0	0	**460**	**234**
20	2033	346	182	144	76	0	0	**490**	**258**

Appendix 10.1
Traffic Survey Forms

Classified Count Survey Form

Road _____ Location _____

Direction _____ Date _____ Surveyor _____

	1 Motorcycle	2 Private car/taxi	3 Jeep/4WD	4 Pick-up/van	5 Micro/Minibus (up to 20 seats)	6 Medium and large bus (>20 seats)	7 Light Truck (<5 tonnes)	8 Medium truck (>5<10 tonnes)	9 Heavy, oil and artic trucks (3 +axle)
06:00 to 07:00									
07:00 to 08:00									
08:00 to 09:00									
09:00 to 10:00									
10:00 to 11.00									
11.00 to 12:00									
12:00 to 13:00									
13:00 to 14:00									
14:00 to 15:00									
15:00 to 16:00									
16:00 to 17:00									
17:00 to 18:00									

Road-Side Interview Surveys: Data Collection Form

All Vehicles *(Semua Kendaraan)*

Where have you come from? *Dari Mana?*

		District *Kabupaten*	Sub-District *Kecamatan*
1	Dili		
2	Liquica		
3	Ermera		
4	Aileu		
5	Bobonaro (Maliana)		
6	Ainaro		
7	Manufahi (Same)		
8	Covalima (Suai)		
9	Manatuto		
10	Viqueque		
11	Baucau		
12	Lautem (Lospalos)		
13	Oecusi		

Tick box *Tandain* Write name *Tulis nama*

Where are you going to? *Tujuan Kemana?*

		District *Kabupaten*	Sub-District *Kecamatan*
1	Dili		
2	Liquica		
3	Ermera		
4	Aileu		
5	Bobonaro (Maliana)		
6	Ainaro		
7	Manufahi (Same)		
8	Covalima (Suai)		
9	Manatuto		
10	Viqueque		
11	Baucau		
12	Lautem (Lospalos)		
13	Oecusi		

Tick box *Tandain* Write name *Tulis nama*

Vehicle Type? *Jenis kendaraan*

		Tick box *Tandain*
1	Motorcycle *(motor)*	
2	Private car/taxi *(mobil privadi/taxi)*	
3	Jeep/4WD *(jeep/4WD)*	
4	Pick-up/van *(pick-up/van)*	
5	Micro/Minibus *(Micro/Minibus)* (<20 seats) *(< 20 tempat duduk)*	
6	Medium and large *(sedang dan besar* (>20 seats) *(> 20 tempat duduk)*	
7	Light Truck *(truck kecil)* (<5 tonnes)	
8	Medium truck *(truck sedang)* (>5<10 tonnes)	
9	Heavy, oil and *(truck besar)* artic. trucks (3 axle)	

Driver *(supir)*

- male *(laki laki)* ☐
- female *(wanita)* ☐ Tick one box *Tandain 1*

No of passengers (exc. Driver) *Jumlah Penumpang (termasuk supir)*

- male *(laki laki)* ☐
- female *(wanita)* ☐ Write number *Tulis*

Motorcycles, Private car, taxi, jeep/4WD, pick-up, van only (Categories 1, 2,3 or 4)

Hanya motor, mobil privadi, taxi, jeep/4WD,pick-up, van

Purpose of trip *(Tujuan Perjalanan)*	1	Business *(Bisnis)*	
	2	Leisure *(Pribadi)*	
Estimated journey time (hours) *Jumlah waktu perjalana (jam)*			
Estimated journey length (km) *jumlah panjang perjalana (km)*			

Trucks only

Hanya Truck

	Cargo *(muataan)*		Goods Description *(Jenis muataan)*
1	Empty *(kosong)*		
2	1/4full *(1/4 penuh)*		
3	1/2 full *(1/2 penuh)*		
4	3/4 full *(3/4 penuh)*		
5	full *(penuh)*		

Buses only (interview five passengers at front only)

Hanya Bis - Tanyain 5 orang di depan

Purpose of trip *(Tujuan Perjalaan)*		Tick Box *tandain*	**Family Income (US$/month)** *Pendapatam Keluarga (US$/bulan)*
Passenger 1 / *Penumpang*	Business		
	Leisure		
Passenger 2 / *Penumpang*	Business		
	Leisure		
Passenger 3 / *Penumpang*	Business		
	Leisure		
Passenger 4 / *Penumpang*	Business		
	Leisure		
Passenger 5 / *Penumpang*	Business		
	Leisure		

Appendix 10.2
Detailed Traffic Data, by Vehicle Type, 2014-2033

A09-1 Traffic , by VehicleType : Normal, Generated, Induced and Total, 2014-2033

Year		Normal											Genarated (estimate)											Induced											All Traffic										
		1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total
		MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC
1	2014	89	1	30	1	2	1	25	2	1	**152**	**63**	0	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	0	**0**	**0**	89	1	30	1	2	1	25	2	1	**152**	**63**
2	2015	98	1	32	1	2	1	30	2	1	**169**	**71**	0	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	0	**0**	**0**	98	1	32	1	2	1	30	2	1	**169**	**71**
3	2016	108	1	35	1	2	1	36	3	1	**188**	**81**	20	0	6	0	0	0	7	1	0	**34**	**15**	0	0	0	0	0	0	0	0	0	**0**	**0**	127	1	41	1	3	1	43	3	2	**223**	**95**
4	2017	118	1	37	1	2	1	43	3	2	**210**	**92**	22	0	7	0	0	0	8	1	0	**39**	**17**	0	1	49	4	2	17	25	4	91	**193**	**193**	140	2	93	5	5	18	76	8	93	**442**	**302**
5	2018	130	1	40	1	3	1	52	4	2	**235**	**105**	24	0	7	0	0	0	10	1	0	**43**	**19**	0	1	53	4	2	18	27	4	91	**202**	**202**	154	3	101	6	5	20	89	9	93	**480**	**326**
6	2019	140	1	43	1	3	1	60	5	2	**257**	**117**	26	0	8	0	1	0	11	1	0	**48**	**22**	0	1	58	5	2	20	29	5	91	**211**	**211**	166	3	109	6	6	22	100	10	94	**516**	**350**
7	2020	151	2	46	2	3	2	69	5	3	**281**	**131**	28	0	9	0	1	0	13	1	1	**53**	**24**	0	1	63	5	3	22	32	5	91	**221**	**221**	179	3	118	7	6	24	113	12	94	**555**	**377**
8	2021	162	2	50	2	3	2	79	6	3	**308**	**146**	30	0	9	0	1	0	15	1	1	**58**	**28**	0	1	68	6	3	24	35	6	91	**232**	**232**	192	3	127	8	7	26	128	13	95	**599**	**406**
9	2022	174	2	54	2	4	2	91	7	4	**338**	**164**	33	0	10	0	1	0	17	1	1	**64**	**31**	0	2	74	6	3	26	38	6	91	**244**	**244**	207	4	137	8	7	28	145	15	95	**646**	**439**
10	2023	187	2	58	2	4	2	104	8	4	**371**	**184**	36	0	11	0	1	0	20	2	1	**71**	**35**	0	2	80	7	3	28	41	7	91	**257**	**257**	223	4	148	9	8	30	165	16	96	**699**	**476**
11	2024	196	2	62	2	4	2	115	9	5	**397**	**201**	38	0	12	0	1	0	22	2	1	**76**	**38**	0	2	87	7	4	30	44	7	91	**272**	**272**	234	4	160	10	8	33	181	18	96	**745**	**511**
12	2025	206	2	66	2	4	2	126	10	5	**425**	**219**	40	0	13	0	1	0	24	2	1	**82**	**42**	0	2	94	8	4	33	48	8	91	**287**	**287**	246	5	173	10	9	35	198	20	97	**794**	**548**
13	2026	217	2	71	2	5	2	139	11	6	**455**	**239**	42	0	14	0	1	0	27	2	1	**88**	**46**	0	2	102	8	4	35	52	8	91	**304**	**304**	258	5	187	11	10	38	218	22	98	**847**	**589**
14	2027	227	3	77	3	5	3	153	12	6	**488**	**261**	44	0	15	0	1	0	30	2	1	**95**	**51**	0	2	111	9	5	38	57	9	91	**322**	**322**	272	5	203	12	11	41	239	24	98	**904**	**633**
15	2028	239	3	83	3	6	3	168	13	7	**523**	**284**	47	1	16	1	1	1	33	3	1	**102**	**56**	0	2	120	10	5	42	61	10	91	**341**	**341**	285	6	219	13	11	45	262	26	99	**967**	**681**
16	2029	245	3	89	3	6	3	185	15	7	**555**	**310**	48	1	17	1	1	1	36	3	1	**109**	**61**	0	3	130	11	5	45	67	11	91	**362**	**362**	293	6	237	14	12	49	288	28	100	**1027**	**734**
17	2030	251	3	95	3	6	3	203	16	8	**590**	**339**	50	1	19	1	1	1	40	3	2	**117**	**67**	0	3	142	12	6	49	72	12	91	**386**	**386**	301	7	256	15	13	53	316	31	101	**1092**	**792**
18	2031	257	3	103	3	7	3	224	18	9	**627**	**370**	51	1	20	1	1	1	45	4	2	**125**	**74**	0	3	154	13	6	53	78	13	91	**411**	**411**	308	7	277	17	14	57	346	34	102	**1163**	**854**
19	2032	264	4	110	4	7	4	246	20	10	**668**	**404**	53	1	22	1	1	1	49	4	2	**134**	**81**	0	3	167	14	7	58	85	14	91	**438**	**438**	317	8	299	18	16	62	380	37	103	**1240**	**923**
20	2033	270	4	119	4	8	4	270	22	11	**711**	**441**	55	1	24	1	2	1	55	4	2	**144**	**89**	0	4	181	15	7	63	92	15	91	**467**	**467**	325	8	323	20	17	67	417	41	104	**1323**	**998**

A09-2 Traffic , by VehicleType : Normal, Generated, Induced and Total, 2014-2033

Year		Normal											Genarated (estimate)											Induced											All Traffic										
		1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total
		MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC
1	2014	76	1	24	1	1	1	16	1	1	**122**	**46**	0	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	0	**0**	**0**	76	1	24	1	1	1	16	1	1	**122**	**46**
2	2015	84	1	26	1	1	1	19	1	1	**135**	**52**	0	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	0	**0**	**0**	84	1	26	1	1	1	19	1	1	**135**	**52**
3	2016	92	1	28	1	1	1	23	1	1	**150**	**58**	21	0	6	0	0	0	5	0	0	**34**	**13**	0	0	0	0	0	0	0	0	0	**0**	**0**	113	1	34	1	1	1	28	2	2	**185**	**72**
4	2017	101	1	30	1	1	1	28	2	2	**167**	**66**	23	0	7	0	0	0	6	0	0	**39**	**15**	0	1	49	4	2	17	25	4	91	**193**	**193**	125	3	86	6	4	19	59	6	93	**399**	**274**
5	2018	111	1	32	1	1	1	33	2	2	**186**	**75**	26	0	7	0	0	0	8	0	0	**43**	**17**	0	1	53	4	2	18	27	4	91	**202**	**202**	137	3	93	6	4	20	68	7	94	**431**	**294**
6	2019	120	1	34	1	1	1	38	2	2	**203**	**83**	28	0	8	0	0	0	9	1	1	**48**	**20**	0	1	58	5	2	20	29	5	91	**211**	**211**	148	3	100	6	4	22	77	8	94	**462**	**314**
7	2020	129	2	37	2	2	2	44	3	3	**221**	**93**	31	0	9	0	0	0	10	1	1	**53**	**22**	0	1	63	5	3	22	32	5	91	**221**	**221**	159	3	108	7	4	24	86	9	94	**495**	**336**
8	2021	138	2	40	2	2	2	50	3	3	**241**	**103**	33	0	10	0	0	0	12	1	1	**58**	**25**	0	1	68	6	3	24	35	6	91	**232**	**232**	171	3	117	8	5	26	97	9	95	**532**	**360**
9	2022	149	2	43	2	2	2	58	4	4	**264**	**115**	36	0	10	0	0	0	14	1	1	**64**	**28**	0	2	74	6	3	26	38	6	91	**244**	**244**	185	4	127	8	5	28	110	11	96	**572**	**388**
10	2023	160	2	46	2	2	2	67	4	4	**289**	**129**	39	0	11	0	0	0	16	1	1	**71**	**32**	0	2	80	7	3	28	41	7	91	**257**	**257**	199	4	137	9	6	30	124	12	96	**617**	**418**
11	2024	168	2	49	2	2	2	73	5	5	**308**	**140**	41	1	12	1	1	1	18	1	1	**76**	**35**	0	2	87	7	4	30	44	7	91	**272**	**272**	209	4	148	10	6	33	136	13	97	**656**	**446**
12	2025	176	2	53	2	2	2	81	5	5	**329**	**153**	44	1	13	1	1	1	20	1	1	**82**	**38**	0	2	94	8	4	33	48	8	91	**287**	**287**	220	5	161	10	7	35	149	14	97	**698**	**478**
13	2026	185	2	57	2	2	2	89	6	6	**352**	**167**	46	1	14	1	1	1	22	1	1	**88**	**42**	0	2	102	8	4	35	52	8	91	**304**	**304**	231	5	174	11	7	38	163	15	98	**743**	**512**
14	2027	194	3	61	3	3	3	98	6	6	**376**	**182**	49	1	16	1	1	1	25	2	2	**95**	**46**	0	2	111	9	5	38	57	9	91	**322**	**322**	243	5	188	12	8	42	179	17	99	**792**	**549**
15	2028	204	3	66	3	3	3	107	7	7	**402**	**198**	52	1	17	1	1	1	27	2	2	**102**	**50**	0	2	120	10	5	42	61	10	91	**341**	**341**	256	6	203	13	8	45	196	18	99	**845**	**590**
16	2029	209	3	71	3	3	3	118	7	7	**425**	**216**	54	1	18	1	1	1	30	2	2	**109**	**55**	0	3	130	11	5	45	67	11	91	**362**	**362**	263	6	220	14	9	49	215	20	100	**897**	**634**
17	2030	214	3	76	3	3	3	130	8	8	**450**	**235**	56	1	20	1	1	1	34	2	2	**117**	**61**	0	3	142	12	6	49	72	12	91	**386**	**386**	270	7	238	16	10	53	236	22	101	**952**	**682**
18	2031	220	3	82	3	3	3	143	9	9	**476**	**257**	58	1	22	1	1	1	38	2	2	**125**	**67**	0	3	154	13	6	53	78	13	91	**411**	**411**	277	7	257	17	11	58	259	24	102	**1012**	**735**
19	2032	225	4	88	4	4	4	157	10	10	**505**	**280**	60	1	23	1	1	1	42	3	3	**134**	**74**	0	3	167	14	7	58	85	14	91	**438**	**438**	285	8	278	18	11	62	284	26	103	**1077**	**792**
20	2033	231	4	95	4	4	4	173	11	11	**536**	**305**	62	1	25	1	1	1	47	3	3	**144**	**82**	0	4	181	15	7	63	92	15	91	**467**	**467**	293	9	301	20	12	68	312	28	105	**1147**	**855**

A09-03 Traffic , by VehicleType : Normal, Generated, Induced and Total, 2014-2033

	Year	Normal											Genarated (estimate)											Induced											All Traffic										
		1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total
		MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC
1	2014	54	1	17	1	1	1	10	1	1	**87**	**33**	0	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	0	**0**	**0**	54	1	17	1	1	1	10	1	1	**87**	**33**
2	2015	59	1	18	1	1	1	12	1	1	**96**	**37**	0	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	0	**0**	**0**	59	1	18	1	1	1	12	1	1	**96**	**37**
3	2016	65	1	20	1	1	1	14	1	1	**107**	**42**	21	0	6	0	0	0	5	0	0	**34**	**13**	0	0	0	0	0	0	0	0	0	**0**	**0**	86	2	26	2	2	2	19	2	2	**141**	**55**
4	2017	72	1	21	1	1	1	17	2	2	**119**	**47**	23	0	7	0	0	0	6	1	1	**39**	**15**	0	1	49	4	2	17	25	4	91	**193**	**193**	95	3	77	6	4	19	48	6	93	**350**	**255**
5	2018	79	1	23	1	1	1	21	2	2	**132**	**53**	26	0	7	0	0	0	7	1	1	**43**	**17**	0	1	53	4	2	18	27	4	91	**202**	**202**	105	3	83	6	4	20	55	7	94	**377**	**272**
6	2019	85	1	24	1	1	1	24	2	2	**144**	**59**	28	0	8	0	0	0	8	1	1	**48**	**20**	0	1	58	5	2	20	29	5	91	**211**	**211**	113	3	90	7	4	22	61	8	94	**403**	**289**
7	2020	91	2	26	2	2	2	27	3	3	**157**	**65**	31	1	9	1	1	1	9	1	1	**53**	**22**	0	1	63	5	3	22	32	5	91	**221**	**221**	122	3	98	7	5	24	69	9	95	**431**	**309**
8	2021	98	2	28	2	2	2	32	3	3	**171**	**73**	33	1	10	1	1	1	11	1	1	**58**	**25**	0	1	68	6	3	24	35	6	91	**232**	**232**	132	4	106	8	5	26	77	10	95	**461**	**330**
9	2022	106	2	30	2	2	2	36	4	4	**187**	**81**	36	1	10	1	1	1	12	1	1	**64**	**28**	0	2	74	6	3	26	38	6	91	**244**	**244**	142	4	114	8	5	28	86	11	96	**495**	**353**
10	2023	114	2	33	2	2	2	42	4	4	**204**	**90**	39	1	11	1	1	1	14	1	1	**71**	**31**	0	2	80	7	3	28	41	7	91	**257**	**257**	153	4	124	9	6	30	97	12	97	**532**	**379**
11	2024	119	2	35	2	2	2	46	5	5	**218**	**98**	42	1	12	1	1	1	16	2	2	**76**	**34**	0	2	87	7	4	30	44	7	91	**272**	**272**	161	5	134	10	6	33	106	13	97	**565**	**404**
12	2025	125	2	38	2	2	2	50	5	5	**232**	**107**	44	1	13	1	1	1	18	2	2	**82**	**38**	0	2	94	8	4	33	48	8	91	**287**	**287**	169	5	145	11	7	36	116	15	98	**601**	**432**
13	2026	131	2	40	2	2	2	56	6	6	**248**	**117**	47	1	14	1	1	1	20	2	2	**88**	**41**	0	2	102	8	4	35	52	8	91	**304**	**304**	178	5	157	12	7	39	127	16	99	**640**	**462**
14	2027	138	3	44	3	3	3	61	6	6	**265**	**127**	49	1	16	1	1	1	22	2	2	**95**	**45**	0	2	111	9	5	38	57	9	91	**322**	**322**	187	6	170	13	8	42	139	17	99	**681**	**494**
15	2028	145	3	47	3	3	3	67	7	7	**283**	**138**	52	1	17	1	1	1	24	2	2	**102**	**50**	0	2	120	10	5	42	61	10	91	**341**	**341**	197	6	184	14	9	45	153	19	100	**727**	**530**
16	2029	148	3	50	3	3	3	74	7	7	**299**	**151**	54	1	18	1	1	1	27	3	3	**109**	**55**	0	3	130	11	5	45	67	11	91	**362**	**362**	203	7	199	15	9	49	167	21	101	**771**	**568**
17	2030	152	3	54	3	3	3	81	8	8	**317**	**164**	56	1	20	1	1	1	30	3	3	**117**	**61**	0	3	142	12	6	49	72	12	91	**386**	**386**	208	7	216	16	10	53	183	23	102	**819**	**611**
18	2031	156	3	58	3	3	3	89	9	9	**335**	**179**	58	1	22	1	1	1	33	3	3	**125**	**67**	0	3	154	13	6	53	78	13	91	**411**	**411**	214	8	233	17	11	58	201	25	103	**871**	**657**
19	2032	160	4	62	4	4	4	98	10	10	**355**	**195**	60	1	24	1	1	1	37	4	4	**134**	**74**	0	3	167	14	7	58	85	14	91	**438**	**438**	220	8	253	19	12	63	221	27	105	**927**	**707**
20	2033	164	4	67	4	4	4	108	11	11	**377**	**213**	63	2	26	2	2	2	41	4	4	**144**	**81**	0	4	181	15	7	63	92	15	91	**467**	**467**	227	9	274	20	13	68	242	30	106	**988**	**761**

A09-04 Traffic , by VehicleType : Normal, Generated, Induced and Total, 2014-2033

	Year	Normal											Genarated (estimate)											Induced											All Traffic										
		1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total
		MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC
1	2014	54	1	17	1	1	1	10	1	1	**87**	**33**	0	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	0	**0**	**0**	54	1	17	1	1	1	10	1	1	**87**	**33**
2	2015	59	1	18	1	1	1	12	1	1	**96**	**37**	0	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	0	**0**	**0**	59	1	18	1	1	1	12	1	1	**96**	**37**
3	2016	65	1	20	1	1	1	14	1	1	**107**	**42**	21	0	6	0	0	0	5	0	0	**34**	**13**	0	0	0	0	0	0	0	0	0	**0**	**0**	86	2	26	2	2	2	19	2	2	**141**	**55**
4	2017	72	1	21	1	1	1	17	2	2	**119**	**47**	23	0	7	0	0	0	6	1	1	**39**	**15**	0	1	49	4	2	17	25	4	91	**193**	**193**	95	3	77	6	4	19	48	6	93	**350**	**255**
5	2018	79	1	23	1	1	1	21	2	2	**132**	**53**	26	0	7	0	0	0	7	1	1	**43**	**17**	0	1	53	4	2	18	27	4	91	**202**	**202**	105	3	83	6	4	20	55	7	94	**377**	**272**
6	2019	85	1	24	1	1	1	24	2	2	**144**	**59**	28	0	8	0	0	0	8	1	1	**48**	**20**	0	1	58	5	2	20	29	5	91	**211**	**211**	113	3	90	7	4	22	61	8	94	**403**	**289**
7	2020	91	2	26	2	2	2	27	3	3	**157**	**65**	31	1	9	1	1	1	9	1	1	**53**	**22**	0	1	63	5	3	22	32	5	91	**221**	**221**	122	3	98	7	5	24	69	9	95	**431**	**309**
8	2021	98	2	28	2	2	2	32	3	3	**171**	**73**	33	1	10	1	1	1	11	1	1	**58**	**25**	0	1	68	6	3	24	35	6	91	**232**	**232**	132	4	106	8	5	26	77	10	95	**461**	**330**
9	2022	106	2	30	2	2	2	36	4	4	**187**	**81**	36	1	10	1	1	1	12	1	1	**64**	**28**	0	2	74	6	3	26	38	6	91	**244**	**244**	142	4	114	8	5	28	86	11	96	**495**	**353**
10	2023	114	2	33	2	2	2	42	4	4	**204**	**90**	39	1	11	1	1	1	14	1	1	**71**	**31**	0	2	80	7	3	28	41	7	91	**257**	**257**	153	4	124	9	6	30	97	12	97	**532**	**379**
11	2024	119	2	35	2	2	2	46	5	5	**218**	**98**	42	1	12	1	1	1	16	2	2	**76**	**34**	0	2	87	7	4	30	44	7	91	**272**	**272**	161	5	134	10	6	33	106	13	97	**565**	**404**
12	2025	125	2	38	2	2	2	50	5	5	**232**	**107**	44	1	13	1	1	1	18	2	2	**82**	**38**	0	2	94	8	4	33	48	8	91	**287**	**287**	169	5	145	11	7	36	116	15	98	**601**	**432**
13	2026	131	2	40	2	2	2	56	6	6	**248**	**117**	47	1	14	1	1	1	20	2	2	**88**	**41**	0	2	102	8	4	35	52	8	91	**304**	**304**	178	5	157	12	7	39	127	16	99	**640**	**462**
14	2027	138	3	44	3	3	3	61	6	6	**265**	**127**	49	1	16	1	1	1	22	2	2	**95**	**45**	0	2	111	9	5	38	57	9	91	**322**	**322**	187	6	170	13	8	42	139	17	99	**681**	**494**
15	2028	145	3	47	3	3	3	67	7	7	**283**	**138**	52	1	17	1	1	1	24	2	2	**102**	**50**	0	2	120	10	5	42	61	10	91	**341**	**341**	197	6	184	14	9	45	153	19	100	**727**	**530**
16	2029	148	3	50	3	3	3	74	7	7	**299**	**151**	54	1	18	1	1	1	27	3	3	**109**	**55**	0	3	130	11	5	45	67	11	91	**362**	**362**	203	7	199	15	9	49	167	21	101	**771**	**568**
17	2030	152	3	54	3	3	3	81	8	8	**317**	**164**	56	1	20	1	1	1	30	3	3	**117**	**61**	0	3	142	12	6	49	72	12	91	**386**	**386**	208	7	216	16	10	53	183	23	102	**819**	**611**
18	2031	156	3	58	3	3	3	89	9	9	**335**	**179**	58	1	22	1	1	1	33	3	3	**125**	**67**	0	3	154	13	6	53	78	13	91	**411**	**411**	214	8	233	17	11	58	201	25	103	**871**	**657**
19	2032	160	4	62	4	4	4	98	10	10	**355**	**195**	60	1	24	1	1	1	37	4	4	**134**	**74**	0	3	167	14	7	58	85	14	91	**438**	**438**	220	8	253	19	12	63	221	27	105	**927**	**707**
20	2033	164	4	67	4	4	4	108	11	11	**377**	**213**	63	2	26	2	2	2	41	4	4	**144**	**81**	0	4	181	15	7	63	92	15	91	**467**	**467**	227	9	274	20	13	68	242	30	106	**988**	**761**

C-15 Traffic , by VehicleType : Normal, Generated, Induced and Total, 2014-2033

Year		Normal											Genarated (estimate)											Induced											All Traffic										
		1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total	1	2	3	4	5	6	7	8	9	Total	Total
		MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC	MC	Car	Jeep 4WD	Picup Van	Smal Bus	Md/Lg Bus>20	light Truck	Med Truck	Lg Truck	Inc MC	Exc MC
1	2014	54	1	1	1	1	1	13	1	1	**74**	**20**	0	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	0	**0**		54	1	1	1	1	1	13	1	1	**74**	**20**
2	2015	59	1	1	1	1	1	16	1	1	**83**	**23**	0	0	0	0	0	0	0	0	0	**0**	**0**	0	0	0	0	0	0	0	0	0	**0**		59	1	1	1	1	1	16	1	1	**83**	**23**
3	2016	65	1	1	1	1	1	19	1	1	**93**	**27**	24	0	0	0	0	0	7	1	1	**34**	**10**	0	0	0	0	0	0	0	0	0	**0**		90	2	2	2	2	2	26	2	2	**127**	**38**
4	2017	72	1	1	1	1	1	22	2	2	**104**	**32**	27	0	0	0	0	0	8	1	1	**39**	**12**	0	0	0	0	0	0	0	0	0	**0**		99	2	2	2	2	2	31	2	2	**143**	**44**
5	2018	79	1	1	1	1	1	27	2	2	**117**	**38**	29	0	0	0	0	0	10	1	1	**43**	**14**	0	0	0	0	0	0	0	0	0	**0**		108	2	2	2	2	2	37	3	3	**160**	**52**
6	2019	85	1	1	1	1	1	31	2	2	**128**	**43**	32	1	1	1	1	1	12	1	1	**48**	**16**	0	0	0	0	0	0	0	0	0	**0**		117	2	2	2	2	2	43	3	3	**176**	**59**
7	2020	91	2	2	2	2	2	36	3	3	**140**	**49**	34	1	1	1	1	1	13	1	1	**53**	**18**	0	0	0	0	0	0	0	0	0	**0**		126	2	2	2	2	2	49	4	4	**193**	**67**
8	2021	98	2	2	2	2	2	41	3	3	**154**	**56**	37	1	1	1	1	1	15	1	1	**58**	**21**	0	0	0	0	0	0	0	0	0	**0**		135	2	2	2	2	2	56	4	4	**212**	**77**
9	2022	106	2	2	2	2	2	47	4	4	**169**	**63**	40	1	1	1	1	1	18	1	1	**64**	**24**	0	0	0	0	0	0	0	0	0	**0**		146	2	2	2	2	2	65	5	5	**233**	**87**
10	2023	114	2	2	2	2	2	54	4	4	**186**	**72**	43	1	1	1	1	1	21	2	2	**71**	**27**	0	0	0	0	0	0	0	0	0	**0**		157	3	3	3	3	3	75	6	6	**256**	**100**
11	2024	119	2	2	2	2	2	60	5	5	**198**	**79**	46	1	1	1	1	1	23	2	2	**76**	**30**	0	0	0	0	0	0	0	0	0	**0**		165	3	3	3	3	3	82	6	6	**274**	**109**
12	2025	125	2	2	2	2	2	66	5	5	**212**	**87**	48	1	1	1	1	1	25	2	2	**82**	**33**	0	0	0	0	0	0	0	0	0	**0**		173	3	3	3	3	3	91	7	7	**294**	**120**
13	2026	131	2	2	2	2	2	72	6	6	**227**	**95**	51	1	1	1	1	1	28	2	2	**88**	**37**	0	0	0	0	0	0	0	0	0	**0**		182	3	3	3	3	3	100	8	8	**315**	**132**
14	2027	138	3	3	3	3	3	79	6	6	**242**	**104**	54	1	1	1	1	1	31	2	2	**95**	**41**	0	0	0	0	0	0	0	0	0	**0**		192	4	4	4	4	4	110	8	8	**337**	**145**
15	2028	145	3	3	3	3	3	87	7	7	**259**	**115**	57	1	1	1	1	1	34	3	3	**102**	**45**	0	0	0	0	0	0	0	0	0	**0**		202	4	4	4	4	4	122	9	9	**362**	**160**
16	2029	148	3	3	3	3	3	96	7	7	**274**	**126**	59	1	1	1	1	1	38	3	3	**109**	**50**	0	0	0	0	0	0	0	0	0	**0**		208	4	4	4	4	4	134	10	10	**383**	**176**
17	2030	152	3	3	3	3	3	106	8	8	**290**	**138**	61	1	1	1	1	1	43	3	3	**117**	**56**	0	0	0	0	0	0	0	0	0	**0**		214	4	4	4	4	4	148	11	11	**407**	**193**
18	2031	156	3	3	3	3	3	116	9	9	**307**	**151**	64	1	1	1	1	1	47	4	4	**125**	**62**	0	0	0	0	0	0	0	0	0	**0**		220	5	5	5	5	5	164	13	13	**432**	**213**
19	2032	160	4	4	4	4	4	128	10	10	**326**	**166**	66	2	2	2	2	2	53	4	4	**134**	**68**	0	0	0	0	0	0	0	0	0	**0**		226	5	5	5	5	5	181	14	14	**460**	**234**
20	2033	164	4	4	4	4	4	141	11	11	**346**	**182**	68	2	2	2	2	2	59	5	5	**144**	**76**	0	0	0	0	0	0	0	0	0	**0**		232	6	6	6	6	6	199	15	15	**490**	**258**

CHAPTER 11: ECONOMIC EVALUATION

11.1 Introduction

The economic analysis reported here, utilizes the "Roads Economic Decision Model" (RED) computer program developed by the World Bank. RED is a derivative of the Highway Development and Management Model (HDM-4), using some simplified procedures applicable for low volume roads. The Vehicle Operating Cost (VOC) in RED (for three terrain and three road types) are derived from and computed by an HDM-4 VOC module, using HDM-4 equations and procedures. Subsequently, these data are input into an economic evaluation module (Maim/Program) which executes the economic analyses.

Most of the input for this RED model analysis, reported here, is derived from the Road Engineering Surveys, Analysis and Assessment, reported in Chapter 4; and from Transport/Traffic Surveys, Analysis and Assessment, reported in Chapter 10.

Other inputs to RED, such as vehicle characteristics, cost and utilization (by vehicle type), as well as vehicle occupancy and Value of Time (VOT) for work and leisure, were prepared by the Consultant, mainly as a 2013 update to 2009 values reported in TA 7100.

The basic unit of analysis, in RED, is the Road Link. Five road links were analyzes:

- A09-01 (22.8 km)
- A09-02 (11.5 km)
- A09-03 (33.5 km)
- A09-04 (11.7 km)
- C-15 (10.3 km)

They were later combined into various aggregated road sections, using distance (km) as a base for estimating weighted average values.

Note, road characteristics may vary over each link (particularly when the link is long and runs over none-uniform terrain). Nevertheless the Road Link remains the basic unit of analysis, and uses average values to describe its characteristics (say IRI) and estimated costs. Estimated costs, for construction and for maintenance, are given in 1000s US$ per-km.

The economic analysis is based on analyzing streams of cost and benefits over a 20 year period, "without" and "with" project, discounted at interest rate of 12%.

The economic analysis is based on three proposed scenarios “with “project (described below). The analysis evaluates each of the three alternative scenarios “with” project against the “without” project scenario. The following sections describe the attributes and estimated costs of each of the scenarios.

Assessment of each road link (basic analytical unit in RED) is largely based on the economic indices of Internal Rate of Return (IRR), Net Present Value (NPV), Financial Cost of Investment, and PV Agency Economic Cost.

11.2 Analytical Scenarios/Alternatives

The economic analysis evaluates three alternative Scenarios/Treatments for each of the five road links in the Study Area, against “without Project” Scenario 0, as follows:

- Scenario 0 - Essential Maintenance" ("Without 0")
- Scenario 1 - Rehab & Reconstruct 4.5m TST Surface (“With 1”)
- Scenario 2 - Reconstruct 4.5m TST Surface (“With 2”)
- Scenario 3 - Reconstruct 6.0m Asphalt-Concrete Surface (“With 3”)

The alternatives are listed in terms of increasing quality and cost per km: “Scenario 0” provides the lowest level of service at the lowest cost per- km, and “Scenario 3” provides the highest quality and highest cost per- km.

Whereas “Scenario 0” leaves the road just “passable,” “Scenario 3” is the quality road desired by the GoTL. “Scenario 2” and “Scenario 3” were added by the Consultant, to assess feasibility of narrower and less costly surfaced road, in lieu of the existing (and projected) low traffic and low axle load.

Detailed description of each alternative is provided in Chapter 4 "Engineering” above. This section provides a summary description of each scenario

11.2.1 Essential Maintenance ("Without 0")

This scenario means continue the existing maintenance program and practice as it had ought to have been. Provide proper maintenance to the road according to defined guidelines and expected professional judgment. Because most length of the five road sections on the Manatuto-Natarbora road have not received (and do not receive) proper maintenance for many years (due to lack of resources and other reasons), this scenario implies in practice, a significant increase in maintenance cost, compared to current expenditure. The significant maintenance budget is needed allow the road to be "passable," including (but not limited to) maintenance work to fill the endless pot-holes, maintain and clear drainage, and prevent further deterioration of the road's foundations and surface.
Note, sometimes this scenario is designated as "Do Nothing," however in fact it means "Do Something".

11.2.2 Reconstruct & Rehab 4.5m TST Surface ("With 1")

The basic concept of this Scenario is either complete reconstruction, when a sector of a road has fallen into a complete state of disrepair; or repair and overly of a paved road which is in a reasonable conditions, but which could provide better service (lower roughness) if improved and resealed.
In both cases the resulting upgraded road is 4.5 meter (m) wide surfaced carriageway, with 1.0 m shoulder on each side. The entire road is surfaced with about 30 mm Triple Surface Treatment (TST).
This Scenario is similar to the following Scenario 2, "Reconstruct 4.5 m TST Surface". However, to save costs it takes advantage of the fact that some portions (not all) of the road links in the flat areas, near the northern or southern coasts, are still in reasonable conditions; and thus can be rehabilitated, rather than reconstructed entirely.
The specific portions which will be rehabilitated are:

- A09-1b, a 6.0 km section, from km 82.0 to km 88.0 (the other 16.8 km of A09-01 will be reconstructed).
- A09-4b, a 4.2 km section, from km 140.5 to km 144.7 (the other 7.5 km will be reconstructed).

All other links (and sub-links) of the Manatuto-Natarbora road will be reconstructed.

11.2.3 Reconstruct 4.5m TST Surface ("With 2")

This Scenario envisions complete reconstruction (only; no rehabilitation) of all five links of the Manatuto-Natarbora road, to bring all of them into a new common state of reconstruction, from sub-surface to surface. This is because most of the links' sectors are in a state of disrepair.
This Scenario plans a 4.5 m surfaced carriageway, with 1.0 m shoulder on each side of the road. The entire road is surfaced with about 30 mm Triple Surface Treatment (TST).
This scenario, provides a less expensive solution (compared to Scenario 3) for a rebuilt surfaced road between Manatuto and Natarbora, given the existing and the expected low traffic volumes and low axle loads.

11.2.4 Reconstruct 6.0m Asphalt-Concrete Surface ("With 3")

This scenario is the GoTL "wish list". This Scenario envisions complete reconstruction (only; no rehabilitation) of the entire Manatuto-Natarbora road (including the Laclubar braanch) into a 6.0 m wide, asphalt-concrete carriageway, with 1.0 m shoulder on each side of the road. The entire road is surfaced with 50 mm of Asphalt-Concrete.
However, in order to save on cost (in the short run), some existing 4.5 m wide bridges, which are in good conditions; as well as critical mountainous sites which require significant investment to widen them into 6.0 m, are retained "as is" (4.5 m).
Nevertheless, the road will adhere to international design standards, and will be able, among others, to handle, comfortably, trucks with one TEU.

11.3 Road Characteristics & Cost Estimates of Alternative Scenarios

11.3.1 General

Table 11.1 shows engineering characteristics and cost estimates (in 1000s US$) per-km, for construction and for maintenance, for each road-link, as required by RED.
The values for RED for links A09-1 and A09-4, is a weighted average for the entire link, based on the relative length of each sub-section.
Table 11.1 is divided into three parts:

A. Road characteristics, and estimates for reconstruction (and/or rehabilitation), and annual maintenance costs, per-km (input to RED costs)
B. Estimated Costs of road construction per-km, divided among:
    - Road works per-km
    - Bridges and special culvert works per-km
    - Total prer-km (sum of the two parts above)
C. Total estimates for reconstruction (and/or rehabilitation), and annual maintenance costs, per road-link and per total Project

Total road costs are divided because "bridges and special culvert works" are expected to last more than 20 years, and are counted also as residual benefits (in year 20).

11.3.2 Road width and Shoulders

For the most parts, existing road width is 4.5 m, with shoulders of 0.5 m. In Laclubar branch the road width is 3.5 m , and shoulders of 0.5 m.
For Scenario 1 and 2 (Reconstruct and/or Rehab 4.5 m TST Surface), the proposed road width "with" project is 4.5 m, with shoulders of 1.0 m on each side.
For Scenario 3 (Reconstruct 6.0 m asphalt-concrete), the proposed road width "with" project is 6.0 m, with shoulders of 1.0 m on each side.

11.3.3 Road Roughness

Existing International Roughness Index (IRI) is an average for each link, derived from machine-survey, conducted in early February 2013. Existing IRI varies between 10.8 on A09-01 to 22.3 on A09-4, to 22.0 and over on the other links.
Projected road roughness "without" project (but with doing some "essential maintenance" to make it "passable"), is projected to be 85% of the existing IRI (somewhat, but not significantly better). It varies between 10.8 on A09-01, to 22.3 or more on all the other links[*1].
Projected road roughness "with" project, is based on best estimates by the Consultant. It varies between 3.5 scenarios 1 and 2, and 2.5 in scenario 3.

11.3.4 Annual Maintenance Costs Per Km

Annual Maintenance costs, "without" and "with" project, are based on estimated cost in 2009, reported in TA 7100, and inflated here to 2013. Note, in TA 7100 these cost vary according to the Geo-Technical Stability Zone, and to maintenance type –"essential maintenance" ("without" project), or normal maintenance ('with" project) [*2].
For "without" project (Scenario 0), average annual maintenance cost per-km, varies between US$ 11,541 on link A09-01, to US$ 23,730 in link C-15.
For "with" project (Scenarios 1-3), average annual maintenance cost per-km, varies between US$ 4,200 and US$ 5,140, on all links.

[*1] RED does not allow IRI over 25.0, even though some of the existing measures show IRI values over 30.0.
[*2] See: ADB TA 7100 Final Report, Chapter 4, Engineering; Table 4-6 Normal Maintenance Unit Costs; Table 4-7 Essential Maintenance Unit Costs.

The significantly higher cost for "without" project (Scenario 0), reflect the costs as as they had ought to have been to keep the road "passable" at its present poor conditions.

11.3.5 Road Works Costs Per KM

Road woks, "with" project, are the sum of road works, excluding bridges and special culverts, estimated by the Project Engineers for each "with" scenario.
They vary, in each road-link, across "with" scenarios; largely as a function of the road width (4.5 m or 6 m and surface material); and in A09-1 and A09-4 between Rehabilitation and Reconstruction.
The average road works (only) per-km varies between about US$ 390,000 (just rehabilitation of 4.5 m STS surfaced road) to over US$ 800,000 (reconstruct A09-2 and A09-3, as well as Laclobar branch to 6.0 m asphalt- concrete.

11.3.6 Bridges and Special Culverts Costs Per Km

Road woks, "with" project, are the sum of bridges and special culverts, excluding road works (above), estimated by the Project Engineers for each "with" scenario.
They vary, in each road-link, across "with" scenarios; largely as a function of: (i) the road width -- 4.5 m in scenario 1 & 2, or 6.0 min scenario 3; and (ii) the terrain -- significantly more structures (cost per-km) are needed in the steep mountainous links A09-2 and A09-03.
It should be noted that retaining the 4.5 m. road width (scenarios 1 & 2) implies significant saving on bridge work, compared to scenario 3, which designs a 6.0 wide road, as well as 6.0 m wide new bridges (where a 4.5m. wide bridge exits now) [*3].
Thus for example, under scenario 3 (6m, Asphalt-concrete) sub-link A09-2 requires construction of a new 6.0 m wide bridge, costing about US$ 225,000. In contrast, scenarios 1 & 2 (4.5m, TST) construct a 4.5 m bridge, and reducing the cost to about US$ 175,000.

11.3.7 Total Construction Costs Per KM

Total construction costs are the sum of Road Works and Bridges and special culverts, discussed above. These estimated cost, shown below, are quite high, running between about US$ 0.5 million and over US$1.0 million per km.
Total construction cost per-km (in US$) are approximately:

- Link A09-01: 445,000 (scenario 1), 525,000 (scenario 2), and 715,000 (scenario 3).
- Link A09-02: 715,000 (scenario 1 & 2), and 985,000 (scenario 3).
- Link A09-03: 675,000 (scenario 1 & 2), and 930,000 (scenario 3).
- Link A09-04: 405,000 (scenario 1), 510,000 (scenario 2), and 710,000 (scenario 3).
- Link C-15: 635,000 (scenario 1 & 2), and 875,000 (scenario 3).

11.3.8 Total Costs Per Link, and for the Entire Project

Table 11.1-C shows the total cost per link and for the entire project, by scenario. It shows total construction cost (in year 1 and 2), and annual maintenance cost during each of the 20 years of the project. The totals are derived from multiplication of the estimated cost per-km by the corresponding road length (in km).
The list below shows summary for the entire project, by scenario. For specific costs per link, consult the table, part C.
Total construction costs (road works and bridges) for the entire project (89.8 km) are:

- Scenario 1: about US$ 52.3 million
- Scenario 2: about US$ 55.4 million
- Scenario 3: about US$ 76.2 million

[*3] In the short-run, in some cases, as a short-run cost saving measure, 4.5 m bridges in good condition, are not replaced by 6.0 m bridges

Scenario 1 and 2 cost about US$ 55.0 million, while Scenario 3 about US$ 75.0 million. The difference of about US$ 20.0 million is attributed to wider road-way (6.0 m vs 4.5m), additional bridge/culvert work, and more expensive pavement (TST vs. asphalt-concrete)

Total annual maintenance costs for the entire project (89.8 km) are:

- Scenario 0: about US$ 1.50 million per annum
- Scenario 1: about US$ 0.43 million per annum
- Scenario 2: about US$ 0.42 million per annum
- Scenario 3: about US$ 0.37 million per annum

Scenario 1 ("without project) requires about US$ 1.5 per annum to keep the road "passable", still under harsh conditions (IRRs only slightly better that the existing ones).

In contrast, the other Scenarios ("with" Project) require only about US$ 0.40 per annum (less than a third of Scenario 1), to maintain a reconstructed, high-quality, well surfaced road.

Table 11.1-A Engineering Input Data for Economic Analysis –Road Characteristics & Costs Per Km (1000$)

Road Name			Manatuto - Natarbora								Jct Laclubar - Laclubar	
Road ID No.			A09								C15	
Road Section Name			Manatuto to Cribas			Cribas to Jct Laclubar	Jct Laclubar to Mane Hat	Mane Hat to Natarbora			Jct Laclubar to Laclubar	Total
Road Section ID No			A09-1			A09-2	A09-3	A09-4			C15	A09 + C15
Road Sub-Section			A09-1a	A09-1b	Wt Avg.	-	-	A09-4a	A09-4b	Wt Avg.	-	
From (km)			65.2	82.0	65.2	88.0	99.5	133.0	140.5	133.0	0.0	
To (km)			82.0	88.0	88.0	99.5	133.0	140.5	144.7	144.7	10.3	
Length (km)			16.8	6.0	22.8	11.5	33.5	7.5	4.2	11.7	10.3	**89.8**
Rd Width (m)	Existing		4.5	4.5	4.5	3.5 to 4.0	3.0 to 3.5	4.5	4.5	4.5	3.0 to 3.5	
	Proposed	Alt 0	4.5	4.5	4.5	3.5 to 4	3 to 3.5	4.5	4.5	4.5	3 to 3.5	
		Alt 1	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		Alt 2	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
		Alt 3	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	
Shoulder Width (m)	Existing		0.5 to1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0 to 0.5	
	Proposed	Alt 0	0.5 to 1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0 to 0.5	
		Alt 1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
		Alt 2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
		Alt 3	1.0	1.0	1.0	0.5 to 1.0	0.5 to 1.0	1.0	1.0	1.0	0.5 to 1.0	
Road Roughness (IRI Value)	Existing		11.0	10.0	10.8	27.4	31.4	29.0	10.4	22.3	34.0	
	Post-work	Alt 0	9.4	8.5	9.2	23.3	26.7	24.7	8.8	19.0	28.9	
		Alt 1	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
		Alt 2	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
		Alt 3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
Road Works Cost/km (1000$)	Alt 0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Alt 1		528.80	199.06	442.03	714.01	677.67	515.37	208.41	405.18	633.91	
	Alt 2		528.80	512.73	524.57	714.01	677.67	515.37	502.97	510.92	633.91	
	Alt 3		719.13	705.17	715.45	982.89	931.20	716.66	701.78	711.32	876.29	
Annual Maint. Cost/km (1000$)	Alt 0 (Essential)		12.66	8.31	11.51	14.17	19.12	19.12	9.76	15.76	23.73	
	Alt 1 (Normal)		4.22	5.14	4.46	4.22	5.14	4.22	5.14	4.55	5.14	
	Alt 2 (Normal)		4.22	4.22	4.22	4.22	5.14	4.22	4.22	4.22	5.14	
	Alt 3 (Normal)		3.69	3.69	3.69	3.69	4.48	3.69	3.69	3.69	4.48	

Table 11.1-B Engineering Input Data for Economic Analysis – Road Works & Bridges/Culverts Costs Per Km (1000$)

Road Name		Manatuto - Natarbora								Jct Laclubar - Laclubar
Road ID No.		A09								C15
Road Section Name		Manatuto to Cribas			Cribas to Jct Laclubar	Jct Laclubar to Mane Hat	Mane Hat to Natarbora			Jct Laclubar to Laclubar
Road Section ID No		A09-1			A09-2	A09-3	A09-4			C15
Road Sub-Section		A09-1a	A09-1b	Wt Avg.	-	-	A09-4a	A09-4b	Wt Avg.	-
From (km)		65.2	82.0	65.2	88.0	99.5	133.0	140.5	133.0	0.0
To (km)		82.0	88.0	88.0	99.5	133.0	140.5	144.7	144.7	10.3
Length (km)		16.8	6.0	22.8	11.5	33.5	7.5	4.2	11.7	10.3
Road Works Cost/km (1000$)	Alt 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Alt 1	467.25	175.73	688.26	539.66	577.52	502.70	207.82	722.24	571.39
	Alt 2	467.25	466.06	1053.41	539.66	577.52	502.70	501.78	1032.78	571.39
	Alt 3	650.20	649.17	1466.63	755.94	813.35	701.46	700.35	1441.30	802.70
Bridge & Special Culvert Works Cost/km (1000$)	Alt 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Alt 1	61.55	23.33	90.89	174.35	100.15	12.67	0.60	13.30	62.52
	Alt 2	61.55	46.67	120.24	174.35	100.15	12.67	1.19	13.92	62.52
	Alt 3	68.93	56.00	139.36	226.96	117.85	15.20	1.43	16.71	73.59
Total Works Cost/km (1000$)	Alt 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Alt 1	528.80	199.06	779.15	714.01	677.67	515.37	208.41	735.53	633.91
	Alt 2	528.80	512.73	1173.65	714.01	677.67	515.37	502.97	1046.71	633.91
	Alt 3	719.13	705.17	1605.99	982.89	931.20	716.66	701.78	1458.01	876.29

Table 11.1-C Engineering Input Data for Economic Analysis – Total Construction and Maintenance Cost (1000$)

Road Name		Manatuto - Natarbora								Jct Laclubar - Laclubar	
Road ID No.		A09								C15	
Road Section Name		Manatuto to Cribas			Cribas to Jct Laclubar	Jct Laclubar to Mane Hat	Mane Hat to Natarbora			Jct Laclubar to Laclubar	Total
Road Section ID No		A09-1			A09-2	A09-3	A09-4			C15	A09 + C15
Road Sub-Section		A09-1a	A09-1b	Wt Avg.	-	-	A09-4a	A09-4b	Wt Avg.	-	
From (km)		65.2	82.0	65.2	88.0	99.5	133.0	140.5	133.0	0.0	
To (km)		82.0	88.0	88.0	99.5	133.0	140.5	144.7	144.7	10.3	
Length (km)		16.8	6.0	22.8	11.5	33.5	7.5	4.2	11.7	10.3	**89.8**
Total Works Cost (1000$)	Alt 0 (Essential)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Alt 1 (Normal)	8,883.87	1,194.37	17,764.72	8,211.09	22,702.07	3,865.27	875.32	8,605.73	6,529.31	**63,812.93**
	Alt 2 (Normal)	8,883.87	3,076.38	26,759.15	8,211.09	22,702.07	3,865.27	2,112.49	12,246.48	6,529.31	**76,448.10**
	Alt 3 (Normal)	12,081.36	4,230.99	36,616.64	11,303.28	31,195.15	5,374.92	2,947.49	17,058.76	9,025.80	**105,199.63**
Tot Annual Maint. Cost (1000$)	Alt 0 (Essential)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	Alt 1 (Normal)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	Alt 2 (Normal)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	Alt 3 (Normal)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**

11.4 Unit Costs and Operating Data, by Vehicle Type - Input to RED

Vehicle Types

The Consultants defined 9 types of vehicles as follows:

Code	Description	Number of Wheels	Number of Axles
1	Motorcycle	2	2
2	Car Medium	4	2
3	Four-Wheel Drive	4	2
4	Delivery Vehicle	4	2
5	Bus mini	4	2
6	Bus Medium	6	2
7	Truck Light	4	2
8	Truck Medium	6	2
9	Truck Heavy	10	3

Table 11.2 shows unit cost and operating data, by vehicle type, used as input to RED. The values shown here are updates of the 2009 data, reported by TA 7100 in 2009[*4].
The main update features include (but are not necessarily limited to):

- Retail (financial) purchase price of new vehicles. Retail costs were obtained from two dealerships (Indo Mobil, Indonesia; and Toyota, Dili, Timor Leste), and were averaged.
- Retail (financial) "pump" price of petrol and diesel, US$ 1.4 and 1.2, respectively.
- Average number of passengers per vehicles, from the 2013 Road Survey on A01-01, on 1 March 2013[*5].
- Updated cost of labor and Value of Time (VOT), marked in **, at the table. The 2009 prices were inflated to current prices, using the report CPI rates (by IMF).
- Economic prices of vehicles, tires. Import tax on vehicles and tires is 5%. Thus the economic price used as input to RED, is 95% of the financial cost.[*6]

[*4] As indicated before, the TL/ Transport Economic for this Feasibility Study, ADB Loan No. 2857-TIM, and for TA 8146-TIM were also the TL/Transport Economist for TA7100, and thus they updated their 2009 data.
[*5] For example, Light Truck has an average of 6.1 passengers; not only goods. Observation indicated that about ½ of the Light Trucks on Manatuto-Natarbora road, operate as buses. Thus this value seems to represent accurately the average number of passengers on Light Truck.
[*6] Note Table 11.2 shows the price of new vehicle, tires and fuel as financial and/or economic. For other items, unless otherwise mentioned, the price shown is economic.

Table 11.2 Unit Cost & Operating Data, for Representative Vehicles – Input to RED

Unit	*Motor Cycle*	Car/ Taxi	Jeep/ 4WD	Pick-up/ Van	Mini- Bus	Large- Bus	Light Truck	Med. Truck	Heavy Truck
Representative vehicle	***Honda Supra X***	***Toyota Corolla***	***Mitsubishi Pajero***	***Toyota Hilux***	***Dyna 12 seat***	***Dyna 23 seat***	***Dyna 4 tonnes***	***Mitsubishi Colt 135 PS***	***Mitsubishi Fuso 220PS***
Operating characteristsics									
Pass-Car Space Equivalent	0.5	1	1	1	1.4	1.5	1.3	1.4	1.6
No of wheels	2	4	4	4	4	6	4	6	10
No of axles	2	2	2	2	2	2	2	2	3
Tyre type	Bias-ply	Radial-ply	Radial-ply	Bias-ply	Radial-ply	Bias-ply	Radial-ply	Bias-ply	Bias-ply
Base no of retreads	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Retread cost (% of new tyre price)	15%	15%	15%	15%	15%	15%	15%	15%	15%
Annual km travel	12,000	30,000	35,000	35,000	60,000	60,000	35,000	50,000	50,000
Working hours per year	600	1,000	1,000	1,000	2,500	2,500	2,500	2,500	2,500
Average life (years)	10	12	12	10	10	10	8	12	14
Private use (%)[1]	100%	53%	32%	22%	0%	0%	0%	0%	0%
Average no of pass.[2]	1.3	3.9	3.7	3.4	10.9	26.5	6.1	2.8	2.5
Work-related pass trips[1]	49%	47%	68%	78%	80%	90%	80%	80%	80%
Equivalent Standard Axles	0	0.01	0.02	0.02	0.03	0.4	0.2	1.25	2.28
Operating weight (tonnes)	0.2	1.2	1.8	1.5	2.0	4.0	3.5	7.5	13.5
Financial & Economic Costs *									
New vehicle cost (US$) Financial	1,600	20,250	32,000	38,900	32,000	42,000	30,000	33,000	64,000
New vehicle cost (US$) Economic (x 0.95)	1,520	19,238	30,400	36,955	30,400	39,900	28,500	31,350	60,800
Replacement tyre (US$) Financial	25	52	140	140	115	128	128	128	315
Replacement tyre (US$) Economic (x 0.95)	24	49	133	133	109	122	122	122	299
Petrol/diesel cost (US$/litre) Financial	1.4	1.4	1.4	1.4	1.4	1.20	1.20	1.20	1.20
Petrol/diesel cost (US$/litre) Economic (X 0.	1.21	1.21	1.21	1.21	1.21	1.24	1.24	1.24	1.24
Lubricating oil (US$/litre) **	5.30	5.30	5.30	5.30	5.30	5.30	5.30	5.30	5.30
Maintenance labour (US$/hr)[3] *	6.50	27.00	33.00	20.00	20.00	20.00	20.00	27.00	34.00
Crew wages (US$/hr) **	0	0.65	1.30	1.05	0.65	2.70	1.05	1.30	2.40
Overheads (US$/year)[4]	50	100	100	100	200	200	200	200	200
Annual interest (%)[5]	6%	6%	6%	6%	6%	6%	6%	6%	6%
Passenger working time (US$/hr) [6] **	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Passenger non-working time (US$/hr)[7] **	0.32	0.3225	0.3225	0.3225	0.3225	0.3225	0.3225	0.3225	0.3225

Source: Consultants', Consultants' O/D Surveys, ADB TA 71000, *Year 2009*

Note: (1) source: O/D surveys.

(2) Derived from the Consultants' O/D Surveys - and assuming that 100% of drivers of motorcycles are "passengers" and 50%, 30% and 20% of drivers of private cars, jeeps/4WDs and pick-ups/vans etc are respectively the same - the term "passenger" is used here in the sense that these can be drivers if they are not professional/paid employees driving for others - for the latter three modes the percentages asumed are the percentage of leisure trips recorded in the O/D surveys.

(3) These data was artificially inflated to reflect the fact that RED/HDM assume that vehicles are brought into the country new. In fact, almost all imports are of vehicles which are five or more years old and which have annual maintenance costs that much higher than associated with vehicles that would be brought in new. A similar approach was used by the Consultants to TA 7100, TA 3731 and other sources referred to.

(4) Not relevant in that, except in the case of generated traffic, this cost is equal in both the *"base (do nothing)"* and *"with project"* circumstances - assumed as a nominal US$ 50, 100 and 200 depending on vehicle size.

(5) Lending rates in Timor were at the time of publication 11% pa (Bank Mandiri); 14% pa (BNU) and 11% pa (ANZ)- deposit rates were less than 1% pa - loans can only be obtained for a proportion of the value and not frequently taken The appropriate interest is consequently that which is mid-way between that for lending and deposits.

(6) Population = 1,066,000, "non-oil" GDP= US$ 1,487 million, 53.9% of population in labour force (2010 census); 2000 working hours per year - hence value of working time = US$ 1.29/hour

(7) By convention, 25% of value of working time.

* Economic Cost, unless mentioned otherwise

** 2009 data inflated by CPI rates

11.5 Other Input to RED

11.5.1 Road Agency Economic Cost Factor

The Consultant used an Economic Cost Factor of 0.85, adopted from TA 7100, and before from TA 3731.

11.5.2 Terrain and Road Type

Terrain

The terrain type (RED allows three) was derived from the engineering assessment, as follows:

Code	Description	Rise & Fall (m/km)	Horizontal Curvature (deg/km)	*Number of Rises & Falls (#)*	*Super_ elevation (%)*
A	Flat	12	70	2	3
B	Hilly	35	225	2	3
C	Mountain	70	350	2	3

Road Type

The road type (RED allows three) was derived from the engineering assessment, as follows:

		Surface Type			*Speed*		
Code	Description	1-Bituminous 2-Concrete 3-Unsealed	Carriageway Width (m)	Speed Limit (km/hour)	*Limit Enforcement (#)*	*Roadside Friction (#)*	*NMT Friction (#)*
X	Gravel	3	4.5	50.0	1.1	1.2	1.0
Y	Paved Unsealed	3	4.5	50.0	1.1	1.2	1.0
Z	Paved Sealed	1	6.0	50.0	1.1	1.2	1.0

Note, the actual width of the road varies between 3.5 and 5.5 meters. As input we used an average value of 5.0 m. This is after testing the effects of various road widths; we show insignificant variation in VOC.

11.5.3 Note: Insignificant Impact Of Various Variables

Final note: the VOC computed by HDM-4 are mostly affected by the IRI. The RED manual indicates that:

> "The HDM-4 equations are not very sensitive to the following inputs: altitude, percent of time driven on snow, percent of time driven on water, paved roads texture depth, number of rise and falls, super-elevation, speed limit enforcement and roadside and NMT factors; therefore, you can use the supplied values if you don't have country specific values".

11.6 Traffic

11.6.1 Base-Line and Normal Traffic

The baseline traffic is updated traffic for 2013, by each of the nine vehicle type, on each of the five road links of the Manatuto-Natarbora road. The resulting AADT is shown in Table 11.3.
The 2013 traffic count provided a two-day actual count on each of these five links. This is in contrast to the 2009 count, which had actual count only on link A09-01. Traffic on the other four links, in 2009, was estimated, based on some national averages.
The most important finding is that the base line traffic on the Manatuto-Natarbora Study Area roads is very low; and moreover, even the low traffic is composed largely of motorcycles. In 2013 (and 2014) the non-motorcycle rate is only about 40% or less of the total traffic.
For example:

- Link A09-01: Total 148 AADT, of which only 59 (39.8%) are non-motorcycles
- Link A09-02: Total 117 AADT, of which only 40 (34.6%) are non-motorcycles
- Link A09-03: Total 82 AADT, of which only 28 (34.1%) are non-motorcycles
- Link C-15: Total 148 AADT, of which only 59 (39.8%) are non-motorcycles

Link A09-04 is a (temporary) exception. This links showed 65 AADT, of which 41(62.8%) are non-motorcycles. In fact, this is due to current Road Work in the Natarbora area, which resulted in non-typical large movement of 33 trucks (14 Light, and 19 Medium), hauling building material to the work sites. Without them, the traffic characteristics in A09-4 would have been similar to those in the other links.
For RED input, this Study adopted traffic from A09-03, as a substitute for the non-typical (truck) traffic observed during the traffic count in February 2013. Link A09-3 is situated just north of A-09-04 and probably represents the accurate volume of traffic which would have been observed on A09-04, without the current Road Works.
Another change as input to RED, wherever no vehicle type was counted in a given vehicle category (count=0), the Consultant inserted instead one vehicle (1), to allow for some traffic growth in that category, even if minimal, in the future[*7].
This low base-line traffic presents a fundamental problem: The low base- line traffic, composed largely of motorcycle, cannot produce significant traffic volume in the future, to generate sufficient road-based benefits (savings on Vehicle Operating Cost and Value of Time).
This is true, even if estimated traffic growth in the future is large. The simple truth is that when the base is small (as it is here) – the future projections, associated with "normal" traffic will be small as well.

11.6.2 Average Annual Growth Rates

Table 11.4 shows average annual traffic growth rates, by vehicle type. Rationale behind these growth rates is discussed in Chapter 10, Traffic Surveys- Analysis & Assessment.

11.6.3 Generated and Induced Traffic

Generated Traffic - RED produced internally, automatically, "Generated" Traffic. That is new traffic which is generated due to reduced travel cost on the improved road. The elasticity of demand used here is "1" (as the default in RED). Namely, for each X percent decrease in transport cost (of normal traffic), there is X percent increase in demand.
Because the reduction in travel cost by Motorcycles is relatively small, Generated traffic produces more of non-motorcycle traffic (which generates higher road benefits).

Induced Traffic - This study estimated two types of "Induced Traffic" from/to the South Coast, along the Manatuto-Natarbora road:

[*7] Otherwise, multiplication of base-line zero (0) would have resulted also in zero in the future.

1. **General Traffic**. This traffic estimates potential traffic between The South Coast and Dili, where population sizes act as proxies for the strength of the linkages between them. It includes a mix of traffic vehicles (excluding motorcycles), derived from the Road Side Survey. The general traffic includes both people and goods movements, and is expected to grow at the same annual rates as "normal" traffic.
2. **Fuel Hauling Traffic**. This traffic is based on estimates of fuel hauling traffic, by road, between the Refineries in Betano and the North Coast. All of this traffic is by heavy (3 axle) tanker-trucks. It remains constant from the year 2017 onwards, as it depends on a fixed production capacity of the refineries in the foreseeable future.

Growth Rates - The Growth rates for Normal Traffic are applied also to Generated Traffic (by RED), and to the Induced General Traffic (by the Consultant).
Overall impact – From the year 2017, onwards, Generated and Induced traffic more than double the volume of base-line traffic derived solely from the traffic counts. They also contribute to increase share of non-motorcycle traffic (which generates higher road benefits).

11.6.4 Total Traffic, 2014-2033

Table 11.5 shows summary traffic in each of the years 2014-2033, in each of the five links of the Study Area, as calculated or inputted to RED.
The table is divided into four types of traffic categories:

1. Normal Traffic
2. Generated Traffic
3. Induced Traffic
4. Total Traffic (sum of the three above)

Within each traffic category, there is a further division into:

1. Total Traffic, including Motorcycle (Inc-MC)
2. Traffic excluding Motorcycle (Exc-MC)

Appendix 10.2 (Chapter 10) shows the detailed traffic data: traffic by vehicle category in each of the years, for the four type of traffic categories listed above.

Table 11.3 Base-Line AADT, Manatuto –Natarbora Road Links, 2013, by Vehicle Type

Vehicle Type	1	2	3	4	5	6	7	8	9	Total		Avg Annual Growth 2009-2013 (%)	
	Motorcycle	Private car/Taxi	Jeep/4WD	Picup/Van	Micro/Minibus (up to 20 seats)	Medium and large bus (>20 seats)	Light Truck (<5 tonnes)	Medium truck (>5<10 tonnes)	Heavy, oil and Art Truck (3 axle)	Inc. M-Cycle	Exc M-Cycle	Inc. M-Cycle	Exc M-Cycle
A09-01													
AADT 2013	89	0	30	0	2	0	25	2	0	148	59	37.8%	101.6%
Share 2013 (%)	60.2%	0.0%	20.2%	0.0%	1.1%	0.0%	16.9%	1.6%	0.0%	100.0%	39.8%		
A09-02													
AADT 2013	76	0	24	0	0	0	16	0	0	117	40	5.8%	-16.0%
Share 2013 (%)	65.4%	0.0%	20.6%	0.0%	0.0%	0.0%	14.0%	0.0%	0.0%	100.0%	34.6%		
A09-03													
AADT 2013	54	0	17	0	0	1	10	0	0	82	28	103.4%	NA
Share 2013 (%)	65.9%	0.0%	20.9%	0.0%	0.0%	0.9%	12.3%	0.0%	0.0%	100.0%	34.1%		
A09-04 (1)													
AADT 2013	24	0	8	0	0	0	14	19	0	65	41	11.4%	19.7%
Share 2013 (%)	37.2%	0.0%	12.7%	0.0%	0.0%	0.0%	21.2%	28.9%	0.0%	100.0%	62.8%		
C-15													
AADT 2013	54	0	8	0	0	1	13	0	0	75	22	NA	NA
Share 2013 (%)	71.5%	0.0%	10.9%	0.0%	0.0%	1.0%	16.6%	0.0%	0.0%	100.0%	28.5%		
A09-04, Revised for RED (2)													
AADT 2013	54	0	17	0	0	1	10	0	0	82	28	103.4%	NA
	65.9%	0.0%	20.9%	0.0%	0.0%	0.9%	12.3%	0.0%	0.0%	100.0%	34.1%		

Notes (1) Including non-typical large truck traffic, curently hauling material for Road Works near Natarbora

(2) Revised figure fror RED, using same traffic as A09-03

Table 11.4 Average Annual Growth Rates, by Vehicle Type, Up to 2034

	2014-2018	2019-2023	2024-2028	2029-2033
Motorcycle	10.0%	7.5%	5.0%	2.5%
Cars, 4WD, Pickup/Van	7.5%	7.5%	7.5%	7.5%
Buses	7.5%	7.5%	7.5%	7.5%
Trucks	20.0%	15.0%	10.0%	10.0%

Table 11.5 Traffic by Year, 2013 – 2034 by Link; Normal and Generated & Induces; Include/Exclude Motorcycle

Year		A09-01								A09-02							
		Normal		Genert		Induced		All Traff		Normal		Genert		Induced		All Traff	
		Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC
1	2014	152	63	0	0	0	0	**152**	**63**	122	46	0	0	0	0	**122**	**46**
2	2015	169	71	0	0	0	0	**169**	**71**	135	52	0	0	0	0	**135**	**52**
3	2016	188	81	34	15	0	0	**223**	**95**	150	58	34	13	0	0	**185**	**72**
4	2017	210	92	39	17	193	193	**442**	**302**	167	66	39	15	193	193	**399**	**274**
5	2018	235	105	43	19	202	202	**480**	**326**	186	75	43	17	202	202	**431**	**294**
6	2019	257	117	48	22	211	211	**516**	**350**	203	83	48	20	211	211	**462**	**314**
7	2020	281	131	53	24	221	221	**555**	**377**	221	93	53	22	221	221	**495**	**336**
8	2021	308	146	58	28	232	232	**599**	**406**	241	103	58	25	232	232	**532**	**360**
9	2022	338	164	64	31	244	244	**646**	**439**	264	115	64	28	244	244	**572**	**388**
10	2023	371	184	71	35	257	257	**699**	**476**	289	129	71	32	257	257	**617**	**418**
11	2024	397	201	76	38	272	272	**745**	**511**	308	140	76	35	272	272	**656**	**446**
12	2025	425	219	82	42	287	287	**794**	**548**	329	153	82	38	287	287	**698**	**478**
13	2026	455	239	88	46	304	304	**847**	**589**	352	167	88	42	304	304	**743**	**512**
14	2027	488	261	95	51	322	322	**904**	**633**	376	182	95	46	322	322	**792**	**549**
15	2028	523	284	102	56	341	341	**967**	**681**	402	198	102	50	341	341	**845**	**590**
16	2029	555	310	109	61	362	362	**1027**	**734**	425	216	109	55	362	362	**897**	**634**
17	2030	590	339	117	67	386	386	**1092**	**792**	450	235	117	61	386	386	**952**	**682**
18	2031	627	370	125	74	411	411	**1163**	**854**	476	257	125	67	411	411	**1012**	**735**
19	2032	668	404	134	81	438	438	**1240**	**923**	505	280	134	74	438	438	**1077**	**792**
20	2033	711	441	144	89	467	467	**1323**	**998**	536	305	144	82	467	467	**1147**	**855**

Year		A09-03								A09-04								C-15							
		Normal		Genert		Induced		All Traff		Normal		Genert		Induced		All Traff		Normal		Genert		Induced		All Traff	
		Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC	Inc MC	Exc MC
1	2014	87	33	0	0	0	0	**87**	**33**	87	33	0	0	0	0	**87**	**33**	74	20	0	0	0	0	**74**	**20**
2	2015	96	37	0	0	0	0	**96**	**37**	96	37	0	0	0	0	**96**	**37**	83	23	0	0	0	0	**83**	**23**
3	2016	107	42	34	13	0	0	**141**	**55**	107	42	34	13	0	0	**141**	**55**	93	27	34	10	0	0	**127**	**38**
4	2017	119	47	39	15	193	193	**350**	**255**	119	47	39	15	193	193	**350**	**255**	104	32	39	12	0	0	**143**	**44**
5	2018	132	53	43	17	202	202	**377**	**272**	132	53	43	17	202	202	**377**	**272**	117	38	43	14	0	0	**160**	**52**
6	2019	144	59	48	20	211	211	**403**	**289**	144	59	48	20	211	211	**403**	**289**	128	43	48	16	0	0	**176**	**59**
7	2020	157	65	53	22	221	221	**431**	**309**	157	65	53	22	221	221	**431**	**309**	140	49	53	18	0	0	**193**	**67**
8	2021	171	73	58	25	232	232	**461**	**330**	171	73	58	25	232	232	**461**	**330**	154	56	58	21	0	0	**212**	**77**
9	2022	187	81	64	28	244	244	**495**	**353**	187	81	64	28	244	244	**495**	**353**	169	63	64	24	0	0	**233**	**87**
10	2023	204	90	71	31	257	257	**532**	**379**	204	90	71	31	257	257	**532**	**379**	186	72	71	27	0	0	**256**	**100**
11	2024	218	98	76	34	272	272	**565**	**404**	218	98	76	34	272	272	**565**	**404**	198	79	76	30	0	0	**274**	**109**
12	2025	232	107	82	38	287	287	**601**	**432**	232	107	82	38	287	287	**601**	**432**	212	87	82	33	0	0	**294**	**120**
13	2026	248	117	88	41	304	304	**640**	**462**	248	117	88	41	304	304	**640**	**462**	227	95	88	37	0	0	**315**	**132**
14	2027	265	127	95	45	322	322	**681**	**494**	265	127	95	45	322	322	**681**	**494**	242	104	95	41	0	0	**337**	**145**
15	2028	283	138	102	50	341	341	**727**	**530**	283	138	102	50	341	341	**727**	**530**	259	115	102	45	0	0	**362**	**160**
16	2029	299	151	109	55	362	362	**771**	**568**	299	151	109	55	362	362	**771**	**568**	274	126	109	50	0	0	**383**	**176**
17	2030	317	164	117	61	386	386	**819**	**611**	317	164	117	61	386	386	**819**	**611**	290	138	117	56	0	0	**407**	**193**
18	2031	335	179	125	67	411	411	**871**	**657**	335	179	125	67	411	411	**871**	**657**	307	151	125	62	0	0	**432**	**213**
19	2032	355	195	134	74	438	438	**927**	**707**	355	195	134	74	438	438	**927**	**707**	326	166	134	68	0	0	**460**	**234**
20	2033	377	213	144	81	467	467	**988**	**761**	377	213	144	81	467	467	**988**	**761**	346	182	144	76	0	0	**490**	**258**

11.7 Quantifiable Benefits

11.7.1 Road User's Benefits

Road User's quantifiable benefits, calculated by RED, include:

1. Savings on Vehicle Operating Costs (VOC). The difference in VOC due to improved road conditions (lower IRI), "with" vs. "without" project. This difference is calculated by RED.
2. *Saving on Passengers' Value of Time (VOT).* The difference in VOT due to improved road conditions (shorter travel time), "with" vs. "without" project (passengers VOT = US$ 1.29 for work-hr, and US$ 0.32 leisure-hr)

The road user's benefits are derived from three type of traffic:

1. Normal Traffic – Base-line 2013 traffic (see Table 11.3), increases annually according to estimated average annual traffic growth rate (see Table 11.4, and Table 11.5).
2. Generated Traffic – The decrease in travel cost leads to increase in demand for travel. The elasticity of demand used here is "1" (as the default in RED). Namely, for each X percent decrease in transport cost (normal traffic), there is X percent increase in demand (see Table 11.5)
3. Induced Traffic – The additional amount of traffic, attributed to economic development in or around the Study Area. In this case, induced traffic by the Petroleum Industry in the South Coast (see Table 11.5)

11.7.2 . Other Quantifiable Benefits

1. Share of local labour/local economy in road investment costs (5% of investment costs spent locally, compounded by multiplier factor of 1.2).
2. Share of local labour/local economy in road maintenance costs (30% of maintenance costs "with" project are spent on local labour intensive maintenance, compounded by the 1.2 multiplier factor).
3. Proxy for "social benefits" - To account for better access to markets, education, health commercial and administrative facilities (assume US$ 15.0, per person per year, in the affected area).
4. Residual value of bridges and special culverts. Economic life of new bridges and special culvert is more than 20 years (at least 40 years). Thus, their residual value in current prices is a benefit in year 20.

11.8 Estimating Multiplier & Retainer Local Share of Investment / Maintenance Costs

11.8.1 Income Multiplier

Income Multiplier assess the broader macro-economic impacts of funds spent directly by the Project on local labour, as well as material and services purchased locally, as they circulate within the local District/Sub-District/Suco economy.

This WB Project adopted an Income Multiplier for direct investment in transport project, reported by a 2005 study in Indonesia, commissioned by the Government of Indonesia (GOI) and the World Bank (WB)[*8]. The 2005 Indonesian WB Study, reported Income Multipliers for Water Supply, Road/Bridges, and Irrigation, within the Kelamatan Study Area, as well as elsewhere in Indonesia.

The average Income Multiplier for Road/Transport projects, which was adopted here, is 1.2, an average throughout Indonesia. This 1.2 multiplier means that for every 1.0 dollar spent directly on local labour (material and services), 1.2 dollars are eventually generated, as benefits, throughout the community. Given that the study was conducted relatively recently (2005), within the same geographical region (Indonesia), and by reputable source (WB/GOI) it seems to be an appropriate adaptation source.

[*8] "Economic Impact Analysis of Development Program (KDP) Infrastructure Projects,: 2005; Commissioned by the Government of Indonesia and the World Bank; Prepared by Antony Torrens (toro@pacific.net.id)

11.8.2 Share of Investment/Maintenance Costs

Construction - A conservative estimate assigned 5.0% of total investment costs to local labour (material and services).
Maintenance – Similar to other road projects in recent years, it was assumed that 30% of maintenance cost "with" project will go directly to local labor.
In both cases, the base amount (5% of construction, and 30% of maintenance) is multiplied by the 1.2 Income Multiplier, discussed above.

11.9 Proxy for Social Benefits and Affected Population

It is quite obvious that improved roads provide better access to markets, education, health commercial and administrative facilities, and this has value. However, standard literature on road economics does not provide a "dollar value" to those benefits.
This Study proposes a method to provide a Proxy "dollar value" for these benefits, based on definitions of upper poverty income level in Timor Leste, by the World Bank.
In 2008, a World Bank/TL Ministry of Finance Study estimated that the upper poverty line for the nation, in 2007, was US$ 0.88 per person per-day[*9]. Accounting for inflation[*10], this figure translates to approximately US$ 1.50 per-day in 2013.
We assumed that the Proxy for social benefits to be equal to 10 days (2.7% of days in a year) of the minimum upper level of poverty per-person per-day, or about US$ 15/person/yr. This seems to be a conservative estimate to account for better access to markets, education, health, commercial, administrative facilities, etc.
The Study assigned the benefits to each road link, according to the number of people living in the Sub-District, adjacent to that link. For population size in each sub-District see Chapter 2, Table 2.2, Population and Land area.
Overall, the benefits were assigned to all of the District's population, other than those living in Laclo and Laleie Sub-District (7,939, and 3,470 people respectively) located far away from Road A-09.

11.10 Residual Share of Bridges and Special Culverts

Economic life of new bridges and special culvert is more than 20 years (at least 40 years). Thus, their residual value, in current prices, is a benefit in year 20.
To estimate their value, the Engineering Chapter distinguished between pure Road Works, and Cost for Bridges and Special Culverts. This is in spite of the fact that RED requires just one cost input -- Total Cost Per-km of all construction.

11.11 Environmental/Road Safety Impacts

Similar to 2009 TA 7100, other benefits, such as environmental benefits; and improved road safety, were not quantified, due to lack of specific data.

11.12 Standard Economic Analysis, 12% Discount Rate - Summary Results

Table 11.6 shows summery results of the economic analysis, following the standard ADB guidelines for economic analysis (NPV>0, EIRR>12.0%).
The summary shows:

(i) Net Present Value (NPV), discounted at 12%, in million US$
(ii) Economic Internal Rate of Return (EIRR), in percent (%)

Results are shown, first, for each of the five links; and later (bottom of table) for the entire Project. They are calculated as follows:

- The Total NPV is an arithmetic sum of the results for each link

[*9] TL Ministry of Finance/ The World Bank, "Timor Leste: Poverty in Young Nation," November 2008, pp 2.
[*10] IMF Report, 2013. See Chapter 2, Table 2.1 National Accounts, CPI.

- The average EIRR is a weighted average of the EIRRs for each link, where the distance (km) is the weighting factor.

Note, the analysis is carried out for the entire road section A-09 and C-15, between Manatuto and Natarbora, including the Laclubar branch. An initial idea (in the TOR) was to evaluate two separate sections: (i) Manatito-Laclubar, and (ii) Laclubar-Natarbora. However traffic analysis indicates that it is neither applicable, nor meaningful, for the following reason:

Recall, traffic on the entire A-09 road, beyond the natural growth of low base-line traffic, was reinforced by the Consultant, through the introduction of Induced Traffic from the South cost, which more than doubled non-motorcycle traffic on A-09 from the year 2017, onwards.

This traffic is applicable only if the entire length of the road is open for travel, eventually connecting Dili with Liqueque and Betano. Otherwise, the justification for this projected Induced Traffic does not hold. The connectivity of the entire A-09 road is required here to achieve even the modest economic statistics show here.

If the road is cut into two individual self containing sections, the projected traffic, based solely on base-line traffic will not be sufficient to produce even such modest results.

11.12.1 Highlights

- Scenario 2 Scenario 3, based on 4.5m road-way and TST pavement passed the standard economic threshold; and the less expensive Scenario 1, did better than Scenario 2 (the more expensive between them).
- In contract, Scenario 3, based on 6.0m road-way and asphalt-concrete pavement, did not pass the standard economic threshold; it's total cost is too high with respect to the benefits that the road can produce.
- All in all, given the relatively low volume of projected traffic and associated road benefits on the Manatuto-Natarbora road, the least expensive scenario, Scenario 1, produces the best results, as discussed below.
- Scenario 1 produces the highest EIRR of 15.6% and a positive NPV of US$ 9.678 million. It passes the ADB's required threshold of 12.0% EIRR.
- Scenario 2 produces the second level EIRR, of 13.7%, and NPV of US$ 6.246 million.
- Scenario 3 produces an EIRR of just 8.8%, and has a negative NPV of about US$ 10.9 million. Using standard ADB guidelines (positive NPV and EIRR>12%), Scenario 3 does not pass the economic analysis.

Table 11.6 Standard Economic Analysis (12% Discount Rate) – Summary Results

Link	From To	Distance (km)	Economic Index	Senario 1	Senario 2	Senario 3
				4.5 m TST	4.5 m TST	6.0m Asph-Conc
A09-01	Mantuto Cribas	22.8	NPV - (million $) at 12%	-0.810	-2.293	-5.365
			EIRR - (%)	10.2%	7.7%	4.6%
A09-02	Cribas Laclubar	11.5	NPV - (million $) at 12%	2.224	2.224	-0.055
			EIRR - (%)	16.8%	16.8%	11.9%
A09-03	Laclubar Mane Hat	33.5	NPV - (million $) at 12%	4.144	4.144	-4.169
			EIRR - (%)	15.4%	15.4%	9.3%
A09-04	Mane Hat Natarbora	11.7	NPV - (million $) at 12%	2.481	1.507	-0.203
			EIRR - (%)	22.4%	16.9%	11.5%
C-15	Junc Laclubar	10.3	NPV - (million $) at 12%	1.638	0.664	-1.088
			EIRR - (%)	19.0%	14.2%	9.4%
Total		89.8				
All Links			NPV - (million $) at 12% Total -All 5 Links	9.678	6.246	-10.880
			EIRR - (%) Weigted Avg (by km) - All 5 Links	15.6%	13.7%	8.8%

11.13 Alternative Economic Analysis - at 5% Discount Rate

The analysis above (section 11.12) used a discount rate of 12%, as dictated by the ADB guidelines. However, as indicated in Chapter 2, Socio-Economic Review, there is room to review the project also in terms of "Opportunity Cost of Capital" to the GoTL, which seems to be significantly lower than the 12% dictated by the ADB.

Currently the "Petroleum Fund," the main source of internal investment funds for Timor Leste is invested largely in US Government Bonds (or other countries' bonds). The return on these bonds is approximately 2.5%. This rate is actually lower (or about equal) than the US inflation rate[*11]. This means that at the most the "Petroleum Fund" is breaking even (if not losing its real value). Thus, any direct investment by the GoTL in infrastructure (or human resources), which provide a significant return above 2.5% is preferable.

To test this hypothesis, with respect to the Manatuto-Natarbora road, this Study also estimated the NPV and EIRR under an alternative 5.0% discount rate (instead of 12.0%). The 5.0% discount rate was selected because it is about twice as large as the prevailing return rate on the "Petroleum Fund".

Table 11.7 shows the results of this alternative economic evaluation, as well as a comparison with the results obtained by the standard economic analysis at 12% discount rate.

The general structure of the table is identical to the one shown above in Figure 11.6 (discounting at 12%). Table 11.7 has three main parts:

A. Summary results at 12% discount rate
B. Summary results at 5% discount rate
C. Difference between the two (B-A)

11.13.1 Highlights

- NPVs at 5.0% are (as expected) significantly higher than those at 12%.
- All NPVs at 5.0% are positive (and much large), in contrast to NPVs at 12.0%, where only Scenario 1 & 2 were positive.
- EIRRs remain (as expected) identical[*12], for all three scenarios.
- <u>The most significant change is with respect to Scenario 3</u>:
  - The NPV (at 5.0%) is positive, valued over US$ 25.0 million, Vs. a negative NPV of about US$ -10.8 million (at 12.0%).
  - The IRR remains identical, 8.8%; however it is now larger than the (revised) threshold of 5.0%.
- The combination of these two indices implies that if the GoTL decides to invest directly, only out of its own "Petroleum Fund", in the Manatuto-Natarbora road, it should do so because:
  - The project provides positive economic NPV of about US$ 25.0 million, for a financial investment of about US$ 75.0 million.
  - The EIRR generated by the road, 8.8%, is larger than the threshold of 5.0% (proposed by the Consultant). Moreover, it is significantly larger than the prevailing return on US bonds by the "Petroleum Fun," at about 2.5% -- the "Opportunity Cost of Capital" for the GoTL.
- Obviously, the results are also significantly better for Scenario 1 and Scenario 2. As indicated above, the EIRRs remain identical to those at 12% discount rate; however, both NPVs are now significantly large, valuesd at about US$ 47.2. and 43.7 million, respectively.

[*11] The inflation rate in Timor Leste is about twice or three times as large.

[*12] IRR is the discount rate which equalizes the total (discounted) streams of benefits and costs. It remains identical in both cases, so long as the two steams remain identical; which they are here.

Table 11.7 Economic Analysis Comparison – 5% Vs. 12% Discount Rate

Link	From To	Distance (km)	Economic Index	A. Discount Rate 12%			B. Discount Rate 5%			C. Difference (B-A)		
				Senario 1	Senario 2	Senario 3	Senario 1	Senario 2	Senario 3	Senario 1	Senario 2	Senario 3
				4.5 m TST	4.5 m TST	6.0m Asph-Conc	4.5 m TST	4.5 m TST	6.0m Asph-Conc	4.5 m TST	4.5 m TST	6.0m Asph-Conc
A09-01	Mantuto Cribas	22.8	NPV - (million $) at 12%	-0.810	-2.293	-5.365	3.858	2.348	-0.431	4.668	4.642	4.934
			EIRR - (%)	10.2%	7.7%	4.6%	10.2%	7.7%	4.6%	Same		
A09-02	Cribas Laclubar	11.5	NPV - (million $) at 12%	2.224	2.224	-0.055	9.169	9.169	7.005	6.945	6.945	7.060
			EIRR - (%)	16.8%	16.8%	11.9%	16.8%	16.8%	11.9%	Same		
A09-03	Laclubar Mane Hat	33.5	NPV - (million $) at 12%	4.144	4.144	-4.169	21.121	21.121	10.716	16.976	16.976	14.885
			EIRR - (%)	15.4%	15.4%	9.3%	15.4%	15.4%	9.3%	Same		
A09-04	Mane Hat Natarbora	11.7	NPV - (million $) at 12%	2.481	1.507	-0.203	7.292	6.302	4.694	4.811	4.795	4.897
			EIRR - (%)	22.4%	16.9%	11.5%	22.4%	16.9%	11.5%	Same		
C-15	Junc Laclubar	10.3	NPV - (million $) at 12%	1.638	0.664	-1.088	5.777	4.787	3.103	4.139	4.123	4.191
			EIRR - (%)	19.0%	14.2%	9.4%	19.0%	14.2%	9.4%	Same		
Total		**89.8**										
All Links			**NPV - (million $) at 12% Total -All 5 Links**	**9.678**	**6.246**	**-10.880**	**47.217**	**43.728**	**25.087**	**37.540**	**37.482**	**35.967**
			EIRR - (%) Weigted Avg (by km) - All 5 Links	**15.6%**	**13.7%**	**8.8%**	**15.6%**	**13.7%**	**8.8%**	**Same**		

11.14 Sensitivity Analysis

Table 11.7 shows results of the Sensitivity Analysis (for the standard analysis at 12% discount rate). The Sensitivity Analysis compares the basic results (of NPV and EIRR), shown in Table 11.6 above, against the possibility of three "what if" situations:

- Agency Costs increase by 20% (+20%)
- User Benefits decrease by 20% (-20%)
- Combination of both (+20% costs & -20% benefits)

The structure of the Sensitivity Analysis table (Table 11.8) is similar to those of the Summary Results (11.6): First, showing NPV and EIRR for each link, and later (bottom) sum of NPV and weighted average of EIRR for the entire Project.

11.14.1 Highlights

- Only for Scenario 1, under only one "what if" situation (increasing agency cost by 20%, and retaining benefits "as is"), the scenario continues to pass the ADB threshold: NPV = US$ 0.785 million, and IRR= 12.0%.
- In all other "what if" situations (+20% agency costs, -20% benefits, or both), none of the scenarios pass the threshold.
- Even the least expensive Scenario 1 (Rehab & Reconstruct 4.5m TST), falls below the threshold set by ADB's guidelines, if just benefits are reduced by 20%, and obviously when both "what if" occur at the same time.
- The situation is more severe for the Scenario 2 which passed the threshold under basic results (almost 13.7% EIRR, and US$ 6.246 million NPV). Under the sensitivity tests it falls to negative NPVs, and below 12% IRR in all "what if" situations.
- As for Scenario 3, which produced an IRR of 8.8% under basic results (though NPV was negative), it falls to 6.5%, 6.1% and 4.4%, respectively, under each of the "what if" situations.
- Scenario 1 , the best performing scenario, has falls in terms of EIRR from 15.6 %, under basic results to:
  - 12.0% where agency costs are +20%
  - 11.4% where user benefits are -20%
  - 9.2% where both occur (+20% and -20%)
- Scenario 1, falls, in terms of NPV, from positive US$ 9.678 million, under basic results to:
  - US$ 0.785 million where agency costs are +20%
  - Negative US$ -0.819 million where user benefits are -20%
  - Negative US$ -8.055 million where both occur (+20% and -20%)
- Scenario 2, the second performing scenario, falls, in terms of EIRR from 13.7%, under basic results to:
  - 10.9% where agency costs are +20%
  - 10.4% where user benefits are -20%
  - 8.2% where both occur (+20% and -20%)
- Scenario 2, has falls, in terms of NPV, from US$ 6.246 million, under basic results to negative values of:
  - US$ -2.165 million where agency costs are +20%
  - US$ -3.277 million where user benefits are -20%
  - US$ -11.004 million where both occur (+20% and -20%)
- Scenario 3, falls, in terms of EIRR, from 8.8 %, under basic results to:
  - 6.5% where agency costs are +20%
  - 6.1% where user benefits are -20%
  - 4.4% where both occur (+20% and -20%)
- Scenario 3, falls, in terms of NPV from negative US$ -10.880 million, under basic results to much further negative values of:
  - US$ -22.736million where agency costs are +20%
  - US$ -20.391 million where user benefits are -20%
  - US$ -31.402 million where both occur (+20% and -20%)

Table 11.8 Sensitivity Analysis (+/- 20%)

Link	From To	Distance (km)	Economic Index	Senario 1 (Rehab & Recostruct 4.5m TST)				Senario 2 (Reconstruct 4.5m TST)				Senario 3 (Reconstruct 6.0m Asph-Conc)			
				Basic Results	Agency Cost ,+ 20%	User Benefits -20%	Both Cost +20% & Ben -20%	Basic Results	Agency Cost ,+ 20%	User Benefits -20%	Both Cost +20% & Ben -20%	Basic Results	Agency Cost ,+ 20%	User Benefits -20%	Both Cost +20% & Ben -20%
A09-01	Mantuto	22.8	NPV - (million $) at 12%	-0.810	-2.254	-2.092	-3.537	-2.293	-4.035	-3.576	-5.318	-5.365	-7.794	-6.720	-9.149
	Cribas		EIRR - (%)	10.2%	7.8%	7.4%	5.4%	7.7%	5.7%	5.2%	3.5%	4.6%	2.9%	2.5%	1.0%
A09-02	Cribas	11.5	NPV - (million $) at 12%	2.224	1.029	0.584	-0.611	2.224	1.029	0.584	-0.611	-0.055	-1.741	-1.730	-3.416
	Laclubar		EIRR - (%)	16.8%	13.9%	13.3%	10.8%	16.8%	13.9%	13.3%	10.8%	11.9%	9.6%	9.1%	7.1%
A09-03	Laclubar	33.5	NPV - (million $) at 12%	4.144	1.007	0.178	-2.959	4.144	1.007	0.178	-2.959	-4.169	-8.649	-7.815	-12.294
	Mane Hat		EIRR - (%)	15.4%	12.7%	12.1%	9.9%	15.4%	12.7%	12.1%	9.9%	9.3%	7.2%	6.8%	5.0%
A09-04	Mane Hat	11.7	NPV - (million $) at 12%	2.481	1.862	1.366	0.748	1.507	0.694	0.392	-0.421	-0.203	-1.386	-1.346	-2.529
	Natarbora		EIRR - (%)	22.4%	18.3%	17.6%	14.5%	16.9%	13.9%	13.3%	10.9%	11.5%	9.3%	8.8%	6.9%
C-15	Junc	10.3	NPV - (million $) at 12%	1.638	-0.859	-0.855	-1.695	0.664	-0.859	-0.855	-1.695	-1.088	-3.166	-2.779	-4.013
	Laclubar		EIRR - (%)	19.0%	9.7%	9.2%	7.3%	14.2%	9.7%	9.2%	7.3%	9.4%	5.6%	5.2%	3.7%
Total		**89.8**													
All Links			**NPV - (million $) at 12% Total -All 5 Links**	**9.678**	**0.785**	**-0.819**	**-8.055**	**6.246**	**-2.165**	**-3.277**	**-11.004**	**-10.880**	**-22.736**	**-20.391**	**-31.402**
			EIRR - (%) Weigted Avg (by km) - All 5 Links	**15.6%**	**12.0%**	**11.4%**	**9.2%**	**13.7%**	**10.9%**	**10.4%**	**8.2%**	**8.8%**	**6.5%**	**6.1%**	**4.4%**

11.15 Distribution of Benefits

Table 11.7 shows distribution of benefits by Road Link, and Table 11.8 by Scenario; in million US$ and in percent (%) of Total. Benefits are divided among:

- Normal Traffic (VOC & Time Savings)
- Generated Traffic (VOC & Time Savings)
- Other – All other benefits including Induced traffic

11.15.1 Highlights By Link

Assessing each link (with 3 scenarios within each link) indicates that:

- There is variation among links with respect to traffic-based (normal & generated) benefits and other benefits (including induced traffic). Nevertheless, the share of non-traffic based benefits is significant.
- For example, on Link A09-01 about 40% are attributed to traffic–based benefits (normal & generated) and 60% to other benefits (including induced traffic), in all three scenarios.
- On the opposite side, on links A09-03 and A09-04 about 60-70% of benefits are attributed to traffic–based benefits (normal & generated) and 30-40% to other benefits (including induced traffic), in all three scenarios.
- Within the traffic-based benefits, the majority is attributed (as expected in developing countries, such as Timor Leste) to Savings on Vehicle Operating Costs (VOC) and a smaller share to savings on Value of Time (VOT).
- For example, in Link A09-01, VOC (of normal and generated traffic combined) contributes about 35% of total benefits, while VOT (normal plus generated) only about 2% of total.
- Similar results, concerning the division between VOC and VOT are found also in other links. This is because the value of time for passengers in Timor Leste is low.

11.15.2 Highlights By Scenario

Assessing the entire Project (all 5 links combined) indicates that:

- Overall, traffic-based benefits (normal & generated) accounts for about 60% of total benefits, while other benefits (including induced traffic) account for about 40%.
- For example, Scenario 1, the best performing alternative, economic-wise, produces a total of US$ 44.196 million benefits (100%), of which US$ 26.598 million (60%) are traffic-based benefits, and US$ 17.599 million (40%) are other benefits.
- Similar (order of magnitude) benefits and percent distribution also occurs in Scenario 2 and 3.

Table 11.9 Distribution of Benefits by Road Link

	User Benefits ($ million) (%), by Link					
	Normal Traffic		Generated Traffic		Other (inc.	Total
	VOC	Time	VOC	Time	Induced T)	Benefits
Scen	A09-01					
1	1.157	0.089	1.092	0.070	4.005	6.414
	18%	1%	17%	1%	62%	100%
2	1.157	0.089	1.092	0.070	4.005	6.414
	18%	1%	17%	1%	62%	100%
3	1.350	0.070	1.294	0.057	4.005	6.776
	20%	1%	19%	1%	59%	100%
Scen	A09-02					
1	1.617	0.545	2.448	0.644	2.946	8.200
	20%	7%	30%	8%	36%	100%
2	1.617	0.545	2.448	0.644	2.946	8.200
	20%	7%	30%	8%	36%	100%
3	1.687	0.538	2.565	0.640	2.946	8.375
	20%	6%	31%	8%	35%	100%
Scen	A09-03					
1	3.620	1.249	7.322	1.914	5.726	19.831
	18%	6%	37%	10%	29%	100%
2	3.620	1.249	7.322	1.914	5.726	19.831
	18%	6%	37%	10%	29%	100%
3	3.763	1.233	6.273	1.233	5.726	18.228
	21%	7%	34%	7%	31%	100%
Scen	A09-04					
1	0.837	0.255	1.632	0.384	2.466	5.573
	15%	5%	29%	7%	44%	100%
2	0.837	0.255	1.632	0.384	2.466	5.573
	15%	5%	29%	7%	44%	100%
3	0.886	0.250	1.735	0.379	2.466	5.716
	16%	4%	30%	7%	43%	100%
Scen	C-15					
1	0.947	0.355	0.308	0.114	2.456	4.179
	23%	8%	7%	3%	59%	100%
2	0.947	0.355	0.308	0.114	2.456	4.179
	23%	8%	7%	3%	59%	100%
3	0.986	0.351	0.330	0.115	2.456	4.238
	23%	8%	8%	3%	58%	100%

Table 11.10 Distribution of Benefits by Scenario

User Benefit ($ million) (%), by Scenario			
Scenario 1			
Link	N/G Traffic	Other	Total
A09-01	2.408	4.005	6.414
A09-02	5.254	2.946	8.200
A09-03	14.105	5.726	19.831
A09-04	3.107	2.466	5.573
C15	1.723	2.456	4.179
Totlal $	26.598	17.599	44.196
Total %	60%	40%	100%

User Benefit ($ million) (%), by Scenario			
Scenario 2			
Link	N/G Traffic	Other	Total
A09-01	2.408	4.005	6.414
A09-02	5.254	2.946	8.200
A09-03	14.105	5.726	19.831
A09-04	3.107	2.466	5.573
C15	1.723	2.456	4.179
Totlal $	26.598	17.599	44.196
Total %	60%	40%	100%

User Benefit ($ million) (%), by Scenario			
Scenario 3			
Link	N/G Traffic	Other	Total
A09-01	2.771	4.005	6.776
A09-02	5.429	2.946	8.375
A09-03	12.502	5.726	18.228
A09-04	3.250	2.466	5.716
C15	1.782	2.456	4.238
Totlal $	25.734	17.599	43.332
Total %	59%	41%	100%

11.16 Risk Analysis

11.16.1 The Risk Analysis Module - General

The Risk Analysis Module in RED performs a risk analysis, based on triangular probability distributions, for (up to) the main twenty input parameters. With the risk analysis module, one can explicitly include the uncertainty present in the estimates of the input parameters to generate results that show all possible outcomes. The user defines the estimate of an input variable and some measure of the likelihood of occurrence for that estimate, taking the forms of a triangular probability distribution.

The risk analysis module then uses this information to analyze every possible outcome, executing hundreds of what-if scenarios. In each scenario, random inputs following the defined input probability distribution are generated, and the resulting frequency distributions presented in numbs and in graphical form.

11.16.2 Selected Input Variables

The Consultant performed risk analysis, on eleven (11) input variables (for which there is uncertainty about their input value). He set for each of these 11variables a minimum possible value

of 0.70, and maximum possible value of 1.3 (default values for RED) which define the triangular probability distribution.
The input variables include:

- Normal Traffic (vpd)
- Normal Traffic Growth Rate (%)
- Generated Traffic (vpd)
- Induced Traffic (vpd)
- Passenger Time Costs ($/hr)
- Alternative 1, 2 & 3 Investment Costs (000$/km)
- Alternative 1, 2 & 3 Maintenance Costs (000/km/yr)

11.16.3 Selected Results

Table 11.11 shows results for IRR (5% and 12%), for two selected links: A09-01 (with relatively high traffic within the Study Area, located in a in a hilly area), and A09-03 (with relatively lower traffic within the Study Area, located in a in a mountainous area).
In general, the risk analysis shows that the IRR point estimate results (with input variables having +/- 30% variability), is quite reliable.
Results for other links (not shown here) are quite similar.

Table 11.11 Selected Risk Analysis Results for IRR, Links A09-01 & 03

Link A-09-01							
Scenario 1, IRR point estimate	10.2%						
Probability that IRR is less than	5%	is	0%	and more than	5%	is	100%
Probability that IRR is greater than	12%	is	23%	and less than	12%	is	77%
Scenario 2, IRR point estimate	7.7%						
Probability that IRR is less than	5%	is	2%	and more than	5%	is	98%
Probability that IRR is greater than	12%	is	2%	and less than	12%	is	98%
Scenario 3, IRR point estimate	4.6%						
Probability that IRR is less than	5%	is		and more than	5%	is	
Probability that IRR is greater than	12%	is		and less than	17%	is	

Link A-09-03							
Scenario 1, IRR point estimate	15.4%						
Probability that IRR is less than	5%	is	0%	and more than	5%	is	100%
Probability that IRR is greater than	12%	is	96%	and less than	12%	is	4%
Scenario 2, IRR point estimate	15.4%						
Probability that IRR is less than	5%	is	0%	and more than	5%	is	100%
Probability that IRR is greater than	12%	is	96%	and less than	12%	is	4%
Scenario 3, IRR point estimate	9.3%						
Probability that IRR is less than	5%	is	52%	and more than	5%	is	48%
Probability that IRR is greater than	12%	is	0%	and less than	12%	is	100%

11.17 Conclusion and Recommendations

11.17.1 Assessment - Based on ADB Guidelines

Based on the standard ADB guidelines (NPV>0, EIIR>12%), only the two scenarios based on 4.5m road-way width and TST paving, Scenario 1 and Scenario 2 pass the threshold of economic analysis. Both produce positive NPVs of US$ 9.687 and US$ 6.246, respectively; and EIRRs of 15.6 % and 13.7% respectively.

Scenario 3 (6.0m Asphalt-Concrete), the alternative which was originally proposed by the GoTL, does not meet the economic threshold set by the ADB (NPV>0.0 and EIRR> 12%). It produces a negative NPV of US$ -10.880 million, and EIRR of only 8.8 %.

The assessment becomes even more sever, when taking into consideration the Sensitivity Analysis. Allowing for +/- 20% change in costs and benefits (respectively), only Scenario 1 (and perhaps also 2) remains close to the desirable threshold. Scenario 1 produces EIRRs of about 12% when only one variable is changed (9.2% when both variables change together). In contrast, Scenario 3 drops to EIRRs of about 6.0% when one variable is changed (4.6% when both variables change together). And the NPV drops much further, from about US$ 11 million under the base case, to US$ 20 to US$ 31 million

From economic view-point the NPV is the prime economic index: it shows the actual amount of dollar benefits (or losses) produced by a Project. The EIRR is a simple to use comparative index; however it does not show dollar value which is produces by the Project (actually, the EIRR is the interest rate(s) which equalizes the present values of cost and benefit streams). In summary, from economic view-point a project which produces negative NPV, such as Scenario 3, should not be considered for investment (regardless of the EIRR which is lower than the desired 12%).

Scenario 1 and 2 were developed and proposed by the Consultant as a viable alternative to Scenario 3, given the low traffic on the Manatuto-Natarbora road -- at present; and in the future, in spite of relatively large growth rates and induced traffic from the South Coast, employed by the Consultant.

Both alternatives are very close in concept. They both propose a 4.5m sealed road-way, instead of the 6.0m in Scenario 3, originally proposed by the GoTL. And they both propose surfacing the road with TST instead of asphalt-concrete, a material which is sufficient to carry the volumes of projected traffic within the next 20 years. Scenario 1 is slightly cheaper than 2, as it proposes to rehabilitate the short sections in the flat land areas, instead of reconstructing the entire road length.

The combination of 4.5 m road-way and TST provides for significant savings in construction costs. First and foremost, the 4.5m avoid expensive construction of additional new 6.0m wide bridges and special culverts. It uses instead the existing structures of 4.5m wide, and only rehabilitating and re-strengthening them, if necessary. And second, TST is less expensive than asphalt concrete.

All in all, the 4.5m reconstructed sealed road will offer a significantly upgraded high-standard cross-country quality road between Manatuto and Natarbora, in line with the projected traffic for the next 20 years.

If so desired, assuming a significant larger traffic in the longer term, the design can reserve a right-of-way of 6.0m plus 2.0 m for shoulders now; while constructing a 4.5m road now.

11.17.2 Assessment - Based on Opportunity Cost of Capital

However, as indicated above, there is room to review the project also in terms of "Opportunity Cost of Capital" to the GoTL. The "Petroleum Fund," the main source of internal investment funds for Timor Leste, is invested largely in US Government Bonds (or similar). The return on these bonds is approximately 2.5%. This is the "Opportunity Cost of Capital" for GoTL.

The Study also estimated the NPV and EIRR under an alternative 5.0% discount rate (instead of 12.0%). The 5.0% discount rate was selected because it is about twice as large as the prevailing return rate on the "Petroleum Fund".

The most significant change under this scheme, particularly with respect to Scenario 3 (6.0m Asphalt-Concrete) is that the latter becomes an attractive investment because:

(i) The NPV (at 5.0%) is positive, valued at over US$ 25.0 million (versus a negative NPV of about US$-19.9 million, at 12.0%).

(ii) The IRR remains identical, 8.8% (as under the 12% scheme). However, it is now larger than the (proposed) threshold of 5.0%; and definitely larger than the "Opportunity Cost of Capital" for the GoTL, of 2.5%.

The combination of these two facts implies that if the GoTL decides to invest directly, only out of its own "Petroleum Fund" in the Manatuto-Natarbora road, it should do so.

In this case the 6.0m reconstructed asphalt-concrete sealed road will offer a significantly higher engineering standard for a cross-country road between Manatuto and Natarbora, compared to the 4.5m Scenarios; truly in line with International Standard for National Roads.

11.17.3 Recommendations

The recommendations are divided into two:

1. **For an ADB Loan** - The Consultant recommends adopting Scenario 1 or Scenario 2. These scenarios include a 4.5m reconstructed road sealed with TST, with 1.0 m shoulder on each side.
   This is because, under ADB guidelines, in the foreseeable future a 6.0m asphalt-concrete road is not economically feasible, and because a 4.5m road will be able to serve efficiently (though as "second best") the projected traffic demand within the next 20 years.

2. **For Direct Financing Solely by The GoTL** (with no ADB loan) - The Consultant recommends adopting Scenario 3. This scenario includes a 6.0m reconstructed asphalt-concrete sealed road, with 1.0 m shoulder on each side.
   Unquestionably, this type of road provides superior engineering standards, adhering to International Standards, and in line with TL vision for a long-tem National Road Network.
   The only limitation is that this recommendation requires an investment solely by the GoTL (or by an alternative loaning institution which will accept a discount rate of about 5.0%).
   In addition, given the difficulties between qualifying for an ADB loan only for a 4.5m road, on one hand, and the true desire of the GoTL for a 6.0m road, on the other; the Consultant also recommends the following step in the short-run:

3. **Either Way: Reserve Now a 6.0m+ Right-of-Way**. - A corollary recommendation is to reserve now a right-of-way for a 6.0m road plus 2.0 m shoulders, to allow for easier widening of the road into a 6.0m road-way, in the future, if the ADB loan for 4.5m is selected now.