PART 3 REHABILITATION PROJECT

8 Overview of Rehabilitation Project

8.1 Selected Road and Bridge Section for Rehabilitation Project

As for medium- and long-term rehabilitation programs for trunk roads on the East Coast, the section of AA004 from Akkaraipattu to Batticaloa and AA015 from Batticaloa to Trikkandimadu, as well as the Kallady Bridge on AA004 to the south of Batticaloa, were selected in negotiations between JICA and RDA for a feasibility study. This road section, which includes the Kallady Brdige, has a length of about 100 km and passes through such towns as Karativu, Kalmunai and Batticaloa on the tsunami-damaged East coast. In addition, the following bridge, which is also located on the Project road, is to be funded most probably by Spain.

- Oddaimavadi Bridge on AA015 at 33 kmp near Trikkandimadu

8.2 Existing Road Conditions

The vertical alignment on these sections is almost flat, except for the causeway bridge sections, which are between 2 % and 3 %. The horizontal alignment is to have a sufficiently large radius for a design speed of 50 km/hr to 60 km/hr. As for flooding along the Project road, RDA records indicate this occurs on the following sections:

- South of Kalmunai town on AA004
- North of Batticaloa town on AA015
- North of Eravur town on AA015

The Project road is basically to keep to the existing right of way, which is a two-lane road, except in some towns such as Akkaraipattu, Eravur and Valaichchenai where the existing right of way is a four-lane carriageway with sidewalks, or in towns such as Kalmunai, Kattankudi and Batticaloa where there is a two-lane carriageway + parking lanes + sidewalks. On the other hand, in the suburbs between Kalmunai and Talankuda and between Batticaloa and Eravur, the roads are as narrow as 9m because of the encroachment of houses and fences.

The existing pavement type is macadam, and the road surface is experiencing cracking and pot holes at both the center and edges of the carriageway. As the Project road passes over mostly flat area, it is slightly embanked. U-type side ditches, with and without covers, have already been installed or under construction or being planned for town areas. Other areas have no drainage facilities at the foot of slopes due to the sandy ground. Note that sections of the Project road that pass through towns account for approximately 24% of its entire length, with suburb, narrow sections of suburb, and paddy and lagoon field sections making up about 58%, 4%, and 14%, respectively.

8.3 Outline of Rehabilitation Project for Eastern Trunk Road

8.3.1 Outline of Feasibility Study

The feasibility study is supposed to lead to a road rehabilitation portion that will be implemented as one part of a JBIC Yen Loan Package. The study consists of the following work components:

i) Collection and analysis of information and data about the present status of the area and facilities, such as socioeconomic indices, natural conditions, socio-environmental situations, present and planned land use, relevant development plans, traffic flows, technical standards, topographic maps, etc.
ii) Natural condition survey
iii) Traffic survey
iv) Initial Environmental Examination based on the JICA/JBIC guidelines
v) Travel demand forecast
vi) Selection of design standards and criteria
vii) Preliminary design for roads and structures
viii) Construction plan
ix) Project cost estimate
x) Economic project evaluation
xi) Development of a mechanism to revitalize communities along the Project highway through road-oriented schemes in the township plan
xii) Maintenance plan for rehabilitated roads
xiii) Economic project evaluation
xiv) Project implementation plan

8.3.2 Prospective Road Width

Based on the existing road widths, the Study Team discussed the prospective road width with RDA. As a result of these discussions, the basic and minimum widths of the ROW in the rural areas were set to be 11.0 m and 9.0 m, respectively. The prospective rehabilitated road widths in the town areas, on the other hand, were set independently for each town based on existing road width that ranged from 15.0 m to 17.5 m.

8.4 Outline of Rehabilitation Project for New Kallady Bridge

The feasibility study is supposed to lead to a bridge construction portion to be implemented as one part of a JBIC Yen Loan Package. The study consists of the following work components:

i) Natural condition survey
ii) Initial Environmental Examination based on the JICA/JBIC guidelines
iii) Selection of the design standards and criteria
iv) Preliminary facility design
v) Construction plan
vi) Project cost estimate
vii) Economic Project Evaluation
viii) Project implementation plan

9 Environmental & Social Considerations for Rehabilitation Project

9.1 Background

The two components of the Project, namely, the rehabilitation of the Eastern Trunk Road between Akkaraipattu and Trikkandimadu and the construction of the New Kallady Bridge have been excluded from IEE and EIA studies as per the environmental regulations of Sri Lanka. JICA, however, encourages recipient countries to give due consideration to environmental and social aspects as specified in the "*JICA Guidelines for Environmental and Social Consideration*".

According to the JICA Guidelines, proposed projects could be classified into three categories: A, B and C. Proposed projects classified as *Category A* are likely to have significant adverse impacts, whereas proposed projects classified as *Category B* are likely

to have less adverse impacts than those of *Category A* projects. *Category C* projects are likely to have minimal or no adverse impacts. In order to decide the category, the characteristics of the two Projects have been examined using the check items contained in the said Guidelines. Through a general examination, both Projects can be classified as "*Category B*", since their potential impacts on the environment and society are insignificant and normal mitigation measures can be designed readily. Therefore, an IEE of the Projects have been conducted in accordance with the "*JICA Guidelines for Environmental and Social Consideration*".

9.2 Initial Environmental Examination

The IEE reports consist of the following items:

- Introduction
- Description of Project
- Description of environemnt
- Potential environmental impacts and mitigation measures
- Findings and recommendations
- Conclusions

In order to obtain a clear understanding of the potential environmental impacts from the Project, activities were categorized into three phases on the basis of implementation (i.e., pre-construction, where detailed design work will be carried out, construction phase, which will include all construction and earthwork and land reclamation, and post construction, or operation). All activities under each category and their environmental impacts were identified and examined.

9.2.1 Initial Environmental Examination of Eastern Trunk Road Project

In the IEE, all adverse impacts of the road rehabilitation and recovery project have been considered in detail during the process of screening for potential environmental effects. It was determined that very few adverse environmental impacts result from the proposed rehabilitation and recovery of the 100km road section from Trikkandimadu to Akkaraipattu. Furthermore, the scale of these impacts is small and can be mitigated by the recommended mitigation measures. Note also that the effects of construction are small as well temporary. Therefore, the necessity for further environmental assessment does not arise.

On the other hand, the beneficial social impacts are far greater than the adverse environmental impacts, which in any event can be mitigated. Therefore, the rehabilitation and recovery of the 100 km road section from Trikkandimadu to Akkaraipattu is environmentally acceptable.

9.2.2 Initial Environmental Examination of New Kallady Bridge Project

During the IEE it was understood that very few adverse environmental impacts would result from the proposed construction of the new Kallady Bridge. Furthermore, the significance of these adverse impacts is small. Adverse impacts, which can be categorized as moderate, result only from construction activities and these temporary impacts can be minimized through adherence to best practices in construction work. Also, beneficial social impacts outweigh the few adverse impacts, which are easily mitigated. Therefore, the construction of the New Kallady Bridge is environmentally acceptable.

10 Natural Condition Survey for Rehabilitation Project

10.1 Topographic Survey

10.1.1 Scope of Work

A topographical survey of the Project road, which stretches from Akkaraipattu to Trikkandimadu, was carried out with the purpose of preparing a base map for the required engineering drawings of the Study. In addition to this survey, a second topographical survey for the New Kallady Bridge, which was included at a later date in the Study at the request of JICA, was also executed.

10.1.2 Survey Method

The topographical survey for the Project road was carried out applying the Total Station Method using survey stations established by the Study. Note that the road centerline and cross section were surveyed at 20m intervals, with additional spot heights measured as necessary due to abrupt changes in terrain. All survey observations have X, Y, and Z coordinates.

10.2 Geological Survey

10.2.1 Scope of Work

The first geological survey for the Project road was executed with the purpose of determining existing sub-grade strength, pavement layer condition, and confirming the bearing layer of bridges except for the Oddaimauadi Bridge and New Kallady Bridge (via the standard penetration test). At the site of the New Kallady Bridge, three borehole investigations were carried out in a subsequent second geological survey.

10.2.2 Survey Results

1) Subsurface Conditions based on SPT

The geological conditions of the Project road slightly change in the vicinity of the New Kallady Bridge. That is, the section from Akkaraipattu up to the Bridge consists largely of sand, while the section from the Bridge up to Trikkandimadu comprises mostly weathered rock found at shallow depths. The offshore boring for the New Kallady Bridge also found the bearing layer to be located at a shallow depth.

2) Results of DCP Test & Test Pit Excavation

The sub-base and base of the existing road, which are located underneath the surface layer, are about 40cm in thickness. The test pit excavation results confirm the DCP test results. Note that the sub-grade layer, which is under the sub-base and base, has a CBR value of more than 10% on most sections.

10.3 Hydrological Survey

10.3.1 Basic Hydrological Conditions of Project Area

The Project area receives considerable rainfall during the Northeast Monsoon season from November to February. In December, rainfall is the heaviest and the water level of the lagoon can rise up rapidly and inundate surrounding areas, overflowing onto the causeway and other road sections thereby obstructing road traffic. Note that a sandbar has formed at the mouth of the lagoon and hinders the discharge of excess water to the sea, increasing the severity of flooding.

10.3.2 Determination of High Water Level

High water levels under prevailing conditions for 1-, 5-, 10-, 25-, 50- and 100-year return periods were calculated as in Table 10.1 as a part of the hydrological and hydraulic analysis. According to this analysis, the high water level for the Batticaloa Lagoon including the New Kallady Bridge is 1.35m for a 50-year return period. As for the Valachchenai Lagoon, it is 3.30m for the same return period. These results are useful in determining the necessary elevation of the proposed road alignment, clearance under bridge girder and the placement of culverts.

Table 10.1. High Water Level for Existing Conditions

Road Section		High Water Level (MSL) by Return Period					
		1-year RP	5-year RP	10-year RP	25-year RP	50-year RP	100-year RP
1	A004 (387-427km) & A015 (0-15) (Batticaloa Lagoon)	0.55m	0.93m	1.08m	1.26m	1.35m	1.42m
2	A015 (15-37km) (Valachchenai Lagoon)	1.74m	2.39m	2.80m	3.06m	3.30m	-

11 Traffic Demand Forecast

11.1 Objective

The main objective of this chapter is to describe the results obtained from the Project's traffic surveys and how these results are applied together with socioeconomic information for forecasting Project road traffic demand. The traffic surveys carried out are: 1) a roadside origin-destination (OD) survey (for both passenger and goods vehicles), 2) traffic volume survey, 3) bus passenger survey, 4) bus terminal survey, 5) road condition survey, 6) travel speed survey, 7) turning movement survey, and 8) rail terminal survey.

11.2 Existing Traffic Volumes

Based on the results of above-mentioned surveys, existing daily traffic volumes for the Project road are as shown in Figure 11.1.

As Figure 11.1 indicates, the area near Kalmunai has the largest daily traffic flow with a total of 8080 vpd. Average Project road vpd is about 4120, with 16% of this traffic being heavy vehicles. In terms of pcu, the relatively busy Kalmunai area has a daily flow of 7070,

with the Project road's average daily pcu flow being 3770, indicating a large number of small-sized vehicles such as motorcycles. In fact, 72% of existing traffic has a pcu 1.00 or smaller (i.e., passenger cars, 3 wheelers, and motorcycles). Note these traffic flows exclude aid vehicles for the Tsunami relief effort, as this is considered to be temporary traffic.

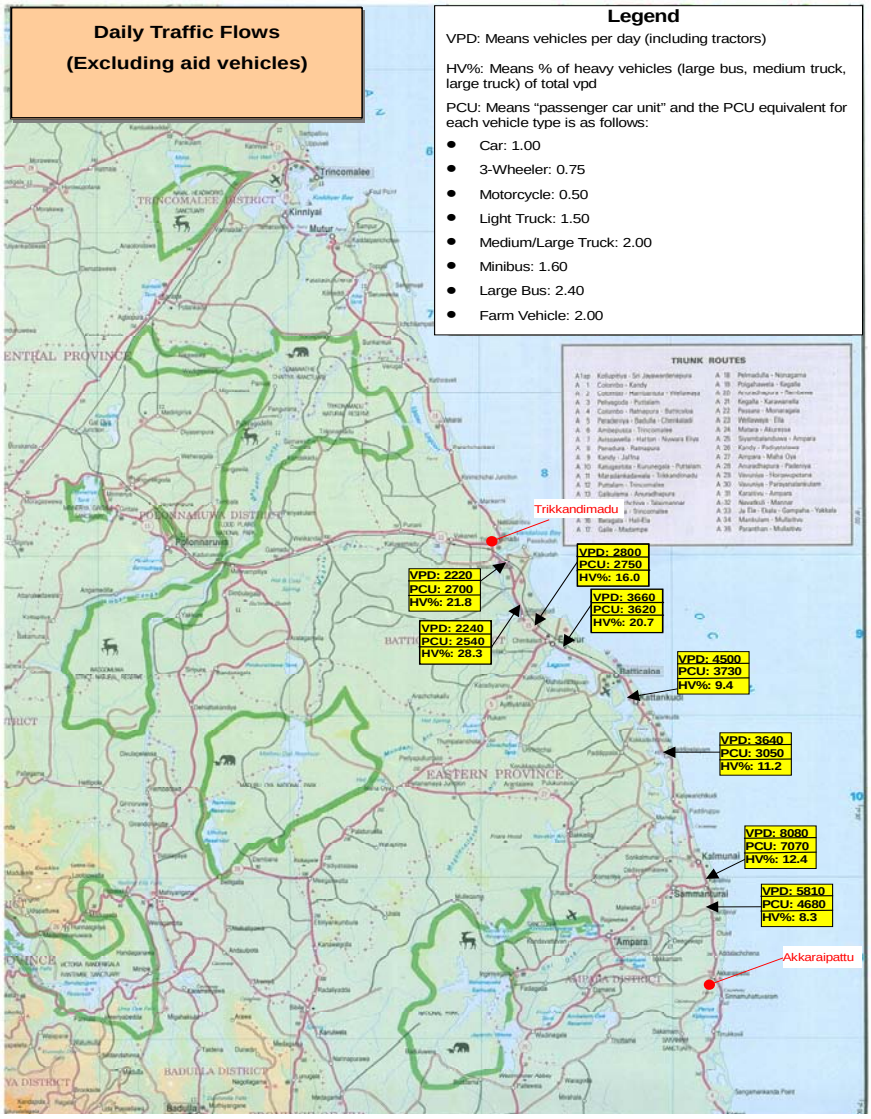


Figure 11.1. Daily Traffic Flows for Project Road (excl. aid vehicles)

11.3 Traffic Demand Model

11.3.1 Outline of Model

The traffic demand model has as its final output daily traffic by road link, daily vehicle-hours for work/non-work trips, and daily vehicle-kilometers for the Project area. The model is built by first simulating traffic demand by inputting vehicle-trip OD matrices into a user-equilibrium traffic assignment model, with the OD matrices then calibrated by

minimizing the root mean square error between calculated link flows and generated trips. The basic concept for deriving OD matrices from traffic counts is described in Eq. (1).

$$V_a = \sum_{ij} T_{ij} p_{ij}^a \qquad 0 \leq p_{ij} \leq 1 \qquad \text{Eq. (1)}$$

Where,

V_a: Observed vehicle trips on link a

$\sum_{ij} T_{ij}$: Summation of all trips moving from zone i to zone j

P_{ij}^a: % of total trips traveling from zone i to j via link a (Derived with traffic assignment model)

After obtaining calibrated 12-hour trip matrices for each vehicle type, the matrices are expanded into 24-hour matrices using expansion factors described in 11.3.2. The 24-hour matrices are then reloaded onto the road network of the traffic assignment model, and daily flows, vehicle-hours, and vehicle-kilometers obtained for present travel, taking into account the proportion of work and non-work trip making. As for future vehicle trip making, present daily OD matrices are factored up applying vehicle traffic growth rates derived from existing information on past traffic growth trends. These factored up matrices are then loaded onto the future road network and final traffic outputs calculated.

11.3.2 Zoning

The Project road is located in the districts of Ampara and Batticaloa of Eastern Province, and it was therefore decided that the Project area would consist of these two districts in analyzing traffic demand. Five additional zones for processing trips from/to the outside of the Project area are also included in the traffic model (i.e., trips to north and northwestern provinces, to Western Province, to southern provinces, and to Trincomalee District).

11.3.3 Future Trip Making Assumptions

In forecasting trips, three types of traffic are considered: normal (or existing), diverted, and generated traffic. In the case of normal traffic, it is common to make future forecasts linking trip making with changes in socioeconomic indices such as population, GDP, income, employment, and vehicle ownership. Unfortunately, due to the past troubles of the Eastern Province, the necessary time-series data is either insufficient or nonexistent for constructing reliable trip generation models. Given this, future trip making is estimated applying a range of traffic growth rate bands by vehicle type for low, medium, and high growth cases, based on a close examination and extrapolation of growth rates from recent studies carried out in Sri Lanka. As Table 11.1 shows, motorcycles have the highest rates of

growth varying from a low of 6% to a high of 10%, while passenger cars have a much lower per annum growth ranging from 3% to 5%, and 3 wheelers grow at rates from 4% to 8%.[1] On the other hand, buses and trucks grow at rates of 3% to 5% and 3% to 6%, respectively, which are in line with existing information and RDA recommendations.[2]

Table 11.1. Growth Rate Bands by Vehicle Type

Vehicle Type	Range of Growth (%)
Car	3-5
Motorcycle	6-10
3 Wheeler	4-8
Bus	3-5
Truck	3-6
Tractor	3-5

The above growth rate bands are applied to construct three growth scenarios (low, medium, and high) for normal traffic for the different vehicle types for the period of 2006 to 2025 and are divided into three sub-periods as shown in Table 11.2 to 11.4.

Table 11.2. Low Traffic Growth Scenario

Veh. Type	2006-2010 Annual Growth	2011-2020 Annual Growth	2021-2025 Annual Growth
Passenger Car	3.0%	3.5%	4.0%
Motorcycle	8.0%	7.0%	6.0%
3 Wheeler	6.0%	5.0%	4.0%
Bus	5.0%	4.5%	4.0%
Truck	3.0%	3.5%	4.0%
Tractor	3.0%	3.0%	3.0%

Table 11.3. Medium Traffic Growth Scenario

Veh. Type	2006-2010 Annual Growth	2011-2020 Annual Growth	2021-2025 Annual Growth
Passenger Car	3.0%	4.0%	4.5%
Motorcycle	9.0%	8.0%	7.0%
3 Wheeler	7.0%	6.0%	5.0%
Bus	4.5%	4.0%	3.5%
Truck	3.5%	4.5%	5.5%
Tractor	4.0%	4.0%	4.0%

[1] In a recent May 2005 ADB report for a study (*Tsunami Emergency Recovery Programme*) carried out by BCEOM & RDC on roads near the southern coast of the country, traffic growth rates of 5.5% were adopted for passenger cars, 3 wheelers, and motorcycles, while growth rates of 3.5% to 3.8% were adopted for all trucks. On the other hand, in an earlier November 1998 ADB RRP (*SRI 28331*), traffic growth rates for roads outside of Colombo and the southern coastal area were 7.5% to 9.6% for motorcycles, 3.3% to 4.2% for cars, an average of 5.0% to 6.4% for trucks, and an average 4.5% to 5.7% for buses.

[2] The RDA April 1999 *Guide to the Structural Design of Roads Under Sri Lankan Conditions* recommends growth rates of 4% to 7% for trucks and 3% to 5% for buses in cases where existing traffic data is insufficient. Note, however, it was decided that the growth rates for trucks be reduced by 1% due to the small amount of industrial activity in the Project area, while bus growth rates were applied as is.

Table 11.4. High Traffic Growth Scenario

Veh. Type	2006-2010 Annual Growth	2011-2020 Annual Growth	2021-2025 Annual Growth
Passenger Car	3.0%	4.5%	5.0%
Motorcycle	10.0%	9.0%	8.0%
3 Wheeler	8.0%	6.0%	5.0%
Bus	4.0%	3.5%	3.0%
Truck	4.0%	5.0%	6.0%
Tractor	5.0%	5.0%	5.0%

As for diverted traffic, which is traffic that changes from another road or mode to the Project road, the possibility of the former type of diversion is considered in the traffic assignment model and the latter in the setting of the growth rates. Finally, generated traffic, which occurs as a response to the provision or large improvement of a road, is not considered in the case of the Project road being rehabilitated, as it is thought that the level of change is insufficient to trigger significant numbers of such trips. However, the economic impact of generated trips arising from the realization of the Trikkandimadu to Trincomalee link via Mutur and Kinniyai is considered in Chapter 15.

Based on the preceding, total vehicle trips made within the Project area for each of the growth scenarios for the period of 2006 to 2025 is as shown in Table 11.5, and overall traffic growth for trips made within the Project area is predicted to grow from a low of 5.9% to a high of 7.6%, which is considered to be a realistic range by the Study Team.[3] Note, however, that the Medium Growth Scenario is considered as the most likely case (i.e., base case) for the Project road.

Table 11.5. Future Daily Trips within the Project Area by Growth Scenario

Scenario	2005	2010	2025	Av. Annual Growth
Low Growth	20,530	28,030	64,720	5.9%
Medium Growth	20,530	29,030	76,150	6.8%
High Growth	20,530	30,060	88,300	7.6%

Note: Vehicle trips rounded off to the nearest ten.

11.4 Future Traffic Demand & Traffic Evaluation Criteria

In Tables 11.6 and 11.7, the traffic evaluation criteria of daily vehicle-kilometers (Veh-km), vehicle-hours (Veh-hr), and average area speed are used to assess the impact of the rehabilitation of the Project road.

[3] The RDA April 1999 *Guide to the Structural Design of Roads Under Sri Lankan Conditions* recommends growth rates of 4% to 7% for trucks and 3% to 5% for buses in cases where existing traffic data is insufficient. Note, however, it was decided that the growth rates for trucks be reduced by 1% due to the small amount of industrial activity in the Project area, while bus growth rates were applied as is.

Table 11.6. Traffic Impact With & Without Rehabilitation for 2010 by Scenario

Scenario		Traffic Evaluation Criteria		
		Daily Veh-km	Daily Veh-hr	Daily Av. Speed
Low Growth Scenario	With Rehabilitation	525,591	12,144	70.7
	Without Rehabilitation		14,226	59.4
	Ratio of With to Without	-	0.854	1.190
Medium Growth Scenario	With Rehabilitation	537,832	12,466	70.7
	Without Rehabilitation		14,598	59.4
	Ratio of With to Without	-	0.854	1.190
High Growth Scenario	With Rehabilitation	549,554	12,746	70.7
	Without Rehabilitation		14,929	59.3
	Ratio of With to Without	-	0.854	1.192

Note: Veh-km are for the Project road only and Veh-hr are for the Project area.

Table 11.7. Traffic Impact With & Without Rehabilitation for 2025 by Scenario

Scenario		Traffic Evaluation Criteria		
		Daily Veh-km	Daily Veh-hr	Daily Av. Speed
Low Growth Scenario	With Rehabilitation	1,007,892	24,983	67.7
	Without Rehabilitation		30,066	56.3
	Ratio of With to Without	-	0.831	1.202
Medium Growth Scenario	With Rehabilitation	1,209,525	30,088	65.3
	Without Rehabilitation		36,644	54.9
	Ratio of With to Without	-	0.821	1.189
High Growth Scenario	With Rehabilitation	1,359,126	35,581	63.5
	Without Rehabilitation		43,835	53.0
	Ratio of With to Without	-	0.812	1.198

Note: Veh-km are for the Project road only and Veh-hr are for the Project area.

The conclusions that can be drawn from the above are as follows:

- With Project road rehabilitation, travel speed increases in the Project area from about 59 km/h to 71 km/h in 2010. In 2025, travel speeds without rehabilitation range from a low of 53 km/h to a high of about 56 km/h, while with rehabilitation speeds would be in the range of 64 km/h to 68 km/h, indicating that improvement of the Project road has a significant impact on vehicle operation speeds in the Project area.
- Due to the preceding, there is a significant decline in daily travel time (Veh-hr), ranging from about 15% in 2010 to 17%-19% in 2025 depending on the growth scenario. Note that with increases in traffic over time, the impact of Project road rehabilitation on travel time saving becomes larger.
- Travel distance (Veh-km) for with and without rehabilitation is the essentially the same for the Project road, since there is no other viable alternative. Savings regarding the distance traveled on the road therefore comes from a decrease in vehicle operating cost, as a result of a reduction in the IRI of the Project road due to its rehabilitation. Note that the Veh-km for the Project road increases over the time period of 2010 to 2025 from a low of about 1.92 times to a high of 2.47 times.

In Table 11.8., the vpd and pcu for the links of the Project road are given for the medium traffic growth scenario or base case. North Karativu Jct. has the largest predicted traffic volumes, with 11,200 vpd in 2010 and 29,200 vpd in 2025. As for South Karativu Jct., predicted traffic volumes vary from 8100 in 2010 to 20,200 in 2025, and are the second largest traffic flows on the Project road. Excluding the northern tail of the Project road, or the North Chenkaladi Jct. and Valaichchenai Jct., traffic volumes north of the Kalmunai area range from 5500 to 6000 vpd in 2010 and from 14,000 to 15,500 in 2025. After Chenkaladi, traffic flows decrease and range approximately from 3600 to 4400 vpd in 2010 to 8,500 to 10,600 in 2025.

Table 11.8. Traffic Volume for Project Road Links for 2010 & 2025

Location	2010 vpd & pcu	2025 vpd & pcu
South Karativu Jct. (Kalmunai area)	vpd: 8,100 pcu: 6,400	vpd: 20,200 pcu: 14,100
North Karativu Jct. (Kalmunai area)	vpd: 11,200 pcu: 9,200	vpd: 29,200 pcu: 21,200
Cheddipalaiyam	vpd: 6,000 pcu: 5,400	vpd: 15,500 pcu: 11,900
Kattankudi	vpd: 5,500 pcu: 5,100	vpd: 14,000 pcu: 11,100
South Chenkaladi Jct.	vpd: 6,000 pcu: 6,100	vpd: 14,900 pcu: 12,900
North Chenkaladi Jct.	vpd: 4,400 pcu: 4,800	vpd: 10,600 pcu: 9,900
Valaichchenai	vpd: 3,600 pcu: 4,100	vpd: 8,500 pcu: 8,400

Note: The order of the road links regarding the Project road is from south to north and corresponds to the links shown in Figure 11.1, except for the second to last link (North Sittandikudi). This is because modeled traffic volumes for North Sittandikudi and Valaichchenai are essentially the same.

12 Preliminary Design for Rehabilitation of Eastern Trunk Road

12.1 Alignment

The Project road shall basically keep to the existing alignment in order to minimize social impacts. However, there are some sections that experience inundation. These sections shall be raised so as to be higher than the inundation levels during the rainy season based on the 1999 guideline of the RDA (*A Guide to the Structural design of Roads under Sri Lankan Conditions)*. According to the guideline, it is prescribed that normal flood levels, which mean flooding with a 1-year return period, not rise higher than 600 mm below a road's formation level. The relation between the road's shoulder level and high water level (H.W.L.) is shown in Figure 12.1.

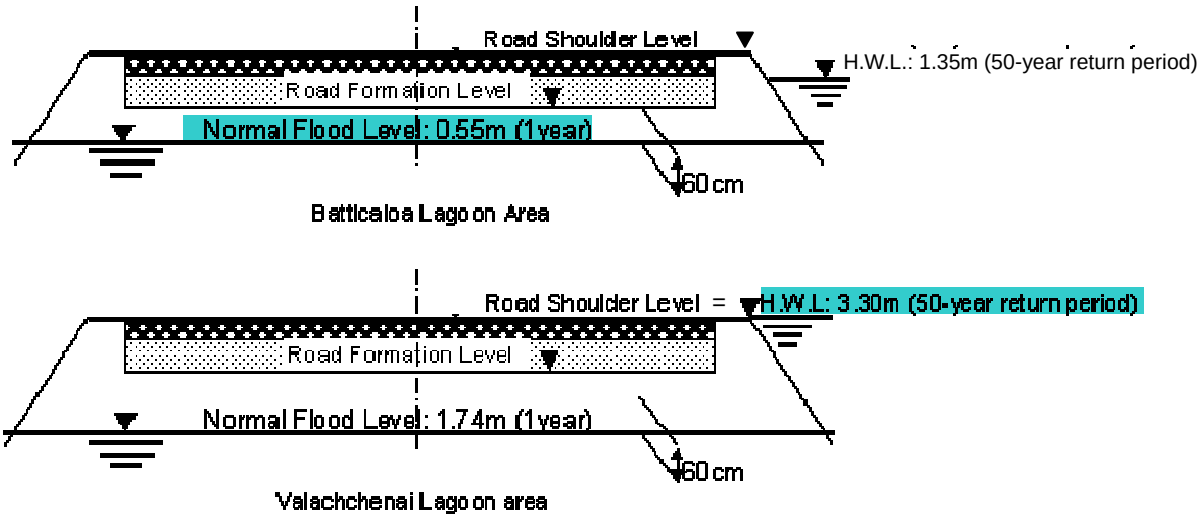


Figure 12.1. Water Levels at Inundation Sections (shaded parts)

12.2 Right of Way (ROW)

The ROW policy for the Project road is that it shall satisfy minimum technical and traffic safety requirements and be implemented in a way to minimize the acquisition of land with adequate compensation being provided[1)]. The ROW for each section, such as town, suburb, paddy field & lagoon, and narrow urban sections is presented in Figure 12.2. and Table 12.1. Note that the town, suburb, paddy field and lagoon, and narrow urban sections account for 24%, 58%, 14% and 4% of the Project road, respectively. Compensation of land acquisition to affected people will be 773m of the parapet wall, 77.1m of the wire fence and 510.88m^2 of the acquired area.

The design criteria for the Project road, which is based on existing road conditions, are specified in Table 12.2.

[1)] Adequate compensation is as defined by the Ministry of Highways documentation on "People Affected by Highway Projects" published in the fall of 2005.

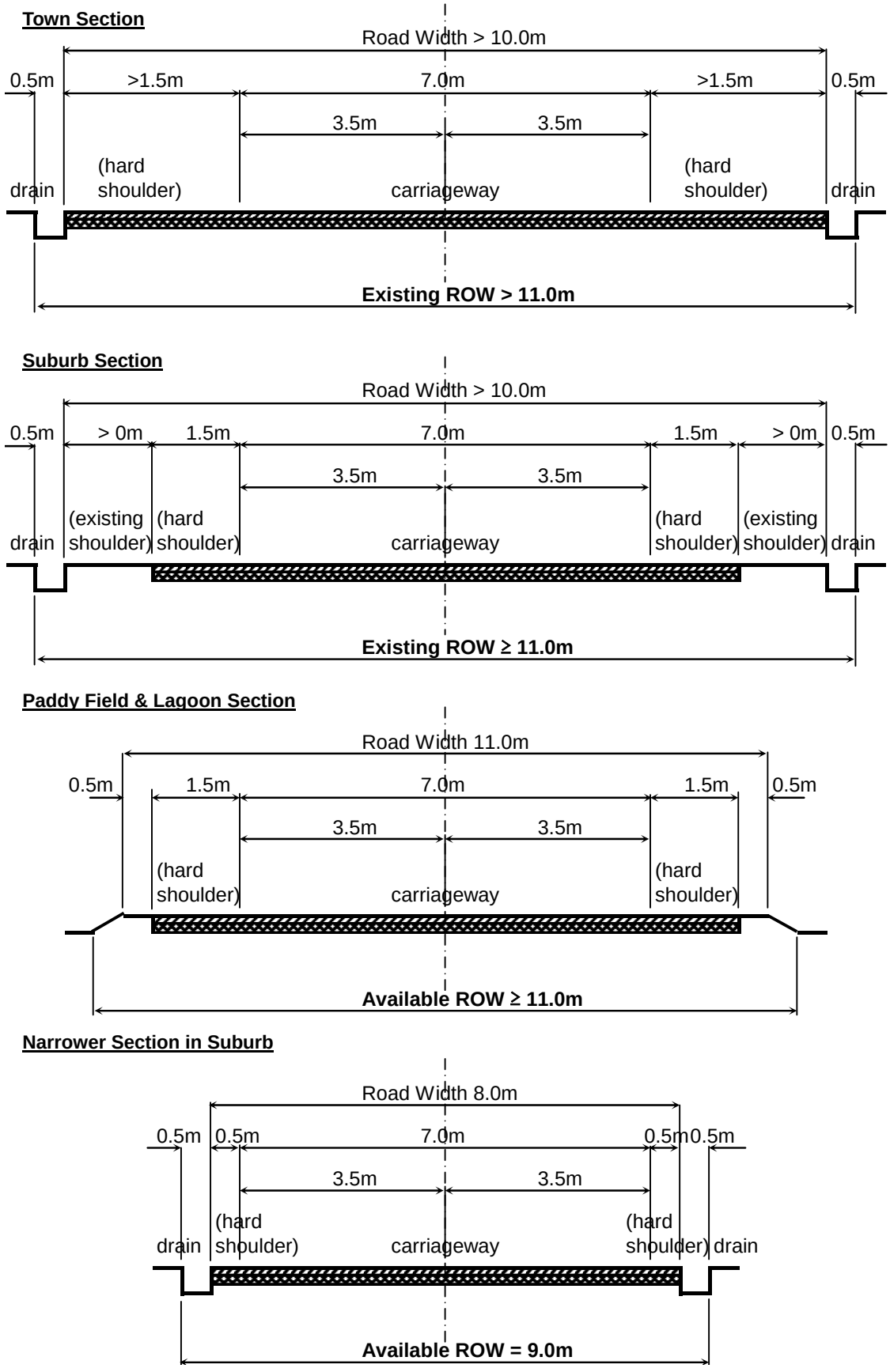


Figure 12.2. Proposed ROW for Project Road

Table 12.1. Available ROW for Project Road

No.	Road	Town	Km Post	Cum. Distance	Pavement Width		Available ROW	ROW Image Plan	Remarks
					Existing	Planned			
1	A04		364.00	860	W = 4.8m	W = 10.0m	W ≥ 11.0m		
2	A04	Akkaraipattu	364.86	2,400	W = 13.8m	W = 13.8m	W > 11.0m		
3	A04	Akkaraipattu	366.40	2,720	W = 13.8m	W = 13.8m	W > 11.0m		
4	A04		366.72	4,210	W = 4.8m	W = 10.0m	W ≥ 11.0m		
5	A04	Addalachchena	368.21	5,110	W = 7.0m	W = 14.0m	W > 11.0m		
6	A04		369.11	6,280	W = 5.4m	W = 10.0m	W ≥ 11.0m		
7	A04		370.28	6,880	W = 5.4m	W = 10.0m	W ≥ 11.0m		Paddy
8	A04		370.88	8,280	W = 4.9m	W = 10.0m	W ≥ 11.0m		
9	A04		372.28	12,980	W = 5.0m	W = 10.0m	W ≥ 11.0m		Paddy
10	A04		376.98	14,000	W = 5.8m	W = 10.0m	W ≥ 11.0m		
11	A04		378.00	14,540	W = 5.8m	W = 10.0m	W ≥ 11.0m		Paddy
12	A04		378.54	15,670	W = 5.3m	W = 10.0m	W ≥ 11.0m		
13	A04	Nintavur	379.67	19,000	W = 5.4m	W = 13.5m	W > 11.0m		
14	A04		383.00	19,590	W = 5.4m	W = 10.0m	W ≥ 11.0m		
15	A04	Karativu, Kalmunai	383.59	24,020	W = 5.5m	W = 13.5m	W > 11.0m		
16	A04		388.02	25,000	W = 5.3m	W = 10.0m	W ≥ 11.0m		
17	A04		389.00	25,400	W = 5.3m	W = 8.0m	W = 9.0m		
18	A04		389.40	26,160	W = 6.5m	W = 10.0m	W ≥ 11.0m		
19	A04		390.16	26,820	W = 6.5m	W = 8.0m	W = 9.0m		
20	A04		390.82	29,580	W = 5.4m	W = 10.0m	W ≥ 11.0m		
21	A04		393.58	31,320	W = 5.0m	W = 8.0m	W = 9.0m		
22	A04		395.32	31,920	W = 7.2m	W = 10.0m	W = 15.0m		Periya Kallar CW
23	A04		395.92	32,340	W = 5.4m	W = 8.0m	W = 9.0m		
24	A04		396.34	33,360	W = 5.9m	W = 10.0m	W ≥ 11.0m		
25	A04		397.36	33,930	W = 5.1m	W = 10.0m	W = 15.0m		Koddaia Kallar CW
26	A04		397.93	36,840	W = 5.6m	W = 10.0m	W ≥ 11.0m		
27	A04	Puddiruppu	400.84	37,110	W = 11.6m	W = 14.5m	W > 11.0m		
28	A04		401.11	37,220	W = 5.3m	W = 8.0m	W = 9.0m		
29	A04	Kaluwanchikudi	401.22	55,090	W = 6.6m	W = 10.0m	W ≥ 11.0m		
30	A04	Cheddipalaiyam	419.09	58,260	W = 11.8m	W = 14.4m	W > 11.0m		
31	A04	Talankuda	422.26	59,420	W = 7.0m	W = 10.0m	W ≥ 11.0m		
32	A04		423.42	61,080	W = 7.0m	W = 14.0m	W > 11.0m		
33	A04	Kattankudi	425.08	62,020	W = 7.4m	W = 10.0m	W ≥ 11.0m		
34	A04		426.02	62,260	W = 7.0m	W = 13.0m	W > 11.0m		
35	A04		426.26	62,550	W = 4.7m	W = 10.0m	W = 14.0m		New Kalladi Bridge
36	A04	Batticaloa	426.55	62,960	W = 6.5m	W = 14.0m	W > 11.0m		
37	A04	Batticaloa	426.96	63,203	W = 8.5m	W = 11.0m	W > 11.0m		
38	A15	Batticaloa	0.82	63,963	W = 7.0m	W = 14.0m	W > 11.0m		
39	A15		1.58	66,413	W = 6.0m	W = 10.0m	W ≥ 11.0m		
40	A15		4.03	66,913	W = 6.0m	W = 10.0m	W ≥ 11.0m		Paddy
41	A15		4.53	67,613	W = 6.0m	W = 10.0m	W ≥ 11.0m		
42	A15		5.23	71,153	W = 6.0m	W = 10.0m	W ≥ 11.0m		Paddy, Lagoon
43	A15		8.77	71,473	W = 5.8m	W = 10.0m	W ≥ 11.0m		
44	A15		9.09	71,503	W = 5.8m	W = 8.0m	W = 9.0m		House
45	A15		9.12	72,823	W = 5.8m	W = 10.0m	W ≥ 11.0m		
46	A15		10.44	74,483	W = 6.0m	W = 10.0m	W ≥ 11.0m		Paddy
47	A15		12.10	75,083	W = 5.8m	W = 10.0m	W ≥ 11.0m		
48	A15	Eravur	12.70	77,023	W = 6.5m	W = 14.5m	W > 11.0m		
49	A15		14.64	77,463	W = 6.0m	W = 10.0m	W ≥ 11.0m		
50	A15	Chenkaladi	15.08	78,123	W = 7.5m	W = 11.5m	W > 11.0m		
51	A15		15.74	79,143	W = 6.0m	W = 10.0m	W ≥ 11.0m		
52	A15	Eastern U.	16.76	79,883	W = 9.5m	W = 9.5m	W > 11.0m		
53	A15		17.50	94,053	W = 6.1m	W = 10.0m	W ≥ 11.0m		
54	A15	Valaichchenai	31.67	95,633	W = 11.8m	W = 11.8m	W > 11.0m		
55	A15		33.25	96,313	W = 6.8m	W = 10.0m	W ≥ 11.0m		
56	A15		33.93	96,553	W = 4.7m	W = 4.7m	W = 4.7m		Oddaimavudi Bridge
57	A15		34.17	97,203	W = 5.8m	W = 10.0m	W ≥ 11.0m		
58	A15		34.82	98,913	W = 5.3m	W = 10.0m	W ≥ 11.0m		

: Existing Pavement Area

Area Available for Widening of ROW

Table 12.2. Summary of Geometric Design Criteria

Items		unit	Specified Values			Remarks
			Town	Suburb	Rural	
Design Speed		Km/h	60	70	70	
Width	Carriageway	m	2 x 3.5	2 x 3.5	2 x 3.5	
	Shoulder	m	(> 2 x 1.5)	(≥ 2 x 0.5)	2 x 1.5	(Minimum)
	Drain	m	2 x 0.5	2 x 0.5	--	
	R.O.W.	m	(> 11.0)	(≥ 9.0)	11.0	(Minimum)
Cross Fall		%	← 2.5↘	← 2.5↘	← 2.5 ↘	Asphalt pavement
Gradient		%	2.00(0+880)	2.29(397+320)	4.00(24+510)	Maximum = 4%
Curve Radius	Horizontal	m	50.0 (386+399.084~ 386+431.706)	40.0 (390+351.080~ 390+391.772)	30.0 (Oddaimavudi Bridge)	Minimum = 185m
	Vertical (Crest)	m	795.455 (0+840)	1749.316 (397+320)	1153.846 (24+470)	Minimum = 3000m
	Vertical (Sag)	m	1403.509 (0+880)	2105.263 (412+290)	1212.121 (24+470)	Minimum = 1300m
Curve Length	Horizontal	m	18.014 (12+850.647~ 2+868.660)	22.042 (390+285.407~ 390+307.449)	13.242 (23+709.744~ 23+722.986)	Minimum = 40m
	Vertical (Crest)	m	40.0 (13+000)	30.0 (14+640)	30.0 (4+710)	Minimum = 60m
	Vertical (Sag)	m	40.0 (12+800)	30.0 (14+670)	30.0 (4+680)	Minimum = 25m

12.3 Pavement Structure

The design life of a road can have a large impact on the design specifications of its pavement structure and it is therefore important to decide an appropriate period. Usually, a 10-, 15-, or 20-year period is adopted, with the selection of an appropriate design life being dependent on the relevant circumstances to the individual project.[1] Resulting from the discussion with the RDA technical member, the design life is recommended that a 10-year design life be applied, and that the necessary maintenance and/or rehabilitation be carried out via the monitoring of traffic conditions to minimize the risk of over investment.

Traffic load is expressed as cumulative equivalent standard axle load (ESAL) for the design life of a road. Based on the traffic survey result, the cumulative ESAL for eight sampled sections of the Project road have been derived and are illustrated in Figure12.3. Furthermore the sub-grade strengths over the whole Project road based on the CBR test are as plotted in Figure 12.4.

The final structures for asphalt concrete (AC) that would be applicable to the Project road, which are grouped into seven in total, are illustrated as the gray shaded portions in Table 12.3.

[1] According to the UK's Transport and Road Research Laboratory's *Overseas Road Note 5: A guide to project appraisal*, an analysis period of 15 years from the opening of a road is in most cases appropriate.

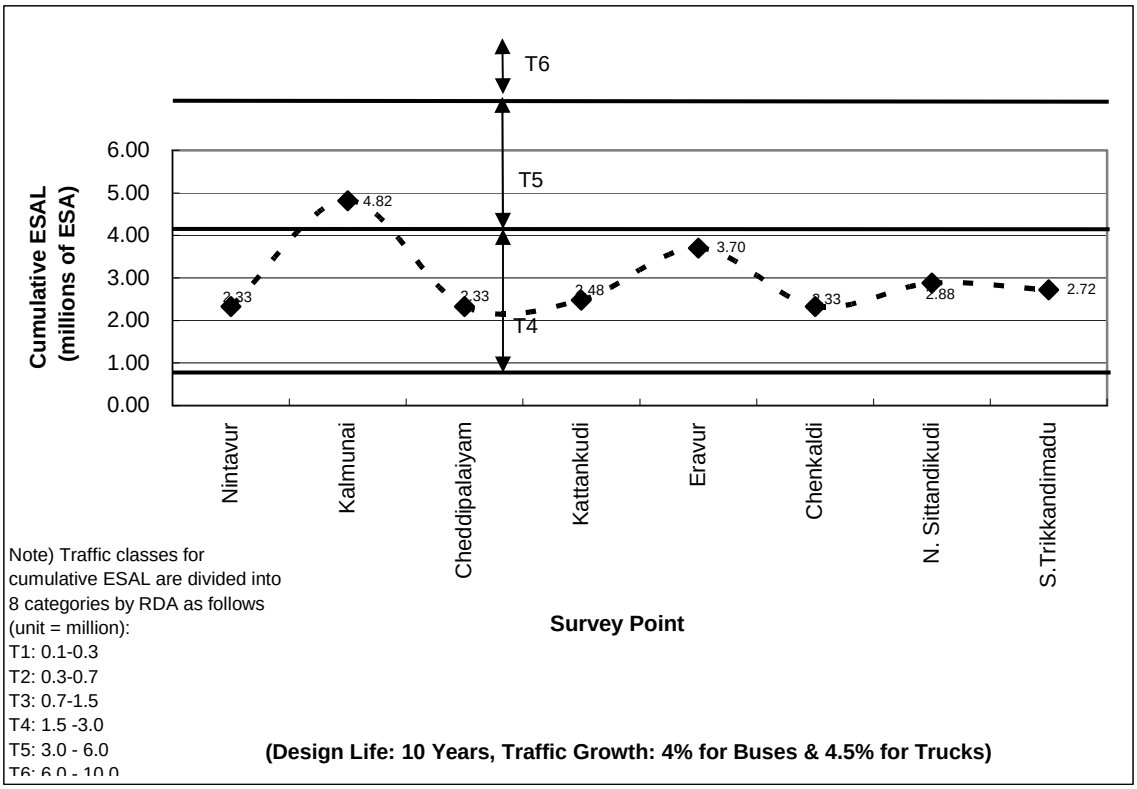


Figure 12.3. Cumulative ESAL and Traffic Class for Project Road

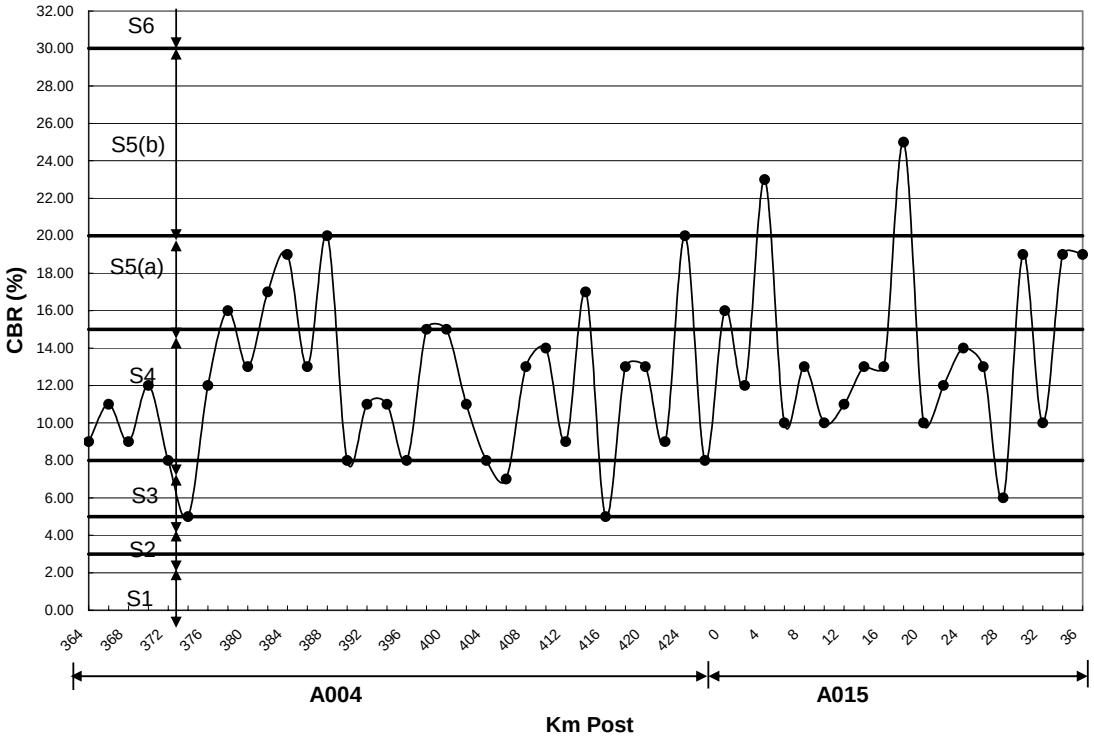
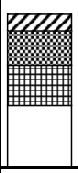
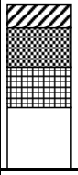
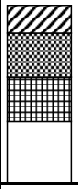
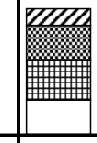
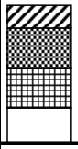
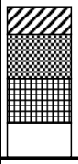
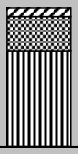
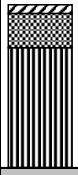
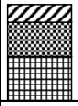
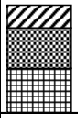
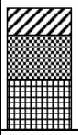
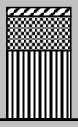
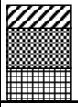
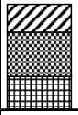
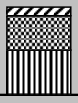
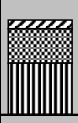
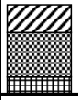


Figure 12.4. Average Sub-grade Strengths over Project Road

Table 12.3. Modified Structural Chart for AC Pavement

	Soil or Granular Subbase/ Crushed Stone Base/ Asphalt		Stabilized Subbase/ Granular Bese/ Asphalt Concrete		
	T4	T5	T6	T7	T8
S1			 100 200 225 350	 125 225 225 350	 150 250 250 350
S2			 100 200 225 200	 125 225 225 200	 150 250 250 200
S3	 50 200 550	 50 200 700	 100 200 250	 125 225 250	 150 250 275
S4	 50 200 400	 50 200 500	 100 200 175	 125 225 175	 150 250 175
S5(a)	 50 200 250	 50 200 300	 100 200 100	 125 225 100	 150 250 100
S5(b)	 50 200 150	 50 200 250	 100 200 100	 125 225 100	 150 250 100
S6			 100 200	 125 225	 150 250

The shaded cells represent applicable pavement structures for the Project road and are based on a modification of the RDA's Chart 3 in its April 1999 "A Guide to the Structural Design of Roads under Sri Lankan Conditions".

Subsequently, the optimal preliminary design has been pursued. First a comparison of the unit costs per sq. meter for the reconstruction and the asphalt overlay has been carried out as shown in Figure 12.5. As the figure indicates, it is less costly to overlay a road up to a thickness of 130mm than to reconstruct it. After this threshold is surpassed, it is more cost-effective to reconstruct than to overlay. For this Project, the average overlay thickness required to improve the Study road is 80mm. Therefore, it has been decided that not the reconstruction but the overlay work be implemented to improve the Project road. As for the type of overlay, as Figure 12.6 indicates, it is more cost-effective to apply an asphalt overlay + ABC (Aggregate Base Course) than a single asphalt overlay, which, consequently, has been recommended.

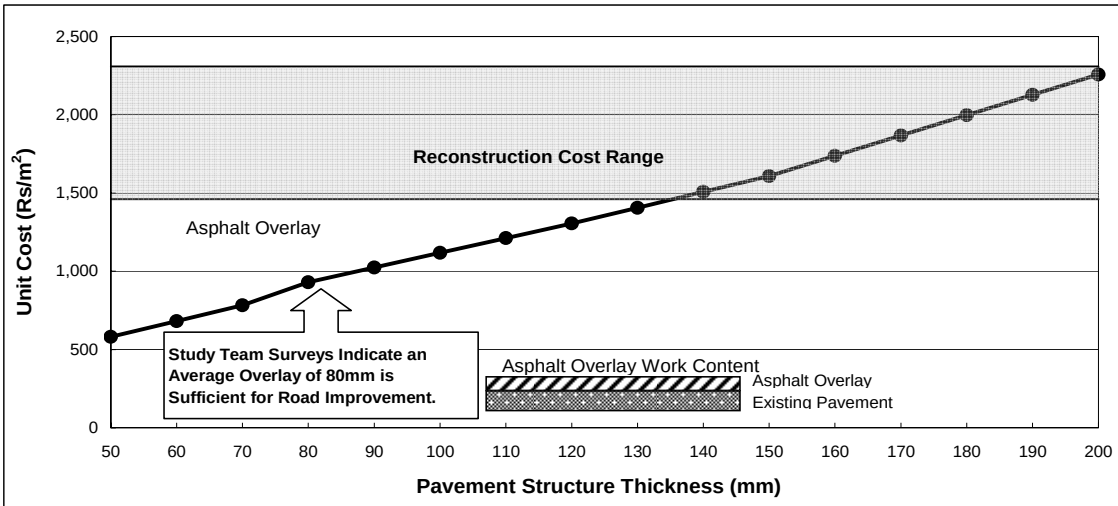


Fig. 12.5. **Reconstruction & Asphalt Overlay Unit Cost Comparison**

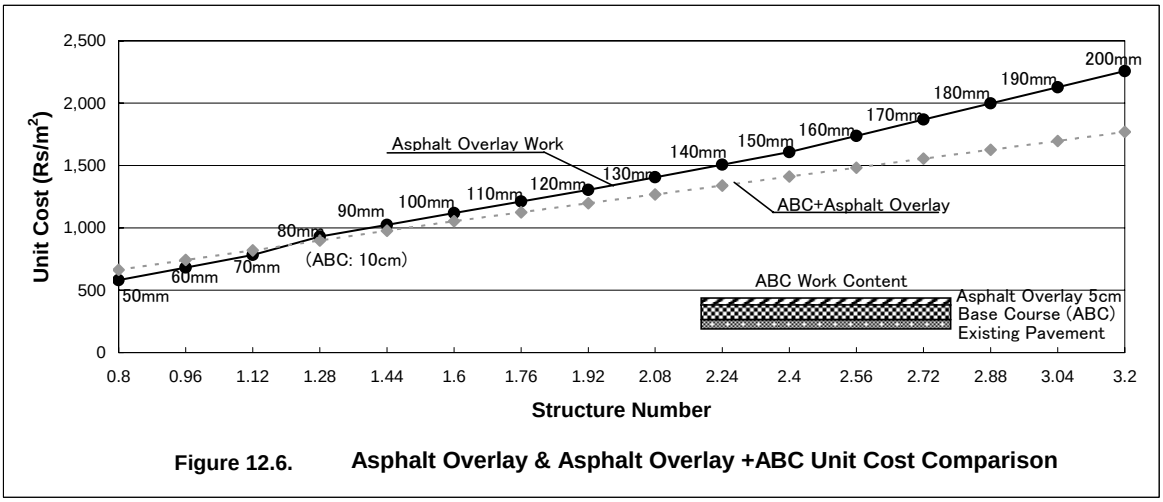


Figure 12.6. **Asphalt Overlay & Asphalt Overlay +ABC Unit Cost Comparison**

Suitable pavement structures for the asphalt overlay + ABC scenario for the different sections of Project road are illustrated in Figure 12.7. (See Table 12.4. for detailed breakdown). Note that in the case of urban road sections, only an asphalt overlay is selected.

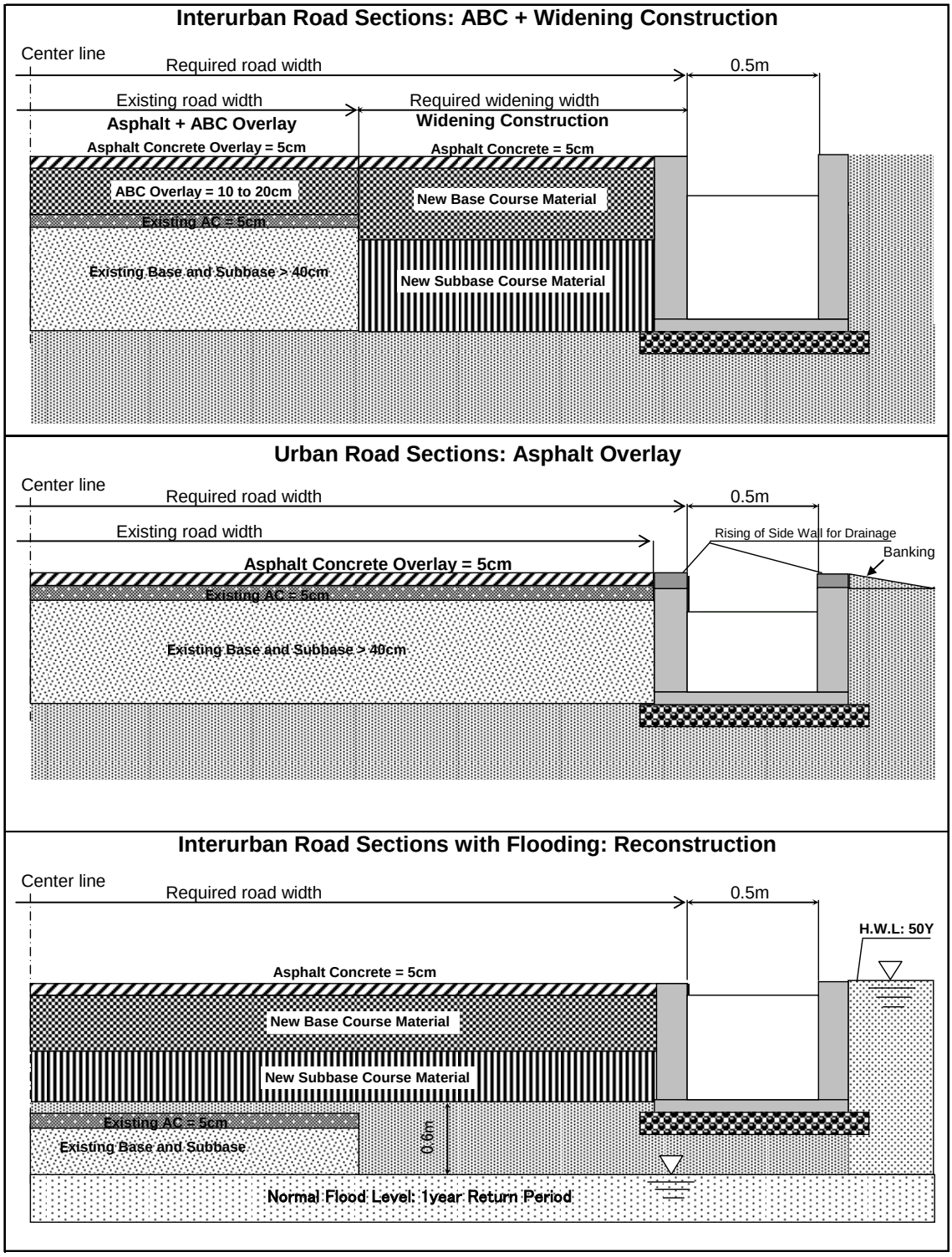


Figure 12.7. Suitable Pavement Structure

Table 12.4. Design Specifications for Most Suitable Preliminary Design for the Project Road

No.	Road	Km-P	Proposed Pavement Composition	Subgrade Class	Traffic Class	Overlay (cm)		Reconstruction (cm)		New Drain Facilities	Paving Image Plan	Return Period for Inundation Section	Remarks
						AC	ABC	Base	Subbase				
1	A04	364.00	As Overlay+Widening Construction	S4	T4	5		20	40	○			
2	A04	364.86	As Overlay+Widening Construction	S4	T4	5		20	40				Akkaraipattu
3	A04	366.40	As Overlay	S4	T4	5							ditto
4	A04	366.72	ABC+Widening Construction	S4	T4	5	10	20	40	○			
5	A04	368.19	As Overlay+Widening Construction	S4	T4	5		20	40				Addalachchena
6	A04	369.11	ABC+Widening Construction	S4	T4	5	10	20	40	○			
7	A04	370.28	ABC+Widening Construction	S4	T4	5	10	20	40				Paddy
8	A04	370.88	ABC+Widening Construction	S4	T4	5	10	20	40	○			
9	A04	372.28	ABC+Widening Construction	S4	T4	5	10	20	40				Paddy
10	A04	373.00	ABC+Widening Construction	S3	T4	5	10	20	55				ditto
11	A04	375.00	ABC+Widening Construction	S4	T4	5	10	20	40				ditto
12	A04	376.98	ABC+Widening Construction	S5(a)	T5	5	10	20	30	○			
13	A04	378.00	ABC+Widening Construction	S5(a)	T5	5	10	20	30				Paddy
14	A04	378.54	ABC+Widening Construction	S4	T5	5	15	20	50	○			
15	A04	379.66	ABC+Widening Construction	S4	T5	5	15	20	50				Nintavur
16	A04	381.00	ABC+Widening Construction	S5(a)	T5	5	10	20	30				ditto
17	A04	383.00	ABC+Widening Construction	S5(a)	T5	5	10	20	30				
18	A04	383.59	As Overlay+Widening Construction	S5(a)	T5	5		20	30				Karativu, Kalmunai
19	A04	385.00	As Overlay+Widening Construction	S4	T5	5		20	50				ditto
20	A04	387.00	As Overlay+Widening Construction	S5(b)	T5	5		20	25				ditto
21	A04	388.02	ABC+Widening Construction	S4	T4	5	10	20	40	○			
22	A04	389.00	ABC+Widening Construction	S4	T4	5	10	20	40				
23	A04	389.40	ABC+Widening Construction	S4	T4	5	10	20	40				
24	A04	390.16	ABC+Widening Construction	S4	T4	5	10	20	40				
25	A04	390.82	ABC+Widening Construction	S4	T4	5	10	20	40	○			
26	A04	393.58	ABC+Widening Construction	S4	T4	5	15	20	40	○			
27	A04	395.32	-		T4								Periya Kallar CW
28	A04	395.92	ABC+Widening Construction	S4	T4	5	10	20	40				
29	A04	396.34	ABC+Widening Construction	S4	T4	5	10	20	40				
30	A04	397.37	-		T4								Koddaia Kallar CW
31	A04	397.94	ABC+Widening Construction	S5(a)	T4	5	10	20	25	○			
32	A04	399.00	ABC+Widening Construction	S5(a)	T4	5	10	20	25	○			
33	A04	400.84	As Overlay	S5(a)	T4	5							Puddiruppu
34	A04	401.11	ABC+Widening Construction	S4	T4	5	10	20	40				Kaluwanchikudi
35	A04	401.22	ABC+Widening Construction	S4	T4	5	10	20	40	○			Cheddipalaiyam
36	A04	403.00	ABC+Widening Construction	S4	T4	5	15	20	40	○			ditto
37	A04	405.00	ABC+Widening Construction	S3	T4	5	10	20	55	○			ditto
38	A04	407.00	ABC+Widening Construction	S4	T4	5	10	20	40	○			ditto
39	A04	409.00	ABC+Widening Construction	S4	T4	5	10	20	40	○			ditto
40	A04	411.00	ABC+Widening Construction	S4	T4	5	15	20	40	○			ditto
41	A04	413.00	ABC+Widening Construction	S5(a)	T4	5	10	20	25	○			ditto
42	A04	415.00	ABC+Widening Construction	S3	T4	5	20	20	55	○			ditto
43	A04	417.00	ABC+Widening Construction	S4	T4	5	10	20	40	○			ditto
44	A04	419.08	As Overlay	S4	T4	5							Talankuda
45	A04	421.00	As Overlay	S4	T4	5							ditto
46	A04	422.26	ABC+Widening Construction	S4	T4	5	10	20	40				
47	A04	423.42	As Overlay+Widening Construction	S5(b)	T4	5		20	15				Kattankudi
48	A04	425.08	Reconstruction	S4	T4	5	20	20	40				
49	A04	426.02	Reconstruction	S4	T4	5		20	40				
50	A04	426.12	-		T4	5							N. Kalladi Bridge
51	A04	426.66	Reconstruction	S4	T4	5		20	40	○			
52	A04	426.96	As Overlay+Widening Construction	S5(a)	T5	5		20	30				Batticaloa
53	A15	0.82	As Overlay+Widening Construction	S5(a)	T5	5		20	30				ditto
54	A15	1.57	ABC+Widening Construction	S4	T5	5	20	20	50	○			
55	A15	2.86	Reconstruction	S5(b)	T5	5		20	25	○		1Year	
56	A15	4.16	ABC+Widening Construction	S5(b)	T5	5	10	20	25	○			
57	A15	4.85	ABC+Widening Construction	S5(b)	T5	5	10	20	25	○			
58	A15	5.08	Reconstruction	S4	T5	5		20	50	○		1Year	
59	A15	8.82	ABC+Widening Construction	S4	T5	5	10	20	50				ditto
60	A15	9.09	ABC+Widening Construction	S4	T5	5	20	20	50				House
61	A15	9.12	ABC+Widening Construction	S4	T5	5	20	20	50	○			
62	A15	9.59	Reconstruction	S4	T5	5		20	50	○		1Year	
63	A15	10.02	ABC+Widening Construction	S4	T5	5	20	20	50	○			
64	A15	10.45	ABC+Widening Construction	S4	T5	5	20	20	50				Paddy
65	A15	10.88	ABC+Widening Construction	S4	T5	5	10	20	50				ditto
66	A15	11.56	Reconstruction	S4	T5	5		20	50			1Year	ditto
67	A15	12.00	ABC+Widening Construction	S4	T5	5	10	20	50				
68	A15	12.69	As Overlay+Widening Construction	S4	T4	5		20	40	○			Eravur
69	A15	14.63	ABC+Widening Construction	S4	T4	5	10	20	40				
70	A15	15.07	As Overlay+Widening Construction	S4	T4	5		20	40	○			Chenkaladi
71	A15	15.73	Reconstruction	S4	T4	5		20	40	○		50Year	
72	A15	16.83	As Overlay+Widening Construction	S5(b)	T5	5		20	25			50Year	Eastern U.
73	A15	17.74	ABC+Widening Construction	S5(b)	T5	5	10	20	25	○		50Year	
74	A15	19.00	Reconstruction	S4	T5	5	10	20	50	○		50Year	
75	A15	20.50	ABC+Widening Construction	S4	T5	5	10	20	50	○		50Year	
76	A15	21.00	Reconstruction	S4	T5	5		20	50	○		50Year	
77	A15	21.32	ABC+Widening Construction	S4	T5	5	15	20	50	○			
78	A15	23.00	ABC+Widening Construction	S4	T5	5	15	20	50	○			
79	A15	25.00	ABC+Widening Construction	S4	T4	5	15	20	40	○			
80	A15	29.00	Reconstruction	S3	T4	5	20	20	55	○		50Year	
81	A15	31.00	ABC+Widening Construction	S5(a)	T4	5	10	20	40	○			
82	A15	31.39	As Overlay	S4	T4	5							Valaichchenai
83	A15	33.25	ABC+Widening Construction	S5(a)	T4	5	10	20	40	○		50Year	
84	A15	33.44	Reconstruction	S5(a)	T4	5		20	40			50Year	
85	A15	33.90	-		T4								Oddaimavudi Bridge
86	A15	34.19	ABC+Widening Construction	S5(a)	T4	5	10	20	25	○		50Year	
87	A15	34.58	Reconstruction	S5(a)	T4	5		20	25	○		50Year	
88	A15	34.82	ABC+Widening Construction	S5(a)	T4	5	10	20	25	○			

: AC Overlay
: ABC
: Widening Construction
: Reconstruction

13 Preliminary Design of New Kallady Bridge

13.1 Design Policy & Concept

The basic design policy and concept for the New Kallady Bridge are as described below.

- Total width of New Kallady Bridge will be 14m, consisting of a 7.4m width dual carriageway determined in conformity with the Bridge Design Manual and sidewalks on either side.
- In consideration of minimizing social and environmental impacts, facilities of the Bridge and the approach roads are to be contained within the right-of-way or on government land and, therefore, no land acquisition or relocation is required.
- Bridge design shall minimize initial construction costs by procuring local materials and equipment and adopting appropriate construction methods, and a structure will be selected to minimize maintenance costs.
- The existing steel truss Kallady Bridge built in the 1920's by the UK will remain as is.
- The New Kallady Bridge's girder soffit shall be higher than that of the existing bridge in order to keep the present navigational clearance. Also, the present span length shall be secured for horizontal navigational clearance. Note that the span length of the new bridge shall be longer than the present span length of the existing bridge.
- Pavement design life of the approach road is assumed to be 10 years in accordance with the Project road design policy.

13.2 Bridge Location

Initially a couple of alternatives for the location of the New Kallady Bridge were considered. However, in discussions with RDA during the course of the Study, it was decided that the new bridge's location be restricted to the proximity of and in parallel with the existing bridge, taking into account the principle of no land acquisition and resettlement. Thus, the upstream side was selected to avoid private and army lands close to the road on both banks. The substructures of the new bridge to be adjacent to the existing one shall be constructed on the same line as those of the existing bridge against the lagoon flow. Accordingly, in order to secure a sufficient distance to avoid undesirable influences from proximate construction that is too close, the center-to-center distance between the centerlines of the existing and new bridges is to be 20m.

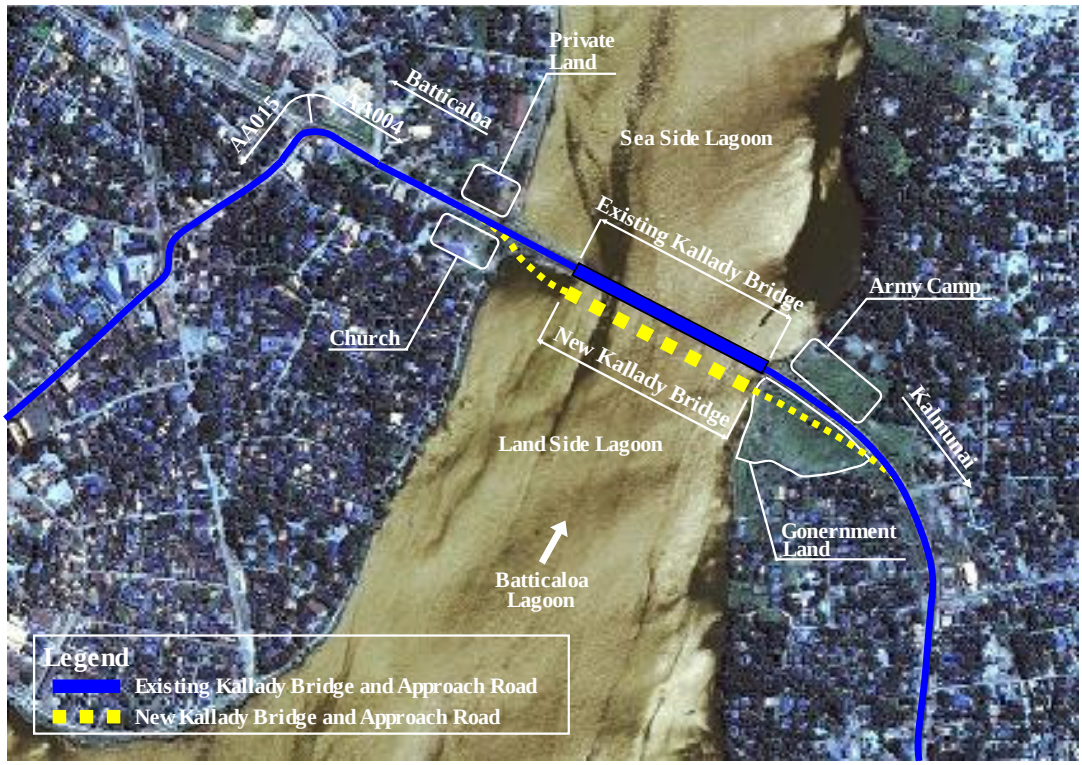


Figure 13.1. Proposed Alignment of New Kallady Bridge & Approach Roads

13.3 Bridge Width

The proposed width of the carriageway is 7.4m (2 lanes x 3.5m +2 shoulders x 0.2m) based on the typical cross section for a 2-lane bridge for a Class A road, with a 1.5m cycle lane and a 1.8m sidewalk on both sides, resulting in a total bridge width of 14.0m. Motorized and non-motorized traffic will be fully separated by installing a curb in compliance with RDA standards at the edge of the carriageway and mounting up the cycle lanes and sidewalks. Hand-railings of pre-cast concrete complying with RDA standards will be installed at the edge of the sidewalks for pedestrian safety. The Bridge cross section is as shown in Figure 13.2, as well as that of the approach roads at both ends of the Bridge in Figure 13.3.

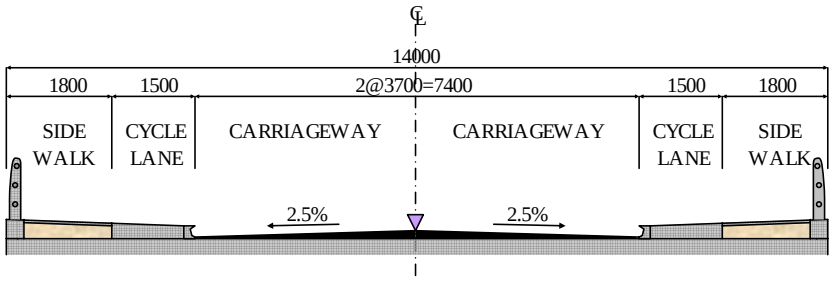


Figure 13.2. Bridge Cross Section

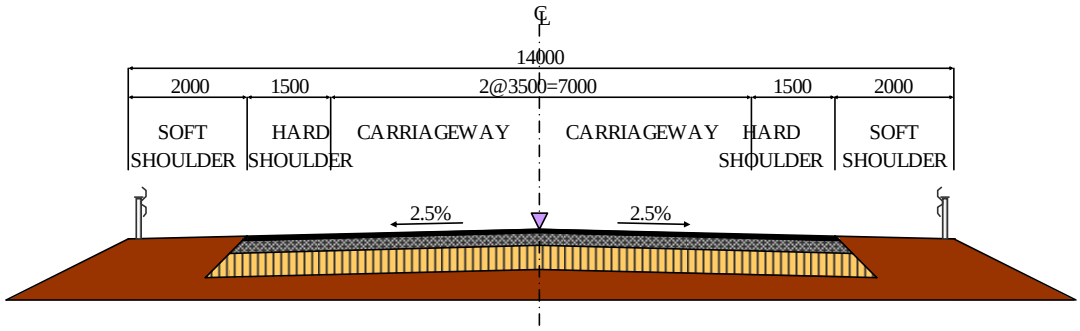


Figure 13.3. Approach Road Section

13.4 Bridge Design Criteria

The preliminary design of the New Kallady Bridge was carried out based on RDA's Bridge Design Manual and British Standards. The detailed design shall also apply both of these criteria.

13.5 Bridge Structure Type & Outlines of Preliminary Design

The proposed bridge structure type for the preliminary design of the New Kallady Bridge consists of a 6-span continuous PC box girder for the superstructure, with the substructure consisting of RC walls and pile-cap piers over cast-in-situ RC piles with steel tubular pipes and reversed T-type abutments (see Table 13.1.). The features of the preliminary design for the New Kallady Bridge are shown in Table.13.2. and Figure 13.4.

Table 13.1. Summary of Bridge Structure Type

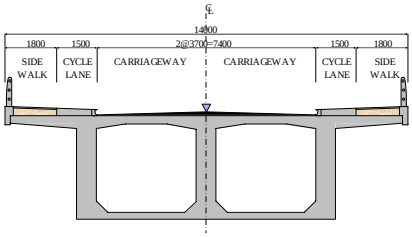
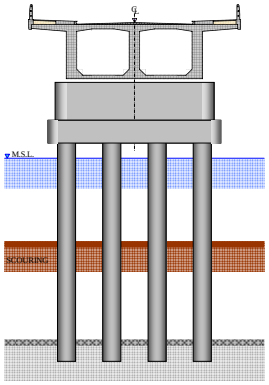
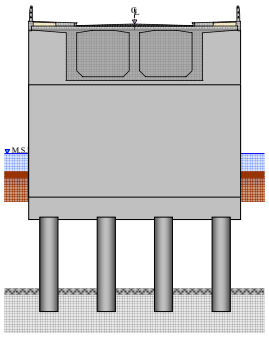
Structure	Outline View (Cross Section)	Comments for Selection
Superstructure		Concrete bridge is more preferable than steel from viewpoints of economical efficiency and maintenance. The selected bridge type is a continuous box-girder bridge with the same span lengths as the existing trussed bridge, satisfying the required opening width. The extrusion method for erecting girders is reasonable due to the deep depth of water in the lagoon.
Substructure Pier		Cast-in-situ protrusion RC pile foundation is selected due to economic efficiency and constructability because of the deep water lagoon and the deep supporting stratum of rock. RC piles are surrounded by a permanent steel tubular pipe for excavation to be used as a stand pipe and concreting work in the water. The pier body is RC wall and pile cap for constructability and structural reliability.
Substructure Abutment		The selected abutment body is a RC reversed-T type as economical efficiency and stability at a height of abutment ranging 6m to 15m. The same RC pile foundation as the pier foundation is selected for economical and constructability.

Table 13.2. Outline of the Facility Plan

Items				Plan
Improvement Method				The bridge will be constructed at parallel with the existing bridge
Bridge Design	Length	Bridge Length		289.5m
		Span Arrangements		6 x 48.05m
	Type	Superstructure		6-span continuous PC box girder (Extruded construction)
		Abutments		RC reversed-T type
		Piers		RC wall and pile cap (oval shape)
		Foundation	Pier	Cast-in-situ protrusion RC pile with steel tubular pipe (dia. 1.2m)
			Abutment	Cast-in-situ RC pile (dia. 1.2m)
		Pavement	Carriageway	Asphalt concrete
			Cycle Lane	Cast-in-situ concrete
			Sidewalk	Pre-cast concrete panel
	Accessory	Expansion Joint		Steel finger type joint on A1 and A2 abutments
		Bearing		Elastic rubber type bearings
Riverside Protection		Bank Protection		A1 side: Soil embankment A2 side: Grouted riprap
		Riverbed Protection		None
Incidental Facilities		Safety Barriers	Handrail	Pre-cast concrete rail (Sri Lankan typical type)
			Curb	Pre-cast Concrete curb at edge of sidewalks
		Drainage		Steel pipe type vertical drain
		Road Marking		Center and shoulder lines
Utility Plan		Road Lighting Poles		Keep spaces in handrail for future installation
		Water Pipe		Water pipes (2×dia.450mm) will be installed on brackets of both outsides of girder web
		Utility Space		Future installation space under mounted up sidewalks
Approach Road		Length		Kalmunai side: approx. 145m Batticaloa side: approx. 105m
		Pavement		Asphalt concrete
		Bank Protection		A1 side: Soil embankment A2 side: Grouted riprap in water
		Safety Barriers		Steel guard rail on embankment higher than 2m

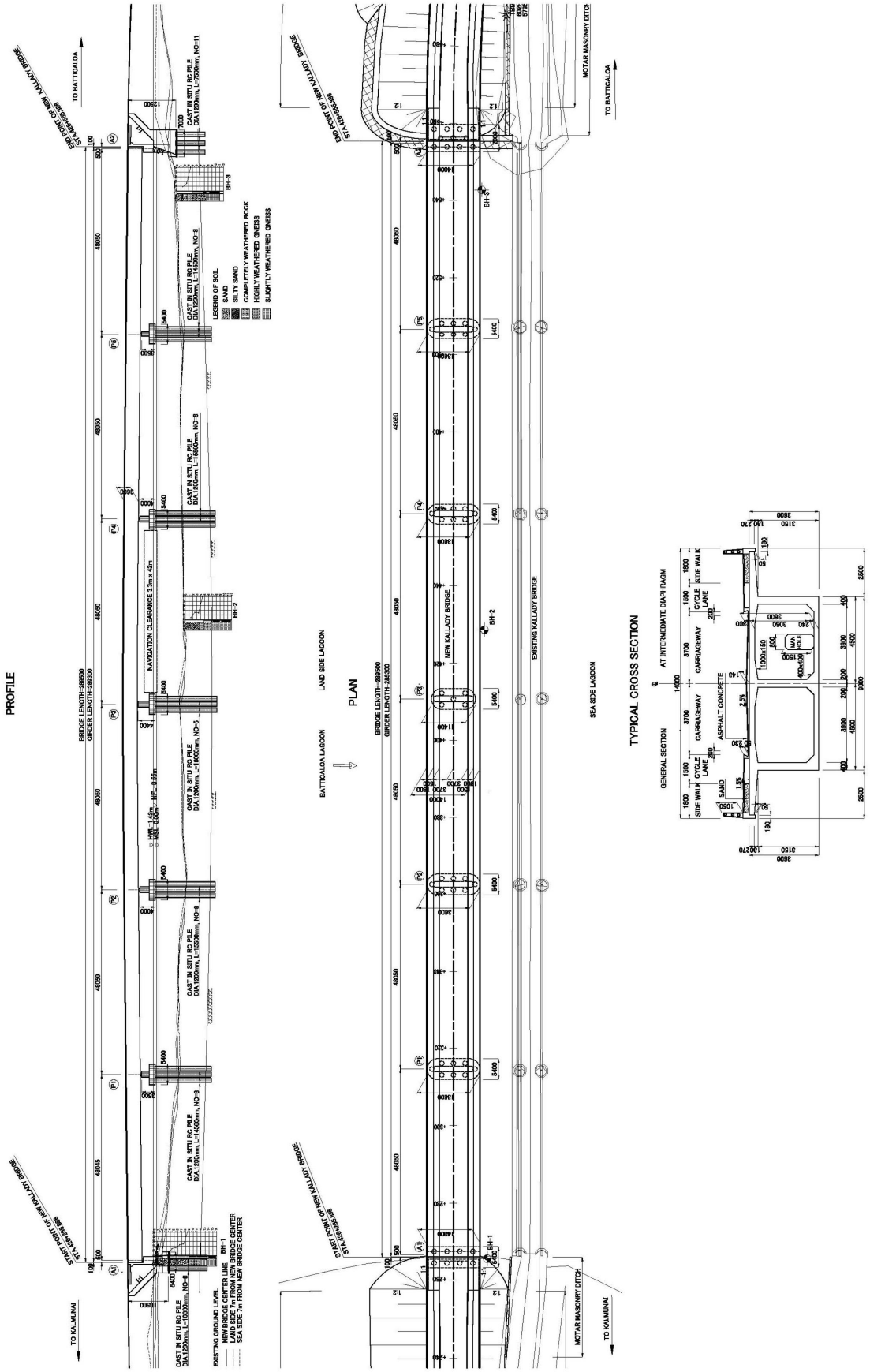


Figure 13.4. Outline Drawing of New Kallady Bridge

14 Preliminary Construction Planning & Cost Estimate for Rehabilitation Project

14.1 Preliminary Construction Planning for Rehabilitation Project

As a result of discussions with RDA and JIBC, the rehabilitation of the trunk road between Akkaraipattu and Trikkandimadu and the construction of the New Kallady Bridge will be carried out as one package. Note that the design-build method will be adopted and the contractor will carry out both the detailed design, which will be checked by the Engineer and RDA, and construction in order to reduce total Project time.

14.1.1 Rehabilitation Work of Project Road

The Project road, which is located in a lowland area, lies between lagoons and the seashore and it is difficult to find borrow material pits and quarries of sufficient quality nearby. Borrow and river sand pits are located at an average distance of approximately 25 km and 20 km away from the Project area. The LTTE controls territory on the northern side of the Project road in several places and there are some borrow and river sand material pits available. Hence, it is necessary to come to an agreement with the LTTE with the mediation of the local RDA in order to assess them for construction work. However, quarries within LTTE areas may not be practical under the current situation, since the Government has imposed a ban on use of the explosives in these areas. The RDA Ampara office is instead suggesting that the Project use a government quarry, which is currently not in operation. This would result in average hauling distance increasing to approximately 65km.

The weather pattern for the Project area is characterized by two seasons: a rainy season (from mid October to mid January) and a dry season (from mid January to mid October). In the rainy season, there is on average an hourly rainfall of over 5mm. Hence it will be difficult to carry out roadwork during this period. During construction it is necessary to avoid any hindrance to the public and traffic. Since the minimum constructed road width is 9.0 m, it is possible to carry out construction in two stages, with each half of the road to be built in separate stages as shown in Figure 14.1.

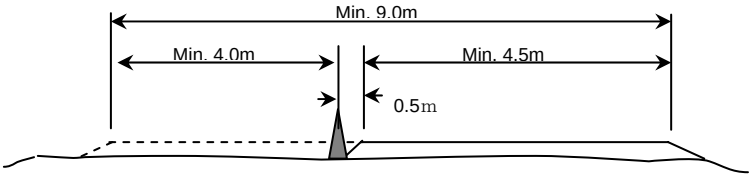


Figure 14.1. Two Stages Construction

14.1.2 New Kallady Bridge

All piers of the New Kallady Bridge are located in the lagoon. Since the water levels of the lagoon rise as high as approximately 1.0 m above the normal water level during the rainy season, substructure work has to be implemented during the dry season. Prior to substructure work, a temporary platform (jetty) will be erected as shown in Figure 14.2.

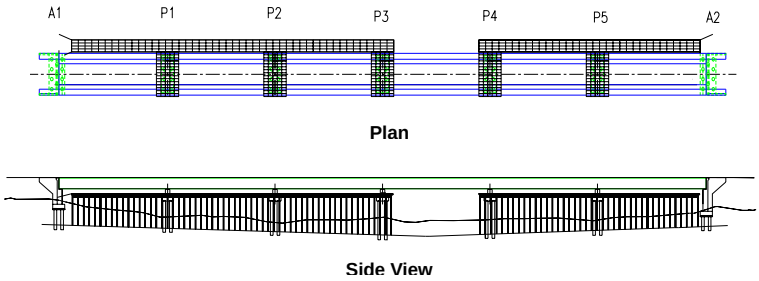


Figure 14.2. Temporary Platform (Jetty)

The possibility of using barges instead of a jetty was also considered. However, barges with adequate capacity for this work are difficult to find in Sri Lanka, and it is possible to get them to site via the sea only during rainy season, since the sand bar in the Batticaloa lagoon will be submerged at that time.

The all-casing method, which uses permanent steel casings to prevent bored holes in the sand layers from collapsing and can cast concrete in the lagoon, is recommended for the piling works of foundations. As for pile cap construction, steel formwork or pre-cast concrete panel will be introduced for the bottom formwork and will be supported by H-iron frames that will be assembled in place by using steel bracket at piles.

The incremental launching method will be used to erect the superstructure with isometric PC box girders. The fabrication and erection of the superstructure will be carried out during both the dry and rainy seasons. The incremental launching method step is as shown in Figure 14.3.

After the erection of girders is completed, the parapet walls on the abutments will be constructed, as well as the bridge accessory work to be undertaken in sequence.

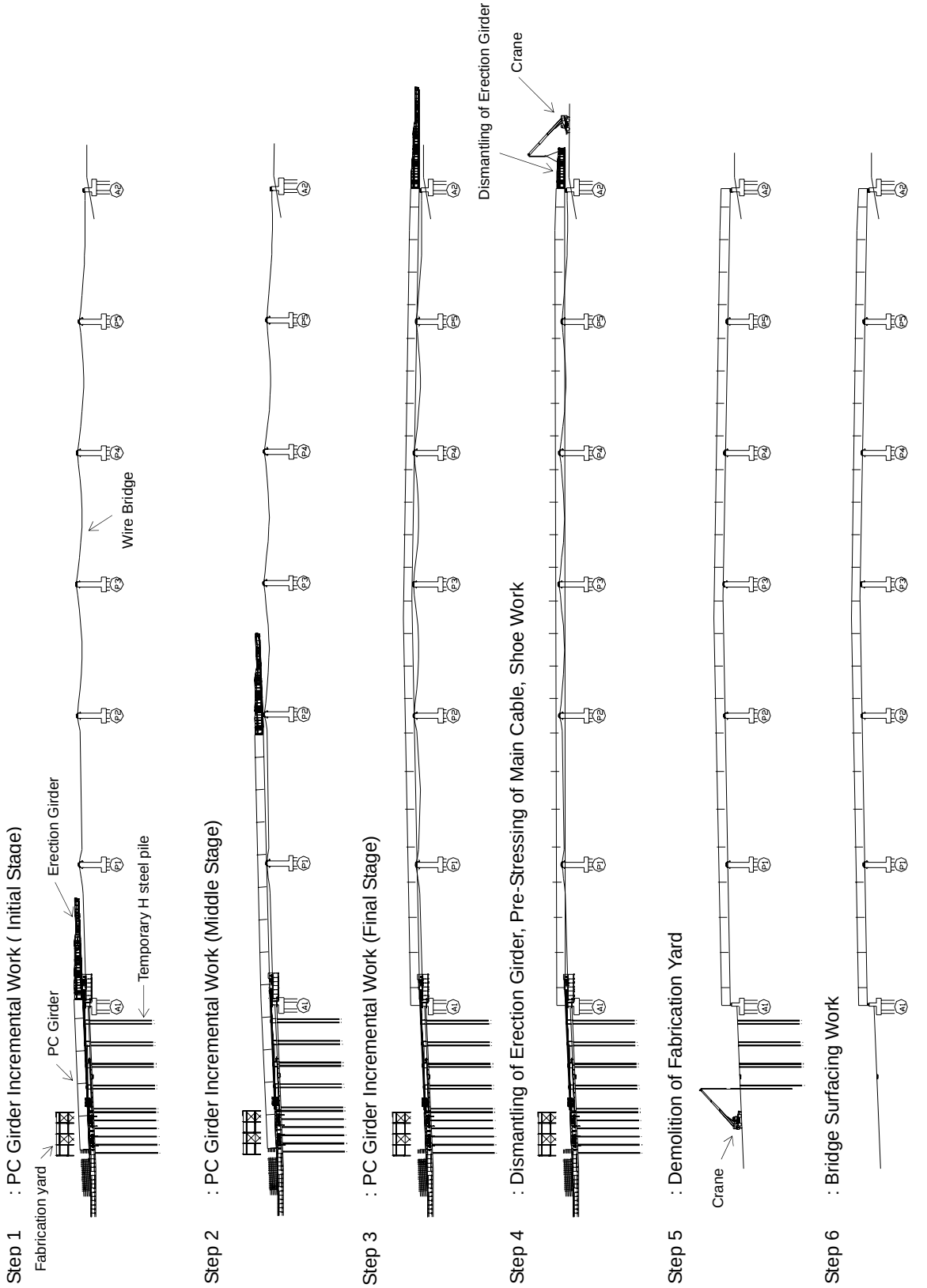


Figure 14.3. Incremental Launching Method

14.1.3 Construction Schedule

Taking into account the work volume, working rate, and the need to minimize disturbances to road traffic caused by the hauling of materials, the construction period was set at 2.5 years for the road rehabilitation work between Akkaraipattu and Trikkandimadu and the construction work of the New Kallady Bridge, which will be carried out in parallel.

Table 14.1. Construction Schedule

11 Nov 2005

ITEM	MONTH																												
Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
ROAD WORK between Akkaraipattu and Trikkandimadu																														
MOBILIZATION																														
Establishment of office and Laboratory																														
Mobilization of plant & Equipment																														
Temporary works (Surveying)																														
SITE CLEARANCE																														
Relocation of Existing Utilities																														
Cleaning & Grubbing																														
ROAD WORK																														
Earth work																														
Sub base Course																														
Base Course																														
Asphalt Paving																														
ROAD STRUCTURES																														
Box culvert, Pipe Culvert,																														
Ditch, etc																														
MISCELLANEOUS																														
Road Signs, Road Markings, Lighting																														
NEW KALLADY BRIDGE WORK incl. 250m approach road																														
MOBILIZATION																														
Establishment of office and Laboratory																														
Mobilization of plant & Equipment																														
Site Surveying																														
Detailed Design																														
BRIDGE WORK																														
Temporary works (Jetty)																														
Piling work																														
Pier & Abutment																														
Preparation work for Superstructure																														
Girder fabrication work																														
Girder erection work & Shoe work																														
Bridge surfacing work																														
Abutment parapet & wingwall work																														
APPROACH ROAD WORK																														
Earth filing work																														
Pavement, Ditch, etc																														
HANDING OVER & DEMOBILIZATION																														
Handover & Demobilization																														

14.2 Preliminary Cost Estimate for Rehabilitation Project

The Project cost is estimated based on the results of this feasibility study and the implementation plan. To arrive at the total Project cost, unit rate components were prepared applying the Sri Lanka Highway Schedule of Rates (HSR) and the Japanese Cost Estimate Standard. When these two were not applicable, consultations were held with relevant contractors to obtain the unit-cost information. In addition, costs were compared with those for the recent major road construction projects funded by international donor agencies in Sri Lanka to confirm their reliability. Thus, the construction cost and total Project cost were estimated as part of the outputs of this feasibility study as shown in Table 14.2. Note that the construction cost includes the detailed design cost as preliminary item, and, consequently, the engineering services cost includes the supervising of the construction work only.

Table 14.2. Preliminary Estimated Project Cost*

Description	Cost (million Rs.)
1. Road between Akkaraippattu and Trikkandimadu	2,213
2. New Kallady Bridge (incl. 250m approach road)	709
3. Relocation of existing public utilities	198
3.1. Electricity	118
3.2. Telephone line	59
3.3. Water supply	21
4. Contingency	312
Total Construction cost (1,2,3,4)	**3,432**
5. Engineering Services (incl. 10% contingency)	417
6. Land Acquisition & Compensation	50
Total Project cost (1,2,3,4,5,6)	**3,899**

Note: *Excluding VAT and the price contingency, Exchange rate Rs.1 = JPY 1.11 (Ave. Aug 2005)

15 Project Evaluation

15.1 Objective

Given that the Sri Lankan and Japanese Governments have essentially decided that the Project road be improved as part of an emergency effort to rehabilitate Tsunami-affected infrastructure, it is important that cost-effectiveness be considered. For this reason, least cost (LC) analysis is carried out to confirm that the overlay/ABC method recommended in Chapter 12 is economically less costly than reconstruction. After that, economic viability of the alternative selected in the LC analysis is examined applying benefit cost (BC) analysis.

15.2 Project Costs & Benefits

Project costs and benefits (including the New Kallady Bridge) are evaluated over the period of 2006 to 2020 for LC analysis, which is based on the Project road design life of 10 years adopted after analysis and discussions with RDA. As for the BC analysis, a 10-year period is too short to sufficiently consider benefits that will flow from the improvement of the Project road.[1] Therefore, 15- and 20-year periods of time for economic evaluation are taken up. The Project costs and benefits examined in this report are as described in Table 15.1.

Table 15.1. List of Project Costs & Benefits

Project Costs	Construction cost
	Compensation for loss of land use cost
	Engineering services cost
	O&M cost
Project Benefits[2]	VOC saving
	Travel time saving

15.3 Cost & Benefit Valuation

The domestic price numeraire is applied for economic evaluation using domestic market prices as the common denominator, with costs/benefits updated to constant 2005 economic prices in Sri Lankan rupees (Rs). Project inputs/outputs are then broken down into tradable and non-tradable items. In the case of tradable items the exchange rate from the Bank of Japan (Aug. 2005) of Rs 0.901 to 1.00 Japanese yen is applied, together with a shadow

[1] According to the UK's Transport and Road Research Laboratory, an analysis period of 15 years is normal for most road projects. Note that 20 years is usually considered to be the maximum.
[2] Benefits from reductions in traffic accidents are usually considered, but the Project will not reduce the amount of travel so this is not considered.

exchange rate factor of 1.042 to take into account foreign exchange effects. For Project components purchased in Sri Lanka no conversion factor is needed, since it is assumed that the market is competitive for these resources and also because they do not impact on exports/imports. Note all taxes/duties are excluded from economic costs. As for Project benefits, since they consist of location-specific intangibles such as time saving, they are considered non-tradable goods and are also evaluated without applying a conversion factor. Other important cost-benefit assumptions are as follows:

- Trips for non-work purpose valuated at 20% of trips made for work purposes.
- Generated trips not expected unless the Trikkandimadu-Trincomalee link is realized.
- Changes in O&M and residual costs are reflected in the different evaluation periods.

15.4 Least Cost Analysis

The results of the LC analysis are shown in Table 15.2. Note that a discount rate of 12% is applied, as this is standard practice. As the table indicates, net present value (NPV) for the reconstruction alternative is about Rs. 2361 million, while the NPV for the overlay/ABC alternative is about Rs.2138 million. Based on this, it is recommended that the overlay/ABC alternative in Chapter 12 be implemented to improve the Project road.

Table 15.2. Least Cost Analysis of Reconstruction & Overlay + ABC Alternatives (Constant 2005 Economic Prices)

Year	Reconstruction Alternative			Overlay/ABC Alternative		
	Capital Costs	O&M Costs	NPV of Total Costs (12% Discount Rate)	Capital Costs	O&M Costs	NPV of Total Costs (12% Discount Rate)
2006	25.00	0.00	25.00	25.00	0.00	25.00
2007	1429.73	0.00	1,429.73	1,357.07	0.00	1,357.07
2008	2045.94	0.00	2,045.94	1,939.66	0.00	1,939.66
2009	905.95	0.00	905.95	861.22	0.00	861.22
2010	0.00	10.31	10.31	0.00	10.31	10.31
2011	0.00	10.31	10.31	0.00	10.31	10.31
2012	0.00	10.31	10.31	0.00	10.31	10.31
2013	0.00	10.31	10.31	0.00	10.31	10.31
2014	0.00	10.31	10.31	0.00	10.31	10.31
2015	0.00	10.31	10.31	0.00	10.31	10.31
2016	0.00	10.31	10.31	0.00	10.31	10.31
2017	0.00	10.31	10.31	0.00	10.31	10.31
2018	0.00	10.31	10.31	0.00	10.31	10.31
2019	0.00	10.31	10.31	0.00	10.31	10.31
2020	(2755.30)	606.88	(2,148.42)	(2,755.30)	606.88	(2,148.42)
Total	1,651.33	709.99	**2,361.32**	1,427.65	709.99	**2,137.63**

15.5 Benefit Cost Analysis of Selected Least Cost Alternative

BC analysis is carried out for the three evaluation periods of 10, 15, and 20 years (see Table 15.3). As the table shows, the economic internal rate of return (EIRR) increases the

longer the evaluation period. In the case of a 10-year period, the EIRR is only 7.76%, meaning the Project road is not economically viable. On the other hand, the EIRR for 15- and 20-year periods is 9.40% and 10.10%. In terms of economic justification, an EIRR of at least 10% should be obtained, meaning the Project satisfies the bare minimum if a longer evaluation period is applied.[3]

Table 15.3. EIRR by Evaluation Period

Evaluation Period	EIRR
10 Years (2010-2020)	7.76%
15 Years (2010-2025)	9.40%
20 Years (2010-2030)	10.10%

Note: The above values are 8.00%, 9.48%, and 10.32%, respectively, in the case when non-work trips are evaluated as zero.

Note that with the lack of sufficient time-series data for the Project road, the margin of error regarding benefits could reach 20%. This could push the EIRR up to 12% for the 20-year evaluation period, which is an acceptable time period given that changes in basic infrastructure are not rapid and that Project road trip patterns are strongly linear. Details of the analysis of the EIRR and NPV for the 20-year time period are as shown in Table 15.4.

Table 15.4. EIRR & NPV of Project Road
(Constant 2005 economic prices, domestic price numeraire, Rs. million)

Year	Costs				Benefits			Results
	Capital Costs	O&M Costs	Compensation Costs	Total Costs	VOC Savings	Time Savings	Total Benefits	Net Benefit
2006			25.0	25.0				(25.0)
2007	1344.6		12.5	1357.1				(1357.1)
2008	1927.2		12.5	1939.7				(1939.7)
2009	861.2			861.2				(861.2)
2010		10.3		10.3	335.0	56.0	391.0	380.7
2011		10.3		10.3	356.9	62.0	419.0	408.6
2012		10.3		10.3	378.9	68.0	446.9	436.6
2013		10.3		10.3	400.9	74.0	474.8	464.5
2014		10.3		10.3	422.8	80.0	502.8	492.5
2015		10.3		10.3	444.8	85.9	530.7	520.4
2016		10.3		10.3	466.7	91.9	558.7	548.4
2017		10.3		10.3	488.7	97.9	586.6	576.3
2018		10.3		10.3	510.7	103.9	614.6	604.2
2019		10.3		10.3	532.6	109.9	642.5	632.2
2020		606.9		606.9	554.6	115.8	670.4	63.6
2021		10.3		10.3	576.6	121.8	698.4	688.1
2022		10.3		10.3	598.5	127.8	726.3	716.0
2023		10.3		10.3	620.5	133.8	754.3	744.0
2024		10.3		10.3	642.5	139.8	782.2	771.9
2025		10.3		10.3	664.4	145.7	810.2	799.8
2026		10.3		10.3	670.6	153.3	823.9	813.6
2027		10.3		10.3	676.7	161.0	837.7	827.4
2028		10.3		10.3	682.9	168.6	851.4	841.1
2029		10.3		10.3	689.0	176.2	865.2	854.9
2030	(1377.6)	1098.4		(279.2)	695.2	183.8	878.9	1158.1
							EIRR= 10.10%	
							NPV at 12% = -478 million	

[3] An EIRR of 12% is usually considered to be the threshold for economic viability. On the other hand, in the case where there are significant non-quantifiable benefits an EIRR greater than 10% may be acceptable to international donors.

Given the above, it is recommended that sensitivity analysis be carried out for the 20-year evaluation time period. However, prior to that, the potential economic impact of the Trikkandimadu - Trincomalee missing link on the Project road, which would result in new trips being generated, was estimated. This was done assuming that the price elasticity of demand for transport regarding this improvement, which will result in a decrease of about 60% in door-to-door transport costs for trips coming from and going to Trincomalee, is -2.[4] Based on this, an EIRR of 10.43% and a NPV of Rs. –398 million was calculated.

15.6 Sensitivity Analysis

Sensitivity analysis is carried out below for the Project road without and with the Trikkandimadu - Trincomalee link for a 20-year evaluation period.

Table 15.5. Sensitivity Analysis (without Trikkandimadu - Trincomalee Link)

Scenario	EIRR (%)	NPV (Mil. of Rs)	Switching Value
Benefits			
+10%	11.19	(186)	Base X 1.1774
+20%	12.23	61	
Costs			
-10%	11.31	(143)	Base X 0.8493
-20%	12.78	148	

Table 15.6. Sensitivity Analysis (with Trikkandimadu - Trincomalee Link)

Scenario	EIRR (%)	NPV (Mil. of Rs)	Switching Value
Benefits			
+10%	11.54	(108)	Base X 1.1435
+20%	12.59	157	
Costs			
-10%	11.66	(72)	Base X 0.8745
-20%	13.14	219	

In the case of the missing link not being constructed, benefits have to increase by about 18% or costs decrease by about 15% before the NPV is positive and the EIRR exceeds 12%. In the case of the missing link being constructed, an increase in benefits of about 14% or a decrease in costs by about 13% is required for the NPV to become positive. In the opinion of the consultant, either of these scenarios is highly possible given the variability of the data and the fact that land development impacts are not considered. Therefore, the Project should not be delayed for the sole reason of the EIRR being less than 12%.

[4] According to the UK's Transport and Road Research Laboratory, the range in developing countries for the price elasticity of demand for transport is -0.6 to –2.0, with an average of about –1.0. It was decided here to apply the maximum value given the large improvement in accessibility.

16 Community Support Program for Rehabilitation Project

16.1 Community Support for Eastern Trunk Road Rehabilitation

As in the case of the Emergency Recovery Project (four causeways reconstruction), the Rehabilitation Project to improve a 100km stretch of the National Highway AA004/AA015 between Akkaraipattu in Ampara District and Trikkandimadu in Batticaloa district has been conceived as an engineering project. However, in this Project, the intended community support takes two forms.

1. Income-earning opportunities would be generated for those tsunami victims who had lost all their means of livelihood via employment in the construction works as well through supplying goods and services to be consumed on the project.

2. Additional community support is expected from the Kalmunai Township Redevelopment (KTR) project currently being conceived under a parallel JICA study (Recovery, Rehabilitation and Development Project for Tsunami Affected Areas of Northern and Eastern Region – referred to as JICA Northeast Study), which is expected to provide other major elements of community support.

16.2 Context of KTR for Eastern Trunk Road Rehabilitation

The Municipality of Kalmunai, which is situated two thirds of the way towards Akkaraipattu on the AA004 is to be rehabilitated under this project and is the most densely populated segment of this road. It also contains a coastal area that experienced the worst impact of the tsunami in Sri Lanka. Thus, the KTR project is being conceived as a way to recover from the tsunami on the one hand and as an opportunity to develop the Kalmunai municipal area into a progressive disaster-resistant city on the other. The KTR features elements on either side of the AA004 with extensive redevelopment being proposed to the west of the road.

16.3 Conceptualizing the KTR Plan

The KTR has been conceived with a set of governing principles and is driven by certain conditions “on the ground” and are described below.

16.3.1 Governing Principles

1. The KTR is not only to reflect the recovery, rehabilitation and reconstruction of all tsunami affected areas, but also the opportunities and constraints for socioeconomic progress and enhanced environmental protection and management of the area.
2. The KTR is to explicitly express natural disaster resistant features.
3. The KTR planning process is to be essentially community driven, technologically adequate and environmentally sound.
4. The KTR is to be compatible with the "Eastern Province Physical Plan (2004)" and "Master Plan for Ampara District (ongoing)" initiated and conducted by the Sri Lankan Government.

16.3.2 Basic Consideration for KTR Concept Plan

1. The existing Kalmunai Township had grown unplanned over the years and, consequently, calls for urgent regularization and upgrading of basic infrastructure, services and facilities.
2. For a significant proportion of the community dependent on fishing and related activities, there is a serious lack of formal safe landing facilities.
3. The annual monsoonal floods limit agricultural production to a single harvest per year on most inland areas west of National Highway AA004 and it is uneconomical to continue such agricultural production. Therefore, some land owners desire to reclaim these lands for more lucrative urban development.
4. Various recent studies on Kalmunai Township development have consistently identified land to the west of AA004 for reclamation and urban development.
5. In addition to providing for natural population increases, the tsunami related massive depreciation of the housing stock requires urgent, large scale re-housing and resettlement, and several public institutions and facilities should also be reconstructed or rehabilitated.
6. Opportunities need to be created to sustain and enhance cottage industries, such as handloom weaving and gold jewelry manufacturing currently unique to Kalmunai as an alternative to the traditional agriculture and fisheries based economy.
7. A comprehensive disaster mitigation and management plan needs to be developed and implemented

16.4 Potential Community Support Sub-Projects in the KTR Project

The conceptual plan for KTR keeps National Highway AA004 as its axis and has the following main features:

1. All new development would be planned to the west, and reconstruction and rehabilitation would be pursued to the east while maintaining a 65m buffer zone.
2. Tsunami related resettlement housing and those for natural increases in population would be planned for in new residential areas on the west and all tsunami damaged public institutions in the east would be reconstructed in the west.
3. To the west, less productive agricultural land and marshy areas close to National Highway AA004 would be reclaimed for future urban development.
4. Land use to the west would be planned according to zoned precincts for various urban functions – institutional, residential, commercial and recreational.
5. Urban development would also include a multi-function centre – "Michinoeki"- at an appropriate transportation node to provide rest and recreation facilities to long-distance public transport users as well as a facility for producers of indigenous goods to popularize and market local goods.
6. To the east, a buffer zone would be developed into a series of beach parks and a Tsunami Memorial would be sited there.
7. Suitable safe landing facilities and anchorages would be constructed for the fishing community, which would be complemented with appropriate fish handling facilities including ice plants.
8. Inland waterways (locally referred to as "thonas") would be rehabilitated and beautified to serve as potential areas for local recreation.
9. A feasibility study would be carried out to examine if the "thonas" at the sea-end (currently dried up) could be developed into fisheries marinas with canals dredged to the sea allowing fishing boats to be brought into the "thonas" for anchoring.

16.5 Conclusion

The Rehabilitation Project is to provide employment opportunities for tsunami affected people who have temporarily lost their means of livelihood. The KTR plan, on the other hand, is to make significant positive impacts on socioeconomic development of the overall community (including people affected by the tsunami).

17 Plan for Maintenance of Rehabilitated Road Facilities

17.1 Basic Types of Facilities to Maintain

The purpose of maintenance is to ensure the preservation of the road facilities as well as the safety of those who use it. The facilities and maintenance work that should be considered, but not be limited to, are classified in Table 17.1.

Table 17.1. Basic Types of Facility Maintenance & Objectives

Type of Facility Maintenance	Facilities Concerned	Objective
Pavement Maintenance	・ Surface and underlying layers of carriageway.	・To provide a safe roadway surface, preserve the capital investments of the government, maintain a satisfactory riding quality to road users.
Shoulder Maintenance	・ Portion of road adjacent to carriageway used for the accommodation of stopped vehicles, emergency use, and lateral support of base and surface courses	・To ensure a smooth transition between the carriageway and shoulder for safety reasons.
Roadside Maintenance	・ Areas between the outside edges of shoulders and right-of-way boundaries.	・Removal of trash to provide a safe and attractive right-of-way. ・Vegetation management carried out in an environmentally sensitive manner to ensure a safe and attractive right-of-way.
	・ Drainage facilities (e.g., ditches, gutters, side drains, outlets, irrigation ditches)	・Removal of debris to ensure normal runoff from roadway and/or right-of-way.
	・ Guardrails & fencing	・To replace or repair when unable to function as intended to ensure driver safety.
Bridge Maintenance	・ Any structure erected over a depression or obstruction, such as water, a highway, or railway, usually 6m or more in length.	・To provide safe reliable passage over a depression or obstruction by preserving bridges as close as possible to their original condition.
Traffic Operation Maintenance	・Highway signs (e.g., regulatory, warning signs)	・To ensure that any missing or damaged (warning/regulatory) signs are replaced or repaired as soon as practical in order to ensure driver safety.

17.2 Cost Considerations

Annual O&M costs, including the costs for functional and structural overlays, are as indicated in Table 17.2. Note that maintenance and operation costs have been derived after examining and extrapolating from RDA unit cost data for similar Class A roads and from

the Project road itself, respectively. As the table indicates, it is estimated that about Rs. 1.35 million for operation and Rs. 9.00 million for maintenance will be required on an annual basis to keep the road in good condition for a total of Rs. 10.5 million.

Table 17.2. O&M (including overlay) Costs for Rehabilitated Road Facilities

Type of Work Content Classification		Cost (Rs.)
Annual O&M	① Maintenance	9,000,000
	② Operation	1,350,000
	Total	≒10,500,000
Overlay	③ Functional Overlay (after 10 years)	618,000,000
	④ Structural Overlay (after 20 years)	1,120,000,000

①: Based on actual Baseline Road maintenance expenditures; ②: 15% of ①; ③: Based on data from RDA's RMBEC; ④: Twice the value of ③.

17.3 Implementation Issues

The RDA, including the RDA-EPO, faces the two following major problems that will affect its ability to maintain the Project road:

- **Lack of Funding:** Although the Sri Lankan Government agreed in July 2003 to implement a Road Fund to finance the maintenance of important facilities such as the Project road, there is no sign of this being done. It is highly recommended that the Government put in place this mechanism as quickly as possible. Otherwise, it seems highly unlikely that the necessary monies to maintain the Project road, as well as other roads, will be realized.
- **Lack of Equipment:** Most existing equipment at depots along the Project road is non-functioning. As a result, the RDA-EPO is forced to lease equipment on an ad-hoc basis to carry out needed maintenance work. It is suggested that a study be executed to decide whether an efficient system of leasing or the rehabilitation/purchasing of equipment, including construction of a workshop, is better.

18 Project Implementation Plan

According to the Minutes of Discussion agreed upon between the JBIC Appraisal Mission and the Government of Sri Lanka on 11th November 2005, the rehabilitation of the 100 km long Eastern trunk road and the construction of the New Kallady Bridge are to be adopted jointly as a single Japanese Yen-Loan project for the Fiscal Year of 2006.

Upon receiving a strong request from the Ministry of Highways of Sri Lanka for the earliest commencement of the civil works, JBIC decided that the period for pre-construction procedures be shortened to the maximum extent possible. Accordingly, JBIC and RDA have agreed to expedite things by procuring the Contractor in parallel with the selection of the supervising Consultant within 13 months. Thus, the construction will be started in April 2007 and completed 30 months later in September 2009.

PART 4 CONCLUSIONS & RECOMMENDATIONS

19 Conclusions & Recommendations

19.1 Conclusions

The work of the JICA Study Team for the Emergency Recovery Project, which is concerned with repairs to the permanent structures of the four damaged causeways on the East Trunk Road, had been mostly completed in May 2005. On the other hand, the Rehabilitation Project, which is a feasibility study for the rehabilitation of the Eastern Trunk Road and the construction of a new Kallady Bridge, was subsequently implemented and an Interim Report and Draft Final Report submitted in November 2005 and February 2006, respectively, detailing its progress. Note that the preliminary design of the selected road facilities for the Emergency Recovery (i.e., the Komari, Periya Kallar, Koddaia Kallar, and Panichchankeni causeways) had been completed at the end of May 2005. The draft tender documents were then prepared based on the implementation system proposed by JICS, i.e. the Design-Build system, and was limited to Japanese tenderers on a lump sum fixed price basis. Through the tender process assisted by the Study Team, the contract was awarded to Hazama Corporation for contract price of JPY 810,000,000 on 26th July 2005.

For medium- and long-term rehabilitation programs for the trunk roads on the East Coast, the sections of AA004 from Akkaraipattu to Batticaloa and AA015 from Batticaloa to Trikkandimadu, as well as the Kallady Bridge on AA004 to the south of Batticaloa, were selected through negotiations between JICA and RDA.

The Emergency Recovery and Rehabilitation Projects have been exempted from IEE and EIA studies as per the environmental regulations of Sri Lanka. However, an IEE was executed in accordance with JICA Guidelines for the Rehabilitation Project and impacts determined as equivalent to Category B (i.e., no significant impacts).

The rehabilitation of the Eastern Trunk Road was designed based on the principle that the Project road shall basically keep to the existing alignment, with the basic minimum ROW being 11.0 m with some exceptions, and the design life of the rehabilitated pavement being 10 years, resulting in thicknesses of 5 to 25 cm and consisting of an overlay + ABC layer.

The basic design policy for the New Kallady Bridge is summarized such that the total width is 14m, total bridge length 289.5 m, and the span length is the same as the existing bridge.

19.2 Recommendations

As the Emergency Recovery Project is ongoing, recommendations are given below only for the Rehabilitation Project.

It is planned for the rehabilitation of the 100-km Eastern Truck Road, which includes the construction of the New Kallady Bridge, to be completed by September 2009 via a loan to be provided by JBIC. Note that other donors are funding the improvement of sections of road north and south of the Project road as well. As a result, the road facilities along Sri Lanka's East Coast will see a vast improvement within the next several years that should produce large economic benefits.

1) Scheduling

The Project is expected to begin in April 2004 and to require 30 months for completion. The construction schedule is shorter than usual as the Project is to be a design-build undertaking. Note that the detailed design should be based on the conceptual drawings contained in this report. On the other hand, when the design for a particular (small) piece of infrastructure is not clearly indicated, it is important that the Contractor quickly carry out his detailed design based on sound engineering principles. That is, it is vital that important design concepts described in the basis design stage be strictly adhered to while allowing for enough flexibility in other matters so that the merits of design and build are realized.

2) Cost Management

This Project, in estimating the cost required for implementation, carefully carried out a comparative analysis in order to determine the most cost-effective pavement structure. Therefore, it is important that the Engineer pay due attention to the design and materials of the Project in order to ensure costs are approximately in line with the preliminary design estimates.

3) Community Support

As part of the overall support system for tsunami affected people, the Contractor for the Project is to exert his effort to provide income-earning opportunities for both skilled and unskilled workers.

4) Maintenance

The design life of the Project road is ten years. In order to keep it in good condition, it is important that routine maintenance, in addition to the respective execution of structural and functional overlays 10 and 20 years after Project completion, be diligently carried out. For this reason, it is important to have the necessary budget, implementation mechanism, and materials, and it is therefore recommended that the Road Fund for Sri Lanka be realized and made operational as quickly as possible.