JAPAN INTERNATIONAL COOPERATION AGENCY
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF POLICY PLANNING AND IMPLEMENTATION

BASIC DESIGN STUDY REPORT
ON
THE INTEGRATED RURAL DEVELOPMENT PROJECT (II)
IN GAMPAHA DISTRICT
IN
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

FEBRUARY, 1994

CHUO KAIHATSU CORPORATION, TOKYO, JAPAN

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PREFACE

In response to a request from the Government of the Democratic Socialist Republic of Sri Lanka, the Government of Japan decided to conduct a basic design study on the Integrated Rural Development Project (II) in Gampaha District and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Sri Lanka a study team headed by Mr. Narihide Nagayo, JICA, and constituted by members of Chuo Kaihatsu Corporation, Tokyo, Japan from July 27 to August 30, 1993.

The Team held discussions with the officials concerned of the Government of Sri Lanka, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Sri Lanka in order to discuss a draft report headed by Mr. Takeo Kai, JICA, from January 12 to January 22, 1994, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relation between our two countries.

I with to express my sincere appreciation to the officials concerned of the Government of Sri Lanka for the close cooperation extended to the teams.

February, 1994

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

February, 1994

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir,

Letter of Transmittal

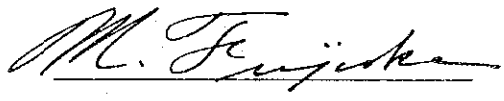
We are pleased to submit to you the basic design study report on the Integrated Rural Development Project (II) in Gampaha District in the Democratic Socialist Republic of Sri Lanka.

This study was conducted by Chuo Kaihatsu Corporation, under a contract to JICA, during the period July 27, 1993 to February 15, 1994. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Sri Lanka and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA and the Ministry of Foreign Affairs, and the Ministry of Agriculture, Forestry and Fisheries. We would also like to express our gratitude to the officials concerned of the Regional Development Division of MPPI, the JICA Sri Lanka Office, the Embassy of Japan in Sri Lanka for their cooperation and assistance throughout our field survey.

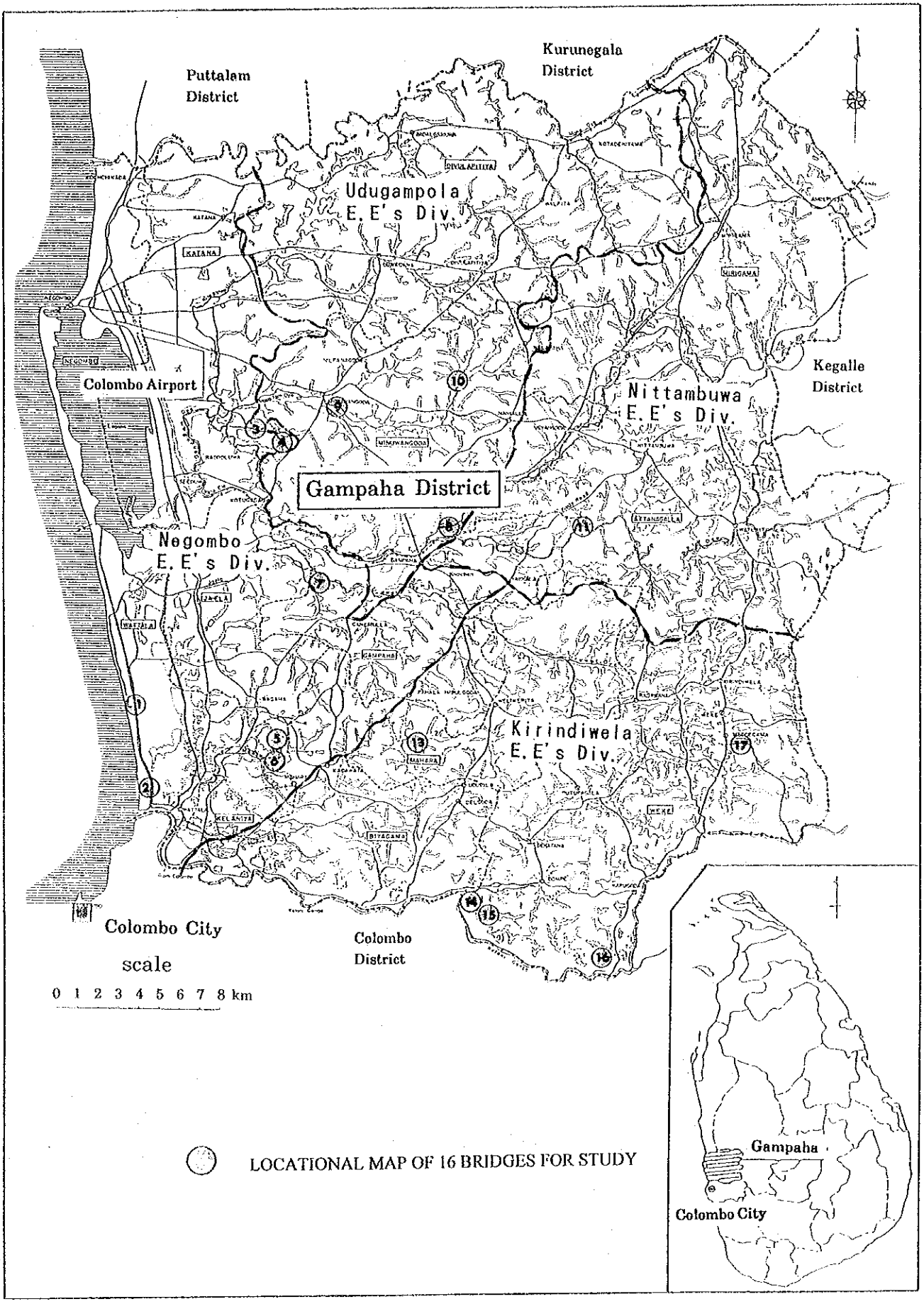
Finally, we hope that this report will contribute to further promotion of the project.

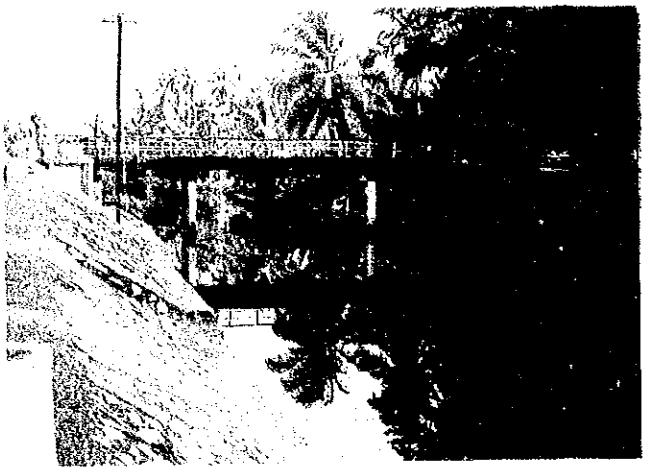
Very truly yours,



Masamitsu Fujioka
Project Manager
Basic design study team on
the Integrated Rural Development
Project (II) in Gampaha District
Chuo Kaihatsu Corporation

Location Map



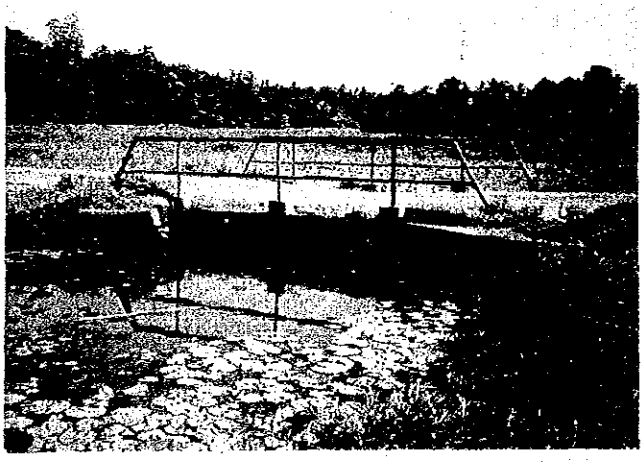


No.1: Uswetakeiyawa-Bopitiya Road

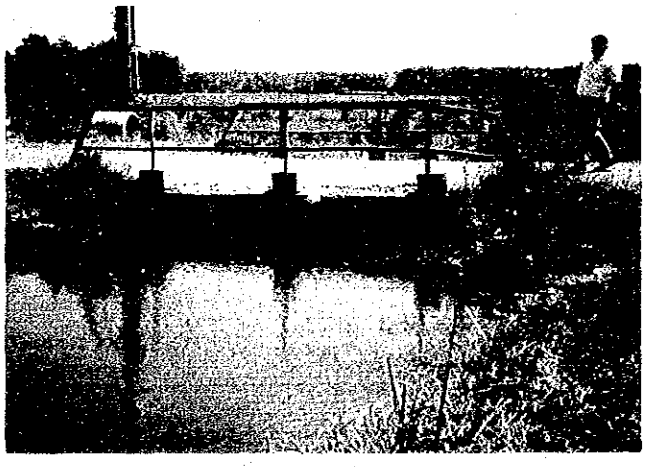
No.2: Paliyawatta-Lansiyawatte Road

No.3: Averiwatte-Yagodamulla Road

No.4: Averiwatte-Yagodamulla Road



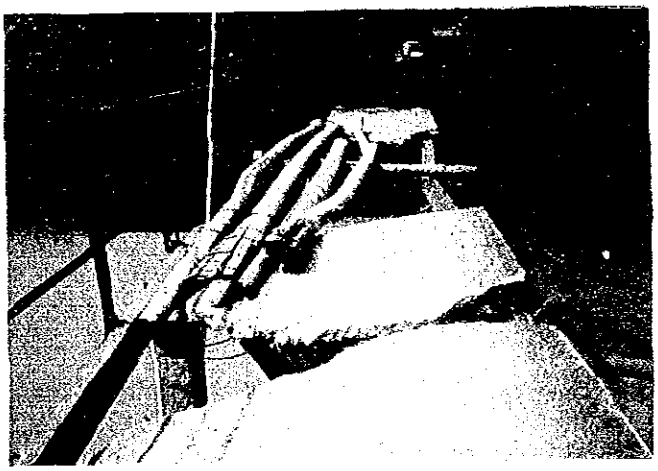
No.5: Dalupitiya-Karagahamuna Road



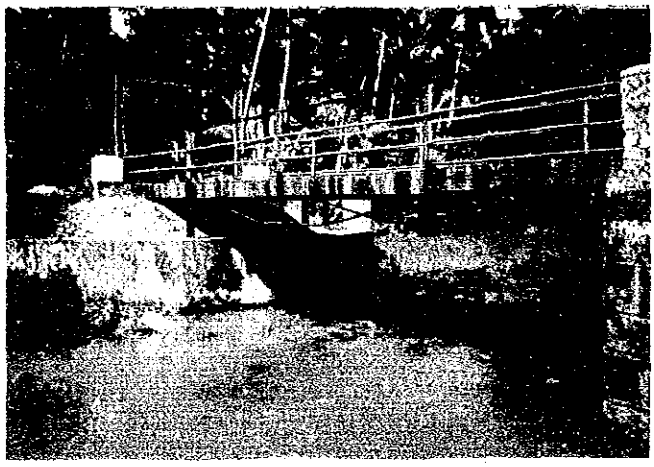
No.6: Dalupitiya-Karagahamuna Road

No.7: Ja-ela-Oragolla Road

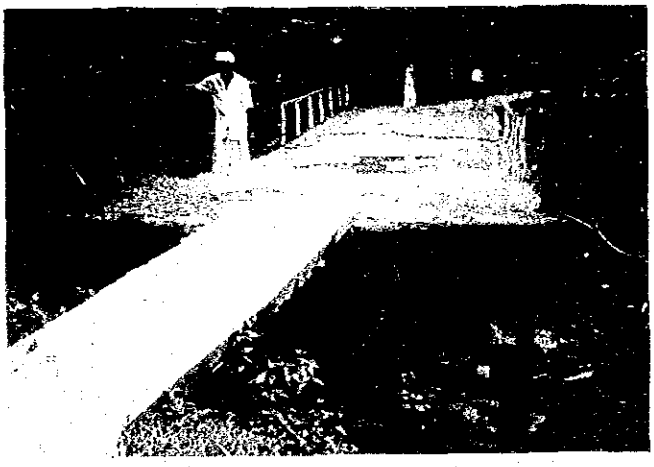
No.8: Doranagoda-Udugampola Road



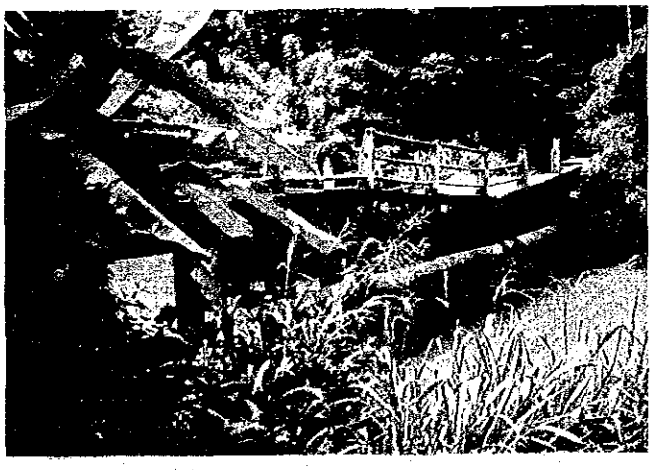
No.9: Aswana-Minuwangoda Road



No.10: Wudamulla-Niwala Road

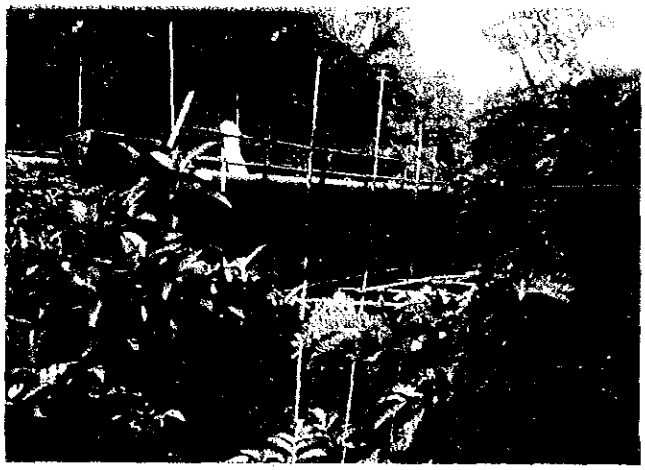


No.11: Bonagola-Rukgahawala Road

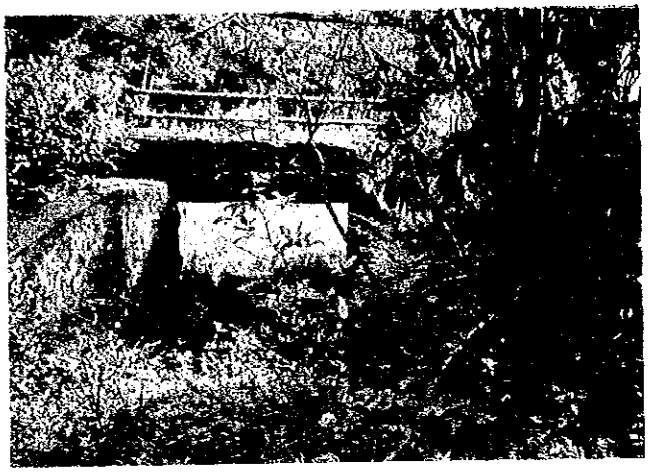


No.12: Mangalathiriya-Bogamuwa Road

No.13: Gonahena-Ruppagoda Road



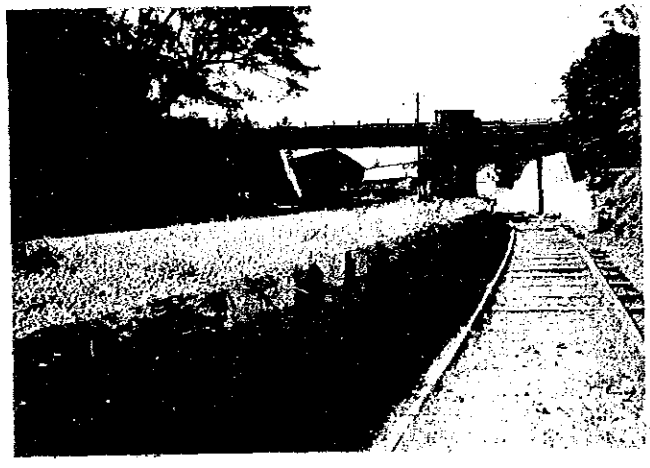
No.14: Malwana-Samanabedda Road



No.15: Malwana-Samanabedda Road

No.16: Samanabedda-Walgama-Kahatagoda Road

No.17: Pallegama-Ranawala-Meethirigala Road



No.18: Hunupitiya Station Road

Executive Summary

Sri Lanka is an island nation situated in the Indian Ocean. Total land area of the country is 65,610 km², and population is 17.4 million (1992). Population growth rate for the past 10 years has been 1.5%; per capita GDP is US$ 526 (1991).

The agricultural sector is the mainstay of the nation's economy, accounting for 22.4% of the GDP, 32% of exports and 45% of employed labor in 1991. Roughly 75% of Sri Lankans live in rural areas and are engaged in agricultural related activities.

Since independence, the Sri Lankan Government has pursued an agricultural policy aimed at self sufficiency in rice production, primarily through the implementation of irrigation projects, and this goal was essentially achieved by the middle of the 1980's. However, a slow down in the agricultural sector has occurred as a result of drought induced drop in productivity for major farm products, compounded by depressed prices for farm exports on the international market. This has resulted in skewed incomes by sector as well as region, a situation which the Government is keen to correct.

Under the Government's current Public Works Investment Plan (1990~1994), maximum priority within the agricultural sector has been given to (i) increasing the self sufficiency rate for staple food crops, (ii) promoting production of export crops, and (iii) raising income levels and expanding employment opportunities. In line with these objectives, integrated rural development projects (IRDP) have been given new emphasis in Government planning.

Gampaha District is north of and adjacent to the capital Colombo in the southwestern part of the island. The District is square in contour, with an area of 1,399 km² and population of 1.74 million (1992). The District falls within the wet zone with annual rainfall of 1,600~2,600 mm. Two rainy seasons occur during the year: April~June and September~November. Temperatures range 22°~33°C.

Development of farmland for cultivation in the District has essentially reached the saturation point, and there is little room for reclaiming new agricultural land. Land holdings are highly fragmented. Holdings of 3 acres (1.2 ha) or less comprise 90 %. Those of 1 acre (0.4 ha) or less comprise 67 %. Full-time farmers are few. Most households engaged in agriculture augment their income from other sources.

Although Gampaha has the most extensively developed road network outside Colombo, roads remain few in paddy field areas. Furthermore, many bridges on farm roads are narrow and in some cases severely deteriorated even to the point of impassability as more than 60 years has elapsed since construction. Overall, maintenance of farm road bridges has not been adequate creating a serious constraint to the effective function of the road network. *It is highly desirable that this situation be improved.*

IRDP implementation is highly desirable to address the problems cited above of regionally skewed income levels and superannuated social infrastructure in the District, and in light of such urgent need request was made to the Japanese government in 1985 for

technical cooperation in project formulation. In response to this request, a Master Plan Study was carried out by the Japan International Cooperation Agency in 1986~87. The Master Plan for Gampaha IRDP was submitted to the Sri Lankan Government in September 1987, comprising (i) a model project for improvement of agricultural production, (ii) development of human resources, and (iii) development of social infrastructure.

The Sri Lankan Government concluded that the model project for improvement of agricultural production warranted the highest priority under the said Master Plan, and on this basis made a request to the Japanese Government for Grant Aid in the construction of facilities and structures required under the Project as Phase I (implemented during 1989~1991). As a result of Phase I, agricultural production infrastructure in the District has been strengthened through schemes including irrigation facilities, agricultural technology transfer, seedling production center, and procurement of farm machinery, and improvements in farm productivity and diversification of farm products have been realized.

In order to further extend the benefits of Phase I throughout the District, it was recognized that improvement of transport capability for agricultural products, and upgrading of the rural living environment would be necessary, and on this basis a subsequent request for cooperation in implementing Phase II of the Gampaha IRDP was made to the Japanese government. In response to this request, JICA dispatched a Basic Design Study Team to Sri Lanka from July 27 to August 30, 1993 (35 days).

The said request is comprised of (i) reconstruction of bridges (including improvement of access roads), (ii) construction of agricultural warehouses and (iii) procurement of equipment for maintenance of farm roads.

On the basis of field survey and analysis, it was concluded that item (i) is critical to recovery of road network function in rural areas as well as ensuring safe travel for rural residents, and item (iii) will contribute greatly to improving maintenance and repair of rural roads suffering from serious surface deterioration. Therefore, (i) and (iii) are suitable for consideration under Japan's Grant Aid program. However, item (ii), in spite of being recognized as an important facility to strengthen transportation and improve product distribution, does not meet the specific criteria for Grant Aid in terms of promoting marketability of farm products, farmer participation and produce quality control, and was accordingly eliminated from consideration under the Project.

Components of the original request and those to be included under the Project as a result of the basic design study are as follows:

	Original request	Result of Study	Remarks
Bridge reconstruction	*Reconstruction of 18 bridges* (including access roads)	*Reconstruction of 16 bridges (including* access roads)	*2 bridges eliminated from* consideration
Warehouse construction	One for unhulled rice, and one for vegetables and fruits	All eliminated from consideration	
Procurement of equipment for rural road O/M	Equipment I-I: 6 types / 23 nos. Equipment I-II: 18 types / 47 nos. Equipment II: 4 types / 44 units Work shop equipment	Equipment I-I: 6 types / 23 nos. Equipment I-II: 10 types / 28 nos. Equipment II: 4 types / 44 units	8 types and 19 nos. of equipment eliminated from (I-II) category; workshop equipment eliminated

All 16 bridges will be reconstructed, and will be either box culvert (in the case of bridge length of less than 15 m: 6 sites) or steel girder type (in the case of bridge length over 17 m: 10 sites) taking into consideration climatic conditions, workability, local conditions, cost effectiveness, bridge length, etc. Also, based on factors of importance and site conditions, 10 of the 16 bridges are to be first class (effective width of 6.5 m) and 6 bridges are to be second class (effective width of 5.0 m).

O/M equipment under category (I) is to be deployed at the Executive Engineer's Offices of the PRDA in Gampaha District, and comprise mainly equipment I-I for repair and maintenance of unpaved roads (road roller, motor grader, bulldozer, backhoe, etc.) and equipment I-II for repair and maintenance of paved roads (premix plant, tar kettle, mobile crusher, etc.). Category II equipment is to be deployed at the 12 local authorities (Pradeshiya Sabhas).

The RDD of the MPPI, executing agency of the Project, will coordinate at the national and district levels, and pursue the Project with the cooperation of the concerned ministries and departments. The PRDA of the Western province will be in charge of the maintenance of the reconstructed bridges and the equipment provided. For the maintenance, inspection and repair of equipment, the PRDA will newly install a work shop at Asgiriya of Gampaha District under its own budget.

In the execution of the project under the Grant Aid program of the Japanese Government, the Project should be divided into two phases because the 16 sites are scattered throughout the District.

Each phase covers 8 bridges with the provision of the equipment in the first phase. First and second phase comprise 8.5 and 10.5 months respectively.

The following effects are expected upon the execution of the present Project.

(i) Implementation of the Project will improve the function of the rural road network, thereby easing constraints on transportation. Improved transportation will reduce the time required for farm products in the District to reach both domestic and international markets. This will serve to lessen delays and damage occurring to produce en route to markets,

factors that have had a major impact on suppressing farm gate prices. As a result, said farm gate prices are anticipated to rise an average 10~20%.

Improved transportation will promote extension of the benefits under Phase I throughout the District, and accelerate farm product diversification and improved productivity.

Improvements in farm gate prices and agricultural productivity are anticipated to spur a strong resurgence in farm income.

(ii) With the infrastructure construction under the subject Phase II, mobility of rural labor will be improved making the expanded employment opportunities established under Phase I more available to workers throughout the rural area of Gampaha District, and thereby greatly contributing to the reduction of the unemployment level in the District which is roughly twice the national average.

(iii) Upgrading of the level of social services available in rural area will contribute significantly to enhancing the rural living environment. Infrastructure construction and rehabilitation under Phase II will make facilities related to social and welfare services such as hospitals, clinics, schools, etc. more readily accessible to the rural population of the District. It is anticipated that this will deepen overall consciousness in rural areas regarding the importance of health and sanitary measures and contribute to a sounder rural living environment.

(iv) Procurement of road repair and maintenance equipment under the Project will eliminate the need for costly equipment rental and materials purchases (premix), which have been the practice in the past and which have contributed to a major portion of road repair costs. It is expected that this will reduce rural road repair costs per annum in Gampaha District by about 30% (Rs 10 million).

(v) Strengthened transportation facilities will foster population mobility, extending the benefits achieved under Phase I to a greater segment of the rural population and further stimulate the rural economy. Opportunities for farmers to act on their own initiative will be enhanced, which is anticipated to provide an impetus to further development in rural areas.

In order to achieve implementation of the Project, it is also strongly recommended that the executing agency take the necessary steps to address its responsibilities under the Project including (i) movement of power poles and water pipelines in preparation for bridge construction works, (ii) acquisition of borrow pit sites, depot space for construction materials/equipment, sites for disposal of removed bridge components and debris in the course of bridge construction works and land acquisition for access roads, (iii) work shop construction, (iv) expediting of procedures for import of construction materials and equipment to be provided under the Project, and (v) budgetary measures to cover costs to be borne by the Sri Lankan side.

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Abbreviation

AGA	Assistant Government Agent
EEO	Executive Engineer's Office
GCEC	Greater Colombo Economic Commission
GM	Gramodaya Mandalaya
GS	Grama Sewaka
IFAD	International Fund for Agricultural Development
IMF	International Monetary Fund
IRDP	Integrated Rural Development Programme
JICA	Japan International Cooperation Agency
MPPI	Ministry of Policy Planning and Implementation
PFP	Policy Frame Papers
PO	Partner Organizations
PRDA	Provincial Road Development Authority
PS	Pradeshiya Sabha
RDD	Regional Development Division

CHAPTER 1 INTRODUCTION

The Government of Democratic Socialist Republic of Sri Lanka requested the Government of Japan for technical cooperation in the formulation of a Master Plan for an Integrated Rural Development Project for Gampaha District (Gampaha IRDP). In response to this request, the Japanese Government determined to conduct a Master Plan study and entrusted the implementation of the study to the Japan International Cooperation Agency (JICA). JICA carried out the study during 1986~87 and presented the formulated Master Plan to the Sri Lankan Government in September 1987.

The Sri Lankan Government concluded that the Model Project for Improvement of Agricultural Production warranted the highest priority under the said Master Plan, and on this basis requested the Japanese Government for Grant Aid in the construction of facilities and structures required under the scheme. As a result of the request, Phase I of the Gampaha IRDP was implemented, resulting in the strengthening of agricultural production infrastructure in the district. The said Phase I included construction of irrigation facilities, agricultural training center and seed farm, and the procurement of farm machinery. These efforts have served to diversify agriculture and upgrade farm productivity in the district.

The Sri Lankan Government subsequently requested the Government of Japan for Grand Aid to implement Phase II of the Gampaha IRDP, aiming at establishment of various infrastructure to improve transport capability of farm products and to upgrade the rural living environment. Phase II is recognized as essential in promoting the mobility of both goods and personnel, a prerequisite for extending the benefits achieved under Phase I throughout the entire district.

In response to this request, the Government of Japan determined to conduct a basic design study on the Project and entrusted the study to JICA. The purpose of the Study is to formulate a plan for construction of required facilities and procurement of necessary equipment under Phase II. JICA dispatched a Basic Design Study Team (Team Leader : Narihide Nagayo, Development Specialist, JICA) to formulate the most appropriate basic design for the Project. The study Team visited Sri Lanka from 27 July to 30 August 1993 (35 days) during which time team members engaged in discussions with personnel of related government agencies, and carried out studies of facilities and construction sites, and site investigation including test drilling, survey, etc. (Basic Design Study Team members, Study schedule, officials concerned in the Sri Lankan Government, and Minutes of Discussions are contained in the attached Appendices).

Findings of the field surveys and subsequent analyses were compiled in the Draft Final Report. A JICA Draft Report Explanation Team, headed by Takeo Kai, Development Specialist, JICA, visited Sri Lanka during 12 January ~ 22 January 1994 (11 days) and briefed the Sri Lankan Government on the contents of the Draft Final Report.

This Final Report has been prepared by the JICA Study Team, incorporating the comments and observations obtained from the concerned officials of the Sri Lankan Government on the above Draft Final Report.

CHAPTER 2 BACKGROUND OF THE PROJECT

2-1 Background of the Project

The nation's economy is agricultural based, supported by exports of tea, rubber and coconut, and the cultivation of rice. The primacy of the agricultural sector is indicated by the fact that it accounts for 26.9% (1991) of the GDP, 31.4% of total export value, and 40.9%(1990) of employment. Roughly 80% of the population lives in rural areas.

The Sri Lanka Government has vigorously pursued economic development through such projects as ① the Mahaweli Ganga Development Project, ② promotion of export oriented manufacturing industries, ③ residential and urban development, ④ expansion of export, ⑤ Integrated Rural Development Project. The Mahaweli Ganga Development Project began full-scale in 1980. By now the project has almost completed the main construction works and with remaining works comprising "soft" aspects of the project such as reinforcement of the management of completed irrigation system, active participation of farmers in the operation and maintenance of terminal facilities built under the project, and agricultural diversification through both upfield crops and animal husbandry. The main target of the project is improvement of productivity and the subsequent increase of income of in-migrated farmers. On the other hand, the Integrated Rural Development Project has been undertaken for more backward areas not benefited by the Mahaweli Ganga Development Project, upon the recognition of the importance to develop and maintain such undeveloped areas. This IRDP enjoys higher priority in the above-stated National Public Investment Programme of the Government, together with the Mahaweli Ganga Development Project, and as a part of the Gampaha IRDP, the Government has pursued the Model Project for Improvement of Agricultural Production under Grant Aid Program of the Japanese Government.

The implementation of the IRDP has improved the fundamental base of agricultural production.

A request for Grant Aid, to take another stride for achievement of the original project objective, was made to the Government of Japan for further upgrading of the level achieved by the Phase I of the IRDP project, aiming at the improvement of transportation networks for agricultural products and the infrastructure necessary for enhanced village life.

This request comprises Phase II of the earlier project, and mainly comprised reconstruction of bridges and improvement of related access farm roads, construction of storage facilities for farm products and procurement of equipment for farm road maintenance.

2-2 Outline of the Request

The said request comprised the 3 items mentioned below:

① Reconstruction of bridges (including improvement of access roads)

② Construction of warehouses for agricultural products

③ Procurement of equipment for farm road maintenance

The following 18 bridges were listed in the request.

Bridge Reconstruction

Bridge No.	Road Name	Road Class
1.	1/1 bridge on Uswetakeiyama-Bopitiya Road	C
2.	1/1 bridge on Paliyawatta-Lansiyawatte Road	C
3.	1/2 bridge on Averiwatte-Yagodamulla Road	C
4.	2/1 bridge on Averiwatte-Yagodamulla Road	C
5.	2/3 bridge on Dalupitiya-Karagahamuna Road	C
6.	2/4 bridge on Dalupitiya-Karagahamuna Road	C
7.	3/4 bridge on Ja-Ela-Oragolla Road	C
8.	New bridge on Doranagoda-Udugampola road	E
9.	Kalawana bridge on Aswana-Minuwangoda road	E
10.	Esella bridge on Wedamulla-Niwala road	C
11.	Ogodapola bridge on Bonagola-Rukgahawala road	C
12.	1/6 bridge on Mangalathiriya-Bogamuwa road	C
13.	1/5 birdge on Gonahena-Ruppagoda road	C
14.	1/1 bridge on Malwana-Samanabedda road	C
15.	1/5 bridge on Malwana-Samanabedda road	C
16.	1/1 bridge on Samanabedda-Walgama-Kahatagoda road	C
17.	1/3 bridge on Pallegama-Ranawala-Meethirigala road	C
18.	Bridge on Hunupitiya Station Road	C

Components of ② construction of agricultural warehouses, and ③ procurement of equipment for maintenance of farm roads are described below.

Warehouse for agricultural products

A. Rice Warehouse	: Planned Location	- Divulapitiya in Gampaha
	Capacity of Storage	- For storage for 42,000 bushels of unhulled rice

B. Warehouse for vegetable and fruit:

Planned Area	- Near Colombo airport
Scale	- Warehouse complex, 2,005 m^2, with 3 buildings including a refrigerator.

Equipment for farm road maintenance

The request for farm road maintenance equipment was divided into (i) that to be provided to the 4 Executive Engineer's Offices (EEO) of the PRDA in Gampaha which are responsible for the maintenance of class C, D and E roads, and (ii) that to be provided to the 12 local authorities (Pradeshiya Sabha (PS) responsible for maintaining F class roads. In principle, the EEO and the PS's would work independently with their own equipment provided under the Project in maintaining the farm roads under their respective jurisdictions.

Equipment to be provided to the EEO's was in principle that for basic road maintenance.

Breakdown of equipment category (I) to be deployed to the EEO's and category (II) to be deployed to the PS's under the said request is as follows:

Equipment (I) [for EEO's]

7 ton vibrating tandem roller
750 kg double drum pedestrian
Vibrating roller
Concrete mixer
Medium size motor grader
Low bed trailer
Bulldozer D.4 type
Backhoe loader
Plate compactor
Poker vibrator

Tamping rammer
Mechanical grass cutter
Double cab pickup

Equipment (II) [for PS's]

Vibrator roller 1.5 ton
Tar boiler
4W-tractor with trailer
2W-tractor with trailer

2-3 Outline of the Project Area

2-3-1 Location

Gampaha District is north of and adjacent to the capital Colombo in the southwestern part of the island. The District is square in contour, with an area of 1,399 km². It is 40 km north to south, and 35 km east to west.

The Free Trade Zone designated by the Greater Colombo Economic Commission is situated on the west coast of the District to promote export oriented industries. Colombo International Airport as well as two investment promotion zones (Katunayaka and Biyagama) are included in the area.

National Highway A-1 (Colombo-Kandy Road) runs from southwest to northeast through the center of the District. National Highway A-3 runs from south to north along the coast, passing the international airport. The district capital of Gampaha City is located in the center of the District about 25 km from Colombo.

2-3-2 Natural Conditions

(1) Topography

A hilly area around EL. 150 m is situated in the eastern part of Gampaha on its border with Kegalle District. Moving westward, land elevation steadily decreases with lagoons and marshland in the vicinity of the coast. With the exception of the one above mentioned section in the east, most parts of the District are under 30 m in elevation. Low areas along rivers and their tributaries are paddy field. The Maha and Kelani rivers flow along the northern and southern borders, respectively, and the Attanagalu River courses through the center of the District. These rivers and their tributaries dissect the District, establishing an undulating topography.

The Study area can be broadly classified into alluvial lowland along the major rivers (Maha Oya, Kelani Ganga, etc.) and their tributaries, and hilly terrain well dissected by these flows. Hilly terrain roughly features two types of topography whose dividing line is an axis running NNW-SSE connecting Kotadeniyawa and Bopagama. To the west of this line, erosion is well advanced and the topography is consequently extremely gentle. To the east, the topography is sharper and characterized by monadnocks.

West of the above line, rivers meander gently as they flow westward, while to the east sharp changes in river course direction occur. The topography of the eastern portion is delineated by folding and faulting. To the east of this topographical dividing line, alluvial lowlands are less often present.

(2) Soil

Sri Lanka is divided into the following three agro-ecological zones on the basis of factors of rainfall, vegetation, soil and land use.

- Wet zone
- Intermediate zone
- Dry zone

These zones are further subdivided into six agro-ecological regions: very wet, wet, semiwet, semidry, dry and very dry.

The entirety of Gampaha District lies within the wet-zone. Most of the district belongs to the WL3 (wet-lowland, laterite region) classification. However, the extreme eastern portion is WL2, while the lagoon and estuary area in the extreme western portion of the District is WL4 (wet lowland, ill-drained region). In general, the surface layer in such wet lowland is soft. Standard penetration testing carried out during geological investigation during field survey indicated N value of 0~20 for surface layer. Although surface layer does not have sufficient bearing strength to support bridge structures envisioned under the Project, successive layers at GL -8 m and deeper are comprised of base rock with sufficient bearing capacity.

Soil in Gampaha District falls within the three following classifications:

- Regosols: distributed in coastal area (sand dune, etc.)
- Alluvial soil: distributed in lowland along rivers and streams
- Red-yellow podzolic soils: widely distributed throughout the District with the exception of the central area and coastal area in the west

In addition to the above, bog and half bog soils, and reddish latosols are also present.

(3) Meteorology

Sri Lanka is located within the tropical climatic zone. Temperatures and rainfall are governed by the monsoons. The northeastern and southwestern monsoons are referred to as

Maha and Yala, respectively. Temperatures throughout the year are warm and fluctuate only slightly.

Gampaha District falls within the wet zone, with annual rainfall at 1,600-2,600 mm. Rainfall occurs primarily during the two yearly monsoons: the Maha from September to November, and the Yala from April to June.

Annual mean temperature in Gampaha ranges is 23°C ~ 31°C through the year, being lower in December and January, and higher in March and April. The mean humidity is about 81%, being higher during the rainy season.

2-3-3 Society and Economy

(1) *Administration of Gampaha District*

Sri Lanka is divided into 9 provinces and 25 districts. Gampaha District is located in the Western Province. The Western Province consists of Colombo, Kalutara and Gampaha districts. Gampaha was made an independent district from Colombo in October 1978.

Gampaha District is divided into 13 Divisions and 44 Grama Sewaka (GS). There are 1 Municipal Council (MC) and 6 Urban Councils (UC) in the District. MC's and UC's are administratively equivalent to Divisions.

Administration is two tiered, being represented by i) the Government Agent (GA) who is appointed by the Ministry of Home Affairs, and 13 presiding Assistant Government Agents (AGA's stationed in the 13 Divisions) and ii) the District Development Council consisting of representatives elected from each Electorate Division.

(2) Rural Conditions

Gampaha is the most industrialized district in the country. Nevertheless, farmland accounts for 41% of district area. Even in the case of the GCEC industrial zone for export oriented industries located on the coast, the majority of area is farmland. In rural areas, there is interspersing of households engaged in agriculture and those who gain their livelihood in other sectors.

The District comprises both upland and lowlands. Lowlands consist of paddy fields, and uplands are the site of residences and upland fields. Dwellings maintain home gardens and are surrounded by coconut fields.

82% of farmland is upland. Of this, 44% is coconut fields. Land holdings are fragmented, and the average farm size is 0.48 ha. Holdings of 1 acre (0.4 ha) or less are 67%. Full-time farmers are few. The majority of households engaged in agriculture supplement their income from other sources.

Gampaha District is north of and adjacent to Colombo, the capital. Close proximity to the capital has resulted in the development of roads, power and other infrastructure at a

relatively early date. Although the degree of development of such infrastructure is higher on the average than for other districts, development is markedly skewed by region within the District itself. Furthermore, facilities are largely superannuated.

(3) Population

The estimated population in 1991 in the District based on the National Census of 1981 is 1.74 million, which is 10% of the national population of 17.25 million.

The population density of 1,254 persons/km^2 is second highest in the country after Colombo. However, population distribution is uneven. It is low in the northeast and high in the southwest, including the coastal area with the GCEC zone.

2-3-4 Social Infrastructures

Development of social infrastructure has progressed since relatively early times due to the District's proximity to Colombo. However, facilities are old and require rehabilitation.

The road network is relatively well developed. Laterite surfaced roads are present in villages. However, roads are few in paddy field areas.

Domestic water supply in rural areas is almost totally by shallow well. However, many wells are without pumps for water supply into the dwellings. Piped water supply projects are being carried out at present only in limited areas such as Gampaha City, Veyangoda and areas immediately adjacent to Colombo.

In the absence of public sewerage facilities, waste water from dwellings is drained by ditch into rivers. Toilet waste is disposed of through underground percolation. The power grid has been developed from earlier years due to the presence of the GCEC zone in the District. At the GS level, electrification is 48.6% in rural area and 80.3% in the GCEC zone. At the village level, it is 44.6% in rural area and 82.8% in the GCEC zone. (1985)

Base hospitals are located at Gampaha City, Negombo and Wathupitiwala. District hospitals under these are at 4 locations, clinics at 4 locations, and various other facilities for a total of 58 locations. Total bed space is 1,860. This is a low rate of 1.0 beds per 1,000 population.

There are 596 general schools in the District for lower education. At the higher education level, there is 1 general university, 1 medical college, and 5 teachers colleges. Enrollment rate for 5-14 year olds is 88.7%, which is higher than the national average of 84.8% and the rate for Colombo of 87.1%. The literacy rate is 94.2%, which is the highest in the nation (national average is 86.5%). However, the drop out rate at a later age is high, with only 30% eventually graduating from middle school.

2-3-5 Traffic Status

In Gampaha District, the increase rate in traffic volume has been much higher than the nation-wide average, due to its location adjacent to Colombo, and industrial areas. This rapid increase has seriously strained the transportation network in the District.

Lengths of individual roads in the district, class-wise, are as follows:

			Total length	Paved length
1. Class-A	:	National highway	127.69 km	127.69 km
2. Class-B	:	Major road	272.10 km	272.10 km
3. Class-C	:	District road	1,004.2 km	784.3 km
4. Class-D	:	District road		
5. Class-E	:	Municipal road		
6. Class-F	:	Municipal road	--	--

Roads below class-C are maintained at the regional and district level, but the shortage of budgetary allocation and equipment, and the difficulty to obtain construction workers pose problems for routine maintenance works.

Further, most of the bridges were built more than 60 years ago, and, therefore, they are not strong enough to meet the present traffic volume. Even the widened roads still leave problems, since bridges are not widened accordingly. These factors together constrain the traffic system in the province.

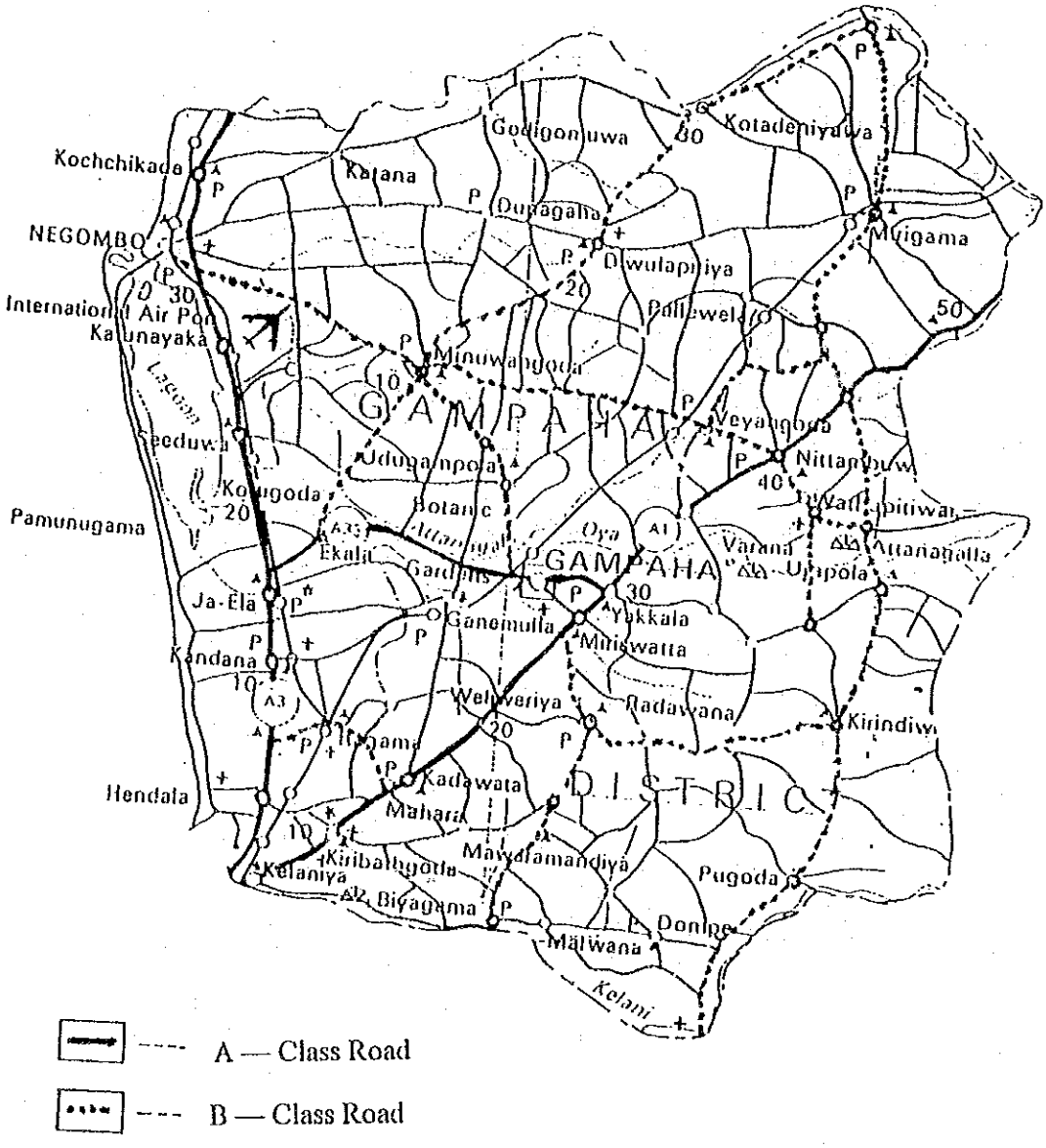


Fig. 2-3-1 Gampaha Road Network

CHAPTER 3 OUTLINE OF THE PROJECT

3-1 Objectives

The objectives of the Integrated Rural Development Project (IRDP) are: to increase farmers' income and employment opportunities; to stabilize rural life; and to alleviate poverty through improving rural living conditions.

A careful plan that suits the features and special conditions of the area and takes into account long-term development prospects of the area is a precondition for attainment of these objects.

The main features of Gampaha District are as listed below:

(1) It is adjacent to Colombo, the capital of the nation;
(2) It has an international airport; and
(3) It has the largest industrial area in the nation.

Due to the above features, local agriculture has a stronger inclination to produce cash crops than other districts. However, the rural areas of the district still suffer from shortages of employment opportunities, a low income level, poor living conditions, etc., which are common problems in many rural areas of the country.

The present status of the rural areas of Gampaha can be summarized as follows:

(1) 70% of the land area has already been developed, leaving no room for developing new agricultural areas;

(2) Small-scale farming determines the land possession pattern of this district; farms with less than 3 acres (1.2 ha) account for over 90% of the total agricultural land while those with less than 1 acre (0.4 ha) account for as much as 67%;

(3) Such land possession pattern results in low productivity, low income and a desire among the farmers to find side jobs other than farming. Due to the shortage of employment opportunities, however, it is not easy to find non-farming jobs, which causes the second highest unemployment rate in the country.

(4) The existing irrigation systems are very old and obsolete and the type of farming practiced in the district is traditional and outdated. This combination is another cause of low productivity. There is little prospect of increased agricultural income unless some measure is taken to address this agricultural structure.

(5) Although relatively extensive, infrastructure in Gampaha District is largely very old and obsolete. Immediate improvement of the aged infrastructure is necessary for the development of the district.

(6) While ranking second in coconut production, Gampaha has not yet to achieve self-sufficiency in food.

While Gampaha has the largest industrial belt in Sri Lanka with output reaching 36% of the nation's total industrial output, its agriculture remains small-scale with many farmers seeking non-farming side jobs. The regional and sectoral gaps in income in the district are marked, and superannuated agricultural production infrastructure and social infrastructure require rehabilitation and strengthening.

The Gampaha IRDP was formulated to address the above issues through a multi-target approach including improvement of farm productivity, and the upgrading of agricultural production and social infrastructures. Specifically, the said IRDP comprises (i) a model project for improvement of agricultural production, (ii) development of human resources, and (iii) development of social infrastructure. Of the foregoing, (i) was as the highest priority component under the Gampaha IRDP, and was implemented during 1989~1991.

The said Model Project for Improvement of Agricultural Production was formulated to increase farmers' income and create more employment opportunities. For these purposes, export minor crops, upland crops, and fruit culture were introduced into coconut fields as inter crops to achieve more efficient land use of coconut fields. Also, high yield breeds of rice and non-rice crops were introduced into rice paddies, thus shifting to a new cultivation system to achieve more efficient land use of rice paddies.

Model farms, various irrigation facilities including anicuts and canals, a seedling bed center, warehouses, training and education facilities were constructed or rehabilitated under the Model Project for Improvement of Agricultural Production. Various agricultural and educational equipment, vehicles and so forth were provided.

The Model Project for Improvement of Agricultural Production has improved the agricultural production infrastructure of Gampaha, and education and training of farmers has been well under way. As a result, the agricultural production of the district has started to increase.

It is now necessary to secure more efficient transportation and distribution of agricultural products to cope with the increased production. Accordingly, Development of Social Infrastructure should now be implemented as proposed in the master plan. The said infrastructure improvement project comprises the following:

① Reconstruction of bridges (including improvement of related access roads);
② Construction of storage for agricultural products; and
③ Procurement of equipment for maintenance of farm roads.

3-2 Study and Examination on the Request

3-2-1 Project Suitability and Urgency

(1) Improvement of Transportation for Agricultural Products

As a result of Phase I of the Gampaha IRDP, Gampaha's agriculture is becoming more diversified and its agricultural production has increased. Specifically, minor export crops such as coffee and pepper have been introduced while the production of traditional crops such as fruit, vegetables, and betel have shown increase. Thus, the important issue now is to ensure efficient transportation of these crops to markets.

Agricultural products from Gampaha have been shipped mainly to foreign markets and the Colombo market. However, farmers have always been at a disadvantage when setting the prices of their crops because (1) the poor and rough road conditions in the district tend to delay transportation and damage crops in transit and (2) farmers do not have their own warehouses, which prevent them from adjusting the timing and amount of shipment. In order to improve such transportation conditions, it appears essential to remove the two major bottlenecks consisting of: (a) aged, impassable or dangerous bridges connected to farm roads; and (b) damaged road surfaces and foundations.

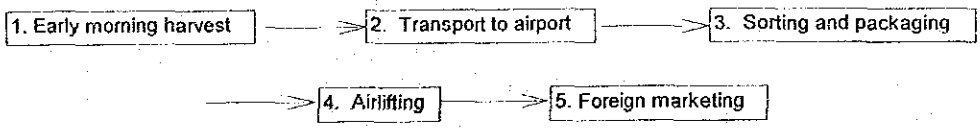
It is believed that ① reconstruction of bridges, which includes as well improvement of access roads; and ③ procurement of equipment for repair of farm maintenance are effective measures to eliminate the bottlenecks (a) and (b).

(2) Improvement of Distribution

The main markets for agricultural products from Gampaha are Colombo and foreign markets. It is considered necessary to improve the distribution system by constructing warehouses as well as by strengthening the transportation system, in order to improve farmer income.

1) Increasing Competitiveness in the International Market

Betel and various fruits are flown out to foreign markets from the international airport in the district. To increase farmers' income, the major objective of the IRDP, it is essential to maintain the prices of these products from Gampaha at appropriate levels. The biggest problem in distribution is the very severe time limitation imposed on transportation of products to the airport. For instance, transportation of betel takes the following steps to ensure the quality required by the market.



It is desirable to complete steps (1) to (4) in one day while it is minimally necessary to cover at least steps (1) to (3) in one day. Therefore, construction of warehouses for keeping betel fresh through steps (3) and (4) as well as improvement at step (2) are believed to greatly enhance distribution efficiency. The same is true for other crops.

2) Coping with the Domestic Market

The Gampaha District has the potential advantage of its proximity to the market of Colombo, the nation's capital. However, the poor road conditions and the lack of adequate processing and packing facilities prevent farmers from making the most out of their advantageous location. The harvest seasons of vegetables and nuts are short, and that tends to cause a glut and low prices in the market. Thus, it is considered necessary to have storage facilities for farm products to avoid selling during the times when prices are low by adjusting the timing and amount of shipment.

(3) Rural Living Conditions Improvement

It is recognized that enhancing the poor public welfare in the rural areas of this district is an effective means to combat poverty.

Towards this end, education in rural health and sanitation is being performed particularly under the home economics courses at the agricultural training facilities established under Gampaha IRDP, Phase I, and this is anticipated to contribute to upgrading in the future of health and welfare levels through dissemination among the rural population of basic and essential knowledge in this regard.

One reason for the low welfare level in Gampaha is the difficulty for the rural population to gain access to various welfare, medical and educational facilities in the cities in the district and in Colombo. This poor accessibility is caused by low mobility due to a poor transportation network. Better road conditions are a precondition for better accessibility.

The unemployment rate of Gampaha ranks second in the country. Although employment opportunities are expected to increase with continuation of the Model Project for Improvement of Agricultural Production, efforts must be made to create more employment opportunities in the industrial areas in the district. Since the above mentioned low mobility is also one of the major causes of the high unemployment rate despite the existence of the largest industrial zone in the country, improving farm road conditions is again an essential matter.

As is clearly seen in the above discussion, the three items: ① reconstruction of bridges (including improvement of farm roads); ② construction of warehouses for agricultural products; and ③ procurement of equipment for maintenance of farm roads are considered essential in addressing the aforementioned issues.

3-2-2 Project Execution and Management

Improvement of infrastructure is regarded as a follow-up to the Model Project for Improvement of Agricultural Production, both components being part of the Gampaha IRDP. Implementation and management of IRDP's has been well established, with 16 such projects nationwide with support from various donor countries and international agencies. Since the subject Project predominantly concerns road construction, the Regional Development Division (RDD) under the Ministry of Policy Planning and Implementation is the executing government agency. The RDD will carry out the Project in cooperation with the PRDA, Western Province, established in 1990 and responsible for the maintenance and management of farm roads.

Rs 400 - 500 million are appropriated annually in the national budget for IRDP's under the national public investment plan. About 80% of the appropriation comes from foreign aid with the remaining 20% funded by the Sri Lankan government. Of the various IRDP's, Rs 700 million has been appropriated for the Hambantota IRDP and Rs 645 million for the Kurunegala IRDP. Reconstruction of bridges and procurement of machinery and equipment for O/M of farm roads will be carried out under the Gampaha IRDP, while the PRDA continues to be responsible for O/M of farm roads including bridges, and management of related equipment.

Its budget of Rs 132 million for fiscal 1993 is divided among the three districts in the Western Province. Having the longest total length of farm roads, the Gampaha District receives 47% or Rs 62 million of the budget. Maintenance of farm road comprises the largest component of this budget, with a major portion of this accounted for by costs for purchase of road repair materials and rental fees for road repair equipment. Procurement of equipment under the Project will serve to greatly reduce this outlay and facilitate O/M operations for farm road (including bridges) after implementation of the IRDP.

3-2-3 Relationship Among Similar Projects

IRDPs have been under way in 16 of the 25 districts in the country with support from industrialized nations, such as Sweden, the Netherlands and Norway, and international aid organizations, such as the IMF and the International Fund for Agricultural Development (IFAD). The IRDP does not end when facilities are completed; it continues to be implemented even after initial objectives are achieved. Accordingly, financial assistance, including project operational funds are provided over an extended time period.

Reconstruction of bridges on farm roads as envisioned under the Project is something that has never been done under the other aid projects undertaken. However, equipment for farm road construction have been procured by Japan under the Project for Acquisition of Equipment to Strengthen the Divisional Secretaries' Office (Grant Aid) and the Model Village Improvement Project (yen credit). Table 3-2-1 shows these machinery and equipment possessed by the PRDA and their deployment status.

Table 3-2-1 Equipment Procured under Assistance from Japan (in possession of PRDA, W.P.)

	Item	Nos.	Present deployment
Through NHDA in 1990 (Model Village Improvement Project)	Bulldozer	1	* L. I. M-I.R.D.P project
	Grader	1	do
	Dump truck	3	do
	Wheel Loader	1	do
	Road roller	1	do
	Vibrating roller	6	do
	Cargo truck	1	transport of bituman, etc.
	Water bowser	1	transport of water
Through PC in 1993 (Acquisition of Equipment to Strengthen the Divisional Secretaries' Office)	Bulldozer	1	PS's EE in Nittambuwa
	Back hoe	1	do
	Dump truck	1	do
	Crusher	1	L.I.M.-I.R.D.P. Project
	Compressor	1	do
	Breaker	1	do
	Cargo truck	1	transport of bituman, etc.
	Generator and welding equipment	1	
	Concrete mixer		
	Pickup truck	1	

* (L.I.M-Lewanduwa, Ittapana, Meegahatenna)

Most of these equipment are now utilized in the on-going Kalutara IRDP. These equipment are not readily available for farm road repairs in Gampaha District. It is highly unlikely that this deployment situation will change in the future. Thus, there will be no redundancy in the equipment to be procured under the Project.

3-2-4 Components of the Project

As discussed above, as Phase II of the Gampaha IRDP, the Project comprises components of (a) improvement of transportation for agricultural products, (b) improvement of distribution and (c) improvement of rural living conditions. Improvement of rural road conditions forms the core of all the three components. (a) mostly concerns improvement of vehicle roads while (b) is intended to improve the storage situation of agricultural products as well as vehicle road conditions. (c), in conjunction with (a) is intended to be achieved as a result of higher mobility of residents

Since there are many old, worn-out bridges, reconstruction of these bridges and procurement of equipment for farm road maintenance is a common and essential part of all three components.

3-2-5 Requested Facilities and Equipment

The Project is composed of the following items:

① Reconstruction of bridges (including improvement of related access roads);
② Construction of warehouses for agricultural products; and
③ Procurement of equipment for maintenance of farm roads.

Each of the above items is examined in this section.

(1) Reconstruction of Bridges (including improvement of related access roads)

Item ① was targeted at the following 18 bridges.

Bridge Number	Name of Road	Class
1	1/1 Bridge on Uswetakeiyama - Bopitiya Road	C
2	1/1 Bridge on Pariyawatta - Lansiyawatte Road	C
3	1/2 Bridge on Averiwatte - Yagodamulla Road	C
4	2/1 Bridge on Averiwatte - Yagodamulla Road	C
5	2/3 Bridge on Dalupitiya - Karagahamuna Road	C
6	2/4 Bridge on Dalupitiya - Karagahamuna Road	C
7	3/4 Bridge on Ja-Ela - Oragolla Road	C
8	New Bridge on Doranagoda - Udugampola Road	C
9	Kalawana Bridge on Aswana - Minuwangoda Road	E
10	Esella Bridge on Wudamulla-Niwala Road	E
11	Ogodapola Bridge on Bonagola - Rukgahawala Road	C
12	1/6 Bridge on Mangalathiriya - Bogamuwa Road	C
13	1/5 Bridge on Gonahena - Ruppagoda Road	C
14	1/1 Bridge on Malwana - Samanabedda Road	C
15	1/5 Bridge on Malwana - Samanabedda Road	C
16	1/1 Bridge on Samanabedda-Walgama - Kahatagoda Road	C
17	1/3 Bridge on Pallegama - Ranawala-Meethirigala Road	C
18	Bridge on Hunupitiya Station Road	C

The condition of the 18 bridges was investigated to determine the urgency and necessity of reconstruction. The result of the investigation is shown in Table 3-2-2.

Table 3-2-2 Condition of 18 Bridges

Bridge Number	Length (m)	Width	Class of Road and Width (m)		Condition	Necessity of Replacement
1	17.1	3.2	C	6.5	Deterioration - 100 years old	Necessary
2	15.0	3.3	C	6.5	Both bridge piers and abutments damaged - 100 years old	Necessary
3	24.3	4.3	C	4.7	Deterioration	Necessary
4	15.3	4.3	C	4.5	Deterioration	Necessary
5	3.5	4.1	C	5.0	Bulkheads/bridge piers damaged -	Necessary
6	3.6	4.1	C	4.5	Deterioration	Necessary
7	12.2	3.9	C	4.6	Deterioration-Not wide enough for	Necessary
8	-	-	E	3.5		Necessary
9	26.6	2.2	E	3.4	Both super and substructure damaged	Necessary
10	13.6	2.6	C	4.2	No bridge across the 20m-wide river	Necessary
11	19.6	4.5	C	4.8	Both super and substructure damaged	Necessary
12	-	-	-	-	Rebuilt in June 1993	(Unnecessary)
12'	18.7	4.6	B(c)	5.5	B Class road	-
13	18.3	4.0	C	3.0	Collapsed bridge	Necessary
14	9.2	3.8	C	4.2	Deterioration - Not level	Necessary
15	3.0	7.4	C	6.0	Patched-up bridge surface-Worn	Necessary
16	2.2	3.7	C	3.9	Deterioration	Necessary
17	9.5	3.8	C	4.5	Deterioration	Necessary
18	-	-	-	-	-	-

Notes:

1 Bridges 1, 2 and 10 are the only ones with levees. Bridges 1 and 2 span canals.
2 Most of the bridges have protruding abutments that narrow the cross sections of flow (widths of the streams).
3 Most of the bridges are not built on normal fully concrete abutments, but on abutments made of piled rocks with part of their surface concreted as beam seats.
4 Most of the bridges have no levee in the front of the abutments. These are the type of bridges whose abutments serve as levees.
5 Deterioration: Corroded steel girders and weathered deck slab concrete of the bridges decrease their bearing capacity remarkably.

1) Bridge no. 12 was repaired by the Sri Lankan side, and there is no problem with passage. Bridge no. 12 has been thus removed from the list of bridges to be reconstructed. Instead of this bridge, the Sri Lankan side requested reconstruction of a bridge connected to the Walpola - Mailawalana road (a national road). Having recently been upgraded to a B class road, however, this is no longer a farm road. Therefore, it is not eligible for repair under the Project.

2) Although bridge no. 18 is connected to a C class road, the Sri Lankan side has proposed to change it to an alternative bridge for reconstruction since it carries a railway over a river. Upon investigation, the alternative bridge has been determined not to meet the criteria for the current repair program. Accordingly, bridge no. 18 is removed from the bridge reconstruction list.

3) Investigations have revealed that the other 16 bridges are all extremely obsolete, including four impassable ones. The other ones are also very dangerous. Fourteen of the 16 bridges are connected to C class roads, which are connected to B class roads. All these bridges are connected to main roads in rural areas and connected to important routes of transportation of agricultural products to the international airport. The remaining two bridges, which are connected to E class roads, are also connected to important routes. In view of the importance of the bridges and the roads, there exists a great necessity for taking immediate measures regarding these 16 bridges.

Based on the above analysis and investigation, it is determined that, of the 18 bridges, the two bridges (nos. 12 and 18) should be removed from the list and that the remaining 16 bridges should be covered under the Project.

(2) Construction of Warehouses for Agricultural Products

The requested warehouses are for storing rice, vegetable and fruit.

1) Rice Warehouses

The request was made to solve a shortage of warehouses for unhulled rice. The shortage is caused by 60 middlemen buying unhulled rice not only in Gampaha District but also from other districts. Request was for the construction of a warehouse at Divulapitiya.

In Sri Lanka, the Paddy Marketing Board has chiefly managed domestic supply of rice while the Food Agency and the Multi-Purpose Cooperative Societies have been responsible for distribution of rice at official rates. However, since 1977 when a liberal economic policy was introduced and promoted, the private sector has come to play the most important role in rice distribution. The present request was made to cope with the shortage of warehouses in the private sector.

Despite that the middlemen are farmers engaged in rice distribution on the side, they are more professional middlemen than farmers. Also, the requested warehouse is intended as a means to expand business by storing rice bought from other districts as well as the Gampaha District. It is thus concluded that the request does not suit the concept of the IRDP and that it is not suitable for Japanese Grant Aid, either.

2) Vegetable and Fruit Storage

The requested vegetable and fruit storage facilities are a warehouse complex in the airport including cold storage. Specifically:

① The proposed site is property of a private company, which buys up and exports a large amount of agricultural products produced in Gampaha District.
② The present request has been made to greatly increase the storage capability of this company.
③ The name of the company is Sri Lanka Cooperative Marketing Federation Ltd. (Chairman: Mr. Weerasoorya)

It is a purely private corporation under the supervision of the Ministry of Food and Cooperatives.

Admittedly, such cool storage will increase the competitiveness of the company's merchandise and Gampaha's agricultural products on the domestic and international markets. However, this is a plan to expand facilities of a private corporation. Accordingly, it is concluded that the request does not suit the concept of the IRDP, and that it is not suitable for Japanese Grant Aid, either, in that it lacks components focused on farmer participation in the distribution system and on quality control.

Thus, the present request for agricultural warehouses and storage is considered incompatible with the Grant Aid concept.

(3) Procurement of Equipment for Repair and Maintenance of Farm Roads

Equipment for repair and maintenance of farm roads are to be deployed to the 4 EEO's of the PRDA (responsible for class C, D, and E roads) and PS's (responsible for class F roads).

As indicated in section 2-2, the foregoing equipment is classified as (I) for EEO's and (II) for PS's.

Category (I) is main equipment for road maintenance, and comprises 6 types of equipment for deployment to the 4 EEO's. In the case of category (II), 4 types of equipment were considered for deployment to the 12 PS's; however as 2 wheel tractors are on hand at 4 PS's this item is to be provided for the remaining 8 PS's only.

Accordingly, (and based on the Minutes):

Equipment (I) [to the 4 EEO's]

	Item	Number of units
A)	7 ton vibrating tandem roller	1
B)	Medium size motor grader	1
C)	Low bed trailer	1
D)	Bull dozers D.4 type	1
E)	Backhoe loader	1
F)	Mechanical grass cutter	1

Equipment (II) [to the 12 PS's listed below]

	Item	Number of units
A)	Vibrating roller 1.5 ton	1
B)	Tar boiler	1
C)	4W tractor with trailer	1
D)	2W tractor with trailer	1

01	Kelaniya Pradeshiya Sabha	(A,B,C,D)
02	Wattala Pradeshiya Sabha	(A,B,C,D)
03	Ja-Ela Pradeshiya Sabha	(A,B,C,D)
04	Mahara Pradeshiya Sabha	(A,B,C,D)
05	Katana Pradeshiya Sabha	(A,B,C)
06	Minuwangoda Pradeshiya Sabha	(A,B,C,D)
07	Divulapitiya Pradeshiya Sabha	(A,B,C,D)
08	Attanagalle Pradeshiya Sabha	(A,B,C)
09	Gampaha Pradeshiya Sabha	(A,B,C,D)
10	Dompe Pradeshiya Sabha	(A,B,C)
11	Mirigama Pradeshiya Sabha	(A,B,C)
12	Biyagama Pradeshiya Sabha	(A,B,C,D)

A desire was expressed by the Sri Lankan side to review the necessary equipment outside of that for basic road maintenance under equipment (I), and a report (PRDA Chairman's Report) was submitted at the end of the field survey by the MPPI. In this report, the original proposal in the Minutes for inspection, maintenance and repair of procured equipment to be performed at garages and small scale workshops to be constructed at each EEO was modified to be performed at a common workshop to be newly constructed at Asgiriya, as this was deemed to be more practical and efficient. Furthermore, as major repair work for equipment was originally planned to be done at the PRDA workshop in Colombo it was proposed to reduce a portion of transport equipment and other equipment. In addition, in light of the strong need for pavement repair equipment, items in this regard were also requested under the Chairman's Report.

As a result, ultimately requested equipment for EEO's is as follows:

Equipment I-I (for EEO's) [basic equipment for road maintenance]

	Type	Nos.
A)	8~10 ton static roller	4
B)	Medium size motor grader	4
C)	Low bed trailer	1
D)	Bulldozer (4.D type)	2
E)	Backhoe loaders with extra, pneumatic hammer, breaker	4
F)	Mechanical grass cutter	8

Equipment I-II (for EEO's) [pavement repair equipment]

	Type	Nos.
A)	1.5 ton pedestrian vibrating roller	4
B)	Tar boiler	4
C)	4-W tractor with trailer	4
D)	Medium size mobile premix plant	1
E)	Premix paver small size with laying machine	1
F)	Dump truck	4
G)	Engine driven mobile beam vibrator	1
H)	Concrete mixer 4/3	2
I)	Concrete mixer 7/5	2
J)	Mechanical tamper	4
K)	Mobile tar kettle with sprayer	2
L)	Cargo truck with crane	1
M)	Mobile crusher unit with compressor, breaker and generator, etc.	2
N)	Mechanical sludge pump	4
O)	4-W double cab	2

1) Equipment I-I

Deployment of these equipment has been planned so that each EEO can independently manage the farm roads in its jurisdiction. The PRDA plans to set up a workshop in the Gampaha District, where maintenance and management of all the equipment will be performed. This plan is judged reasonable because it will be difficult and inefficient to perform all the above maintenance related work at the PRDA workshop in Colombo, considering expected frequencies of use and transportation time. Also, from the view point of giving more independence to the Gampaha district, setting up a workshop is a reasonable plan.

Repair of unpaved road comprises the steps of (1) road surface levelling and (2) compaction. Step (1) requires items B, D and E while step (2) requires item (A). Item F is a

must item to maintain good road condition in this weed-ridden area. Since Item C (low bed trailer) will be used exclusively to transport the other items between construction sites and the workshop, one unit of item C should suffice to cover the four jurisdictions. As for item D (bull dozer D.4 type), two units should suffice to cover the four jurisdictions.

(a) Road Maintenance and Management Conditions under EEO's

The only equipment the four EEO's possess is 4 road rollers. Moreover, all of these road rollers have been used for over 30 years, with frequent breakdowns and extremely poor operation rate. The equipment owned by the PRDA in the Western Province (see Table 3-2-4) are shared by the three districts. Often deployed in other districts and not always available for repair in the Gampaha District, it is difficult to meet the equipment needs of the EEO's. As a result, the EEO's sometimes have no choice but to cope with the situation by renting necessary equipment from commercial equipment rental companies. The following data indicates equipment rental for the Nittamabuwa EEO between July 1992 and June 1993 regarding farm road maintenence.

Table 3-2-3 Equipment Rental by Nittamabuwa EEO
(July 1992 - June 1993)

	Item	Number of units and rental period	Rental fee (Rs)
1.	Road Roller	5 Rollers 20 days per month 12 months	960,000.00
2.	Motor Grader	1 Motor grader 8 days per month 6 months	460,800.00
3.	Backhoe	1 Backhoe 12 days per month 6 month	460,800.00
4.	Bulldozer	1 Bulldozer 3 days per month 12 months	432,000.00
			2,313,600.00

The types and numbers of equipment included under equipment (I-I) are necessary and justifiable, judging from the method of road repair and the shortage of equipment, and given the current status of equipment rental.

Table 3-2-4 Holding Machinery of PRDA (Borupana Work Shop in Colombo)

NO	TYPE OF MACHINE	MAKE/MODEL	CAPACITY	SERVICABILITY	PENDING REPAIRS	COST OF PENDING REPAIES	AGE	REMAINING LIFE TIME
1	BULLDOZER	CATERPILLER D4H	75 HP	SERVICABLE	UNDER CARRIAGE	50000	3 YRS	12 YRS
2	BULLDOZER	KOMATSU	75 HP	UNDER REPAIR	ENGINE REPAIR	350000	10 YRS	5 YRS
3	WHEEL LOADER	KOMATSU WA 180	1.7 M^3	SERVICABLE		.	3 YRS	12 YRS
4	WHEEL LOADER	KOBELCO LK500	1.8 M^3	SERVICABLE	ENGINE REPAIR	250000	9 YRS	6 YRS
5	BACK HOE	MITSUBISHI MS500	50 HP	SERVICABLE			3 MONTHS	15 YRS
6	MOTOR GRADER	KOMATSU 511 E	120 HP	SERVICABLE			3 YRS	12 YRS
7	MOTOR GRADER	MITSUBISHI LG2-H	120 HP	SERVICABLE	BREAK CLUTCH	350000	9 YRS	6 YRS
					CIRCLE REVERSE			
					GEAR CASE			
8	CRUSHER	JYC	10T/HR	SERVICABLE			3 MONTS	10 YRS
9	ROLLER	RUKANIAN(MRR 273)	8-10 TON	SERVICABLE	ENGINE REPAIR	30000	12 YRS	3 YRS
10	ROLLER	RUKANIAN(KERR 282)	8-10 TON	SERVICABLE	ENGINE REPAIR	40000	12 YRS	3 YRS
					TINKERING			
11	ROLLER	RUKANIAN(KERR290)	8-10 TON	SERVICABLE	ENGINE REPAIR	40000	12 YRS	3 YRS
					GEAR FOR REPAIR			
12	ROLLER	RUKANIAN(KERR 302)	8-10 TON	SERVICABLE	MINOR REPAIR	15000	12 YRS	3 YRS
13	ROLLER	RUKANIAN(KERR 317)	8-10 TON	SERVICABLE	ENGINE REPAIR	30000	12 YRS	3 YRS
14	ROLLER	RUKANIAN(RR 318)	8-10 TON	SERVICABLE			12 YRS	3 YRS
15	ROLLER	RUKANIAN(HDRR 311)	8-10 TON	SERVICABLE	MINOR REPAIR	10000	12 YRS	3 YRS
16	ROLLER	RUKANIAN(KERR 378)	8-10 TON	SERVICABLE	MINOR REPAIR	10000	12 YRS	3 YRS
17	ROLLER	RUKANIAN(KERR 380)	8-10 TON	SERVICABLE	MINOR REPAIR	10000	12 YRS	3 YRS
18	ROLLER	RUKANIAN(KERR 355)	8-10 TON	SERVICABLE	ENGINE REPAIR	40000	12 YRS	3 YRS
19	ROLLER	SAKAI(VPRR 01)	8-10 TON	SERVICABLE			3 YRS	12 YRS
20	ROLLER	FADROKA(KERR 305)	6-8 TON	SERVICABLE	CLUTCH	10000	12 YRS	3 YRS
21	ROLLER	GALLIAN(KERR 226)	8-10 TON	SERVICABLE	ENGINE REPAIR	40000	12 YRS	3 YRS
22	ROLLER	BENZS(KERR 123)	6-8 TON	SERVICABLE	MINOR REPAIR	5000	12 YRS	3 YRS
23	ROLLER	AVELING(BARFORD)	6-8 TON	SERVICABLE	MINOR REPAIR	10000	12 YRS	3 YRS
24	VIBRATING ROLLER	SAKAI(VPVR 01)	1-2 TON	SERVICABLE			3 YRS	7 YRS
25	VIBRATING ROLLER	SAKAI(VPVR 02)	1-2 TON	SERVICABLE			3 YRS	7 YRS
26	VIBRATING ROLLER	SAKAI(VPVR 03)	1-2 TON	SERVICABLE			3 YRS	7 YRS
27	VIBRATING ROLLER	SAKAI(VPVR 04)	1-2 TON	SERVICABLE			3 YRS	7 YRS
28	VIBRATING ROLLER	SAKAI(VPVR 05)	1-2 TON	SERVICABLE			3 YRS	7 YRS
29	VIBRATING ROLLER	SAKAI(VPVR 06)	1-2 TON	SERVICABLE			3 YRS	7 YRS
30	TIPPER	ISUZU(FTE)42/A365	3-6 TON	SERVICABLE			3 YRS	12 YRS

31	TIPPER	ISUZU(FTR)42/4368	7-8 TON	SERVICABLE			3 YRS		12 YRS
32	TIPPER	ISUZU(FTR)42/4380	7-8 TON	SERVICABLE			3 YRS		12 YRS
33	TIPPER	NISSAN(UD)43/4381	7-8 TON	SERVICABLE			3 MONTHS		15 YRS
34	TIPPER	TATA(1210 SE)26/2869	7-8 TON	SERVICABLE	PAINTING & MINOR REPAIR	50000	10 YRS		5 YRS
35	TIPPER	ISUZU(KT)40/3949	5 TON	SERVICABLE	GEAR FOR REPAIR	20000	8 YRS		6 YRS
36	LORRIES	TATA(1210)26/8666	7-8 TON	SERVICABLE	TINKERING BRAKES MINOR REPAIRS	75000	10 YRS		5 YRS
37	LORRIES	TATA(1210)26/9055	7-8 TON	SERVICABLE	TINKERING BRAKES MINOR REPAIRS	50000	10 YRS		5 YRS
38	LORRIES	ISUZU(SER)40/3954	5 TON	SERVICABLE	MINOR REPAIRS	40000	10 YRS		5 YRS
39	LORRIES	MITSUBISHI(42/3271	5 TON	SERVICABLE			3 YRS		12 YRS
40	LORRIES	NISSAN(UD)43/4308	5 TON	SERVICABLE			3 YRS		5 YRS
41	LIGHT LORRY	NISSAN(HONER)28/3872	2 TON	SERVICABLE	MINOR REPAIRS	30000	10 YRS		5 YRS
42	LIGHT LORRY	NISSAN (28/3844)	2 TON	SERVICABLE	MINOR REPAIRS	30000	10 YRS		5 YRS
43	LORRY	TATA (1210)26/8660	7-8 TON	UNDER REPAIR	ENGINE BODY WITH TRANSMISSION	400000	10 YRS		5 YRS
44	BOWSER	MITSUBISHI(42/5107)	6000 LTS	SERVICABLE			3 YRS		12 YRS
45	TRACTOR & TRAILOR	MASSEY FERGUSON(135)36/320		SERVICABLE	MINOR REPAIRS	20000	12 YRS		3 YRS
46	TRACTOR & TRAILOR	MASSEY FERGUSON(36/3476)		SERVICABLE	MINOR REPAIRS	20000	12 YRS		3 YRS
47	TRACTOR & TRAILOR	IMF(539)		SERVICABLE	ENGINE REPAIR ELECTRICIAL REPAIR				
48	DOUBLE CAB	ISUZU(53/7329)		SERVICABLE			3 YRS		12 YRS
49	DOUBLE CAB	TOYOTA (51/7511)	2400 CC	SERVICABLE			2 YRS		10 YRS
50	DOUBLE CAB	ISUZU(50/3345)	2200 CC	SERVICABLE			7 YRS		5 YRS
51	DOUBLE CAB	ISUZU(50/3688)	2200 CC	UNDER REPAIR	TINKERING, PAINTING SUSPENSSION ELECTRICAL WORK	70000	7 YRS		5 YRS
52	DOUBLE CAB	DATSUN(50/758)	2000 CC	SERVICABLE			8 YRS		4 YRS
53	JEEP	MITSUBISHI PAJERO(32/2238)	2400 CC	SERVICABLE			8 YRS		4 YRS
54	JEEP	DAIHATSU(31/4215)	2500 CC	SERVICABLE	MINOR REPAIRS	10000	12 YRS		2 YRS
55	JEEP	DAIHATSU(31/3542)	2500 CC	SERVICABLE			12 YRS		2 YRS
56	JEEP	DAIHATSU(31/4382)	2500 CC	SERVICABLE	MINOR REPAIRS	10000	12 YRS		2 YRS
57	SINGLE CAB	DATSUN(40/2363)	2300 CC	SERVICABLE	TINKERING, PAINTING SUSPENSSION ELECTRICAL WORK	90000	9 YRS		3 YRS
58	SINGLE CAB	DATSUN(40/2346)	2300 CC	SERVICABLE	SUSPENSSION ELECTRICAL WORK	25000	8 YRS		3 YRS
59	CAR	HUNDA STELLA(16/8001)	1800 CC	SERVICABLE			3 YRS		9 YRS
60	CAR	DAIHATSU(6/8475)	1500 CC	SERVICABLE			3 YRS		9 YRS
61	SINGLE CAB	DATSUN(40/2330)	2300 CC	SERVICABLE	TINKERING, PAINTING SUSPENSSION, BREAKS	75000	9 YRS		3 YRS
62	JEEP	MITSUBISHI(31/5380)	2500 CC	SERVICABLE	TINKERING, PAINTING STEERING SYSTEN BRAKES	70000	12 YRS		3 YRS
63	JEEP	DAIHATSU ROCKEY(31/1785)	2000 CC	SERVICABLE	TINKERING, PAINTING ENGINE, BRAKES, SUSPENSSION	75000	12 YRS		3 YRS

2) Equipment (I-II)

Since about 80% of C and D class roads are paved, expenses for paved road maintenance account for a substantial portion of the total road maintenance and management expenditure of the EEO's in the district. Thus, there is a need for equipment to perform such repair work.

Table 3-2-5 below shows details of the EEO's' expenses for repair and management of farm roads in the Gampaha District.

Table 3-2-5 Gampaha EEO's' Expenses for C, D and E Class Farm Road Maintenance and Management

EEO	Year	Paving Expenses			Construction Work	Others	Total
		Materials	Labor	Sub-total			
Udumgapola							
	91	-	-	-	-	-	-
Rs	92	375,921.00	300,200.74	676,121.74	449,490.94	65,327.65	1,190,940.33
(%)		(31.6)	(25.2)	(56.8)	(37.7)	(5.5)	
Rs.	93	139,127.62	133,719.36	272,846.98	39,502.99	49,459.50	361,870.53
(%)		(38.4)	(37.0)	(75.4)	(10.9)	(13.7)	
Kirindiwela							
	91	-	-	-	-	-	-
Rs	92	372,822.16	456,142.84	828,965.00	85,992.00	-	914,957.00
(%)		(40.7)	(49.9)	(90.6)	(9.4)		
Rs.	93	204,360.69	222,165.79	426,526.48	22,393.32	-	448,919.80
(%)		(45.5)	(49.5)	(95.0)	(5.0)		
Negombo							
Rs	91	965,000.00	535,000.00	1,500,000.00	1,455,000.00	-	2,955,000.00
(%)		(32.7)	(18.1)	(50.8)	(49.2)		
Rs.	92	6,410,000.00	4,107,500.00	10,517,500.00	1,988,100.00	-	12,505,600.00
(%)		(51.3)	(32.8)	(84.1)	(15.9)		
	93	-	-	-	-	-	-
Nittambuwa							
Rs	91			350,000.00	2,647,000.00	-	2,997,000.00
(%)				(11.7)	(88.3)		
Rs.	92	4,100,000.00	3,412,000.00	7,512,000.00	2,089,900.00	-	9,601,900.00
(%)		(42.7)	(35.5)	(78.2)	(21.8)		
	93	-	-	-	-	-	-

For maintenance operations, the EEO's mainly depend on manual labor and, when necessary, use equipment from a rental company, using premix as the maintenance material purchased from a private company. It should be noted that the EEO's carry out partial repair.

The only paving equipment the PRDA has are road rollers as shown in Table 3-2-4. The EEO's also have only worn-out road rollers. This poor equipment situation tends to slow down operations and cause incomplete maintenances, resulting in increased maintenance costs.

Against this background, the Sri Lankan side requested Japanese assistance in procuring machinery and equipment. Through Japanese assistance, it is planned to improve operation efficiency by producing premix in the district directly under PRDA supervision, and effectively utilizing equipment for road maintenance.

Items to be actually procured have been selected from requested equipment so that each EEO will be able to carry out maintenance independently, while taking into account the above situation.

Selected items are limited to ones that are closely related to paved road maintenance. Accordingly, items for small scale transport C)and O), and items for concrete placement G), H), I), and N) are excluded. Since item K) can serve as item B), four units of item K) are to be procured, excluding item B) from the selection. item E) is not selected either because partial paving is the main maintenance work and manual tar laying can be more efficient considering the viscosity of premix. One unit of item M) is to be procured because there is only one premix plant.

3) Equipment (II)

The following equipment are requested in this classification.

	Item	
A)	0.75 ton pedestrian vibrating roller	12 units
B)	Tar boiler	12 units
C)	4W-tractor with trailer	12 units
D)	2W-tractor with trailer	8 units

According to the request, items A), B) and C) are to be deployed at 12 PS's and item D) at 8 PS's (as 4 PS's already have item D) on hand). In view of the fact that PS's are partly responsible for management of E class roads, item B) is justly needed. Item A) will also be useful in partial maintaining of road surface while items C) and D) are essential for transportation of materials and other related small items.

Since most of the road repairs are manually done under PS's and the above requested items are all essential for efficient manual maintenance. It is thus concluded that the plan for deployment of the items in equipment (II) is adequate.

4) Selected Equipment (At Draft Report Explanation)

The selected equipment at the Minutes of Basic Design Study and P.R.D.A. Chairman's Report explanation were as follows.

Equipment (I-I)

	Item	Number of units
A)	8-10 ton static roller	4
B)	Medium size motor graders	4
C)	Low bed trailers	1
D)	Bulldozers D.4 type	2
E)	Backhoe loaders with extra pneumatic hammer and breaker	4
F)	Mechanical grass cutters	8

Equipment (I-II)

	Item	Number of units
G)	0.75 ton pedestrian vibrating roller	4
H)	Medium size mobile premix plant	1
I)	Dump truck	4
J)	Mechanical tamper	4
K)	Mobile tar kettle with sprayer	4
L)	Cargo truck with crane	1
M)	Mobile crusher unit with compressor, breaker and generator, etc.	1

Note: Selected items have been assigned new reference symbols G) to M) as shown above in the order of selection.

Equipment (II)

	Item	Number of units
A)	0.75 ton pedestrian vibrating roller	12
B)	Tar boiler	12
C)	4W-tractor with trailer	12
D)	2W-tractor with trailer	8

5) Additional Equipment

Following equipment were additionally requested by the Government of Sri Lanka during Draft Final Report Explanation. Upon the request, home office collation, analysis and evaluation of additional equipment were performed by JICA study team. And it was concluded by JICA study team that the request was adequate. And the equipment to be supplied were finalized as shown in Table 3-2-6.

	Item	Number of units
i)	4W-Double cab	1
ii)	Survey Instrument	
	· Theodolite	2
	· Levelling Set	4
	· Electro Distance Meter	1
iii)	Mobile workshop	1

Table 3-2-6 Equipment to be Supplied

	Item	Minutes	Chairman's Report	Draft Report	Basic Design	Rationale
I ~ I	(for EEO)					At the outset of the field study, it was originally envisioned to conduct major maintenance and repair of equipment at a workshop in Colombo. However, the Project plan was subsequently modified to establish a workshop in Gampaha district. Accordingly, of the equipment originally to be deployed at the 4 locations, it was concluded that items (C) and (D) could be reduced to 1 and 2 units, respectively and still cover the entire district. Conversely, (F) was increased to 8 units (2 at each office) to respond to the heavy grass cutting requirements present.
	A. 8~10 ton static roller	4	4	4	4	
	B. Medium size motor grader	4	4	4	4	
	C. Low bed trailer	4	1	1	1	
	D. Bull dozer D4	4	2	2	2	
	E. Backhoe	4	4	4	4	
	F. Mechanical grass cutter	4	8	8	8	
I ~ II	(supplemental equipment)					Repair of paved roads accounts for the greater part of overall road repair expenditure by each EEO. Pre-mix is used for such repair, and this is procured from the private sector. Lengthy transport time, excessive cost and lack of equipment result in incomplete road maintenance and repair. In order to overcome this, it is concluded that equipment directly related to paved road repair is necessary, and focus was accordingly limited to such equipment. Under the Project, it is envisioned that 1 pre-mix plant will service the entire district, and accordingly, item (M) was reduced to 1 unit. As item (K) can perform the functions of item (B) as well, item (B) was eliminated, with the number of units of (K) being increased from 2 to 4. Other items are to be deployed to the 4 EEO's.
	G. 0.75 Ton pedestrian vibrating roller	--	4	4	4	
	Tar boiler	--	4	--	--	
	4W Tractor w/trailer	--	4	--	--	
	H. Medium sized mobile premix plant	--	1	1	1	
	Premix paver, small size mobile with laying machine	--	1	--	--	
	I. Dump truck	--	4	4	4	
	Engine driven mobile beam vibrator	--	1	--	--	
	Concrete mixer 4/3	--	2	--	--	
	Concrete mixer 5/7	--	2	--	--	
	J. Mechanical tamper	--	4	4	4	
	K. Mobile tar kettle w/sprayer	--	2	4	4	
	L. Cargo truck w/crane	--	1	1	1	
	M. Mobile crusher unit	--	2	1	1	
	Mechanical sludge pump	--	4	--	--	
	N. 4W Double cab	--	2	--	1	
	O. Survey instrument	--				
	Theodolite	--	--	--	2	
	Leveling Set	--	--	--	4	
	Electro Distance Meter	--	--	--	1	
	P. Mobile workshop	--	--	--	1	
II	(for PS)					At present all farm road maintenance and repair of farm roads under the jurisdiction of the local authority PS is done manually. As a result, work is time consuming and of poor quality. The numbers of equipment envisioned under the Project is considered appropriate for upgrading work efficiency.
	A. Vibrating roller	12	12	12	12	
	B. Tar boiler	12	12	12	12	
	C. 4W Tractor w/ trailer	12	12	12	12	
	D. 2W Tractor w/trailer	8	8	8	8	
	Workshop tools and equipment	--	1 set	--	--	

3-2-6 Necessity of Post-Project Technical Assistance

Since this Project mainly concerns reconstruction of bridges and procurement of equipment for farm road maintenance, once the Project is completed, no further technical assistance appears to be needed.

3-2-7 Assistance Policy

The analysis above of the Project indicates that the approach to achieving objectives, its feasibility and Sri Lanka's ability to implement the Project are all appropriate. The policies proposed by the Sri Lankan government concerning the Project are also found appropriate. Furthermore, there is a good prospect of the benefit of the Project being widely spread. Anticipated effect of the Project agrees with Japan's criteria for Grant Aid. On the basis of this analysis, it is concluded that this Project should be implemented under Japan's Grant Aid programme.

However, it appears to be desirable to make some changes in the Project as requested by the Sri Lankan government, which is discussed above in the sections on analysis of the contents of Sri Lanka's request for facilities and equipment.

3-3 Project Description

3-3-1 Executing Agency and Operational Structure

Overall responsibility for implementation of IRDP's lies with the MPPI. In the case of the subject Project, construction of facilities and procurement of equipment will be the responsibility of the RDD of the MPPI.

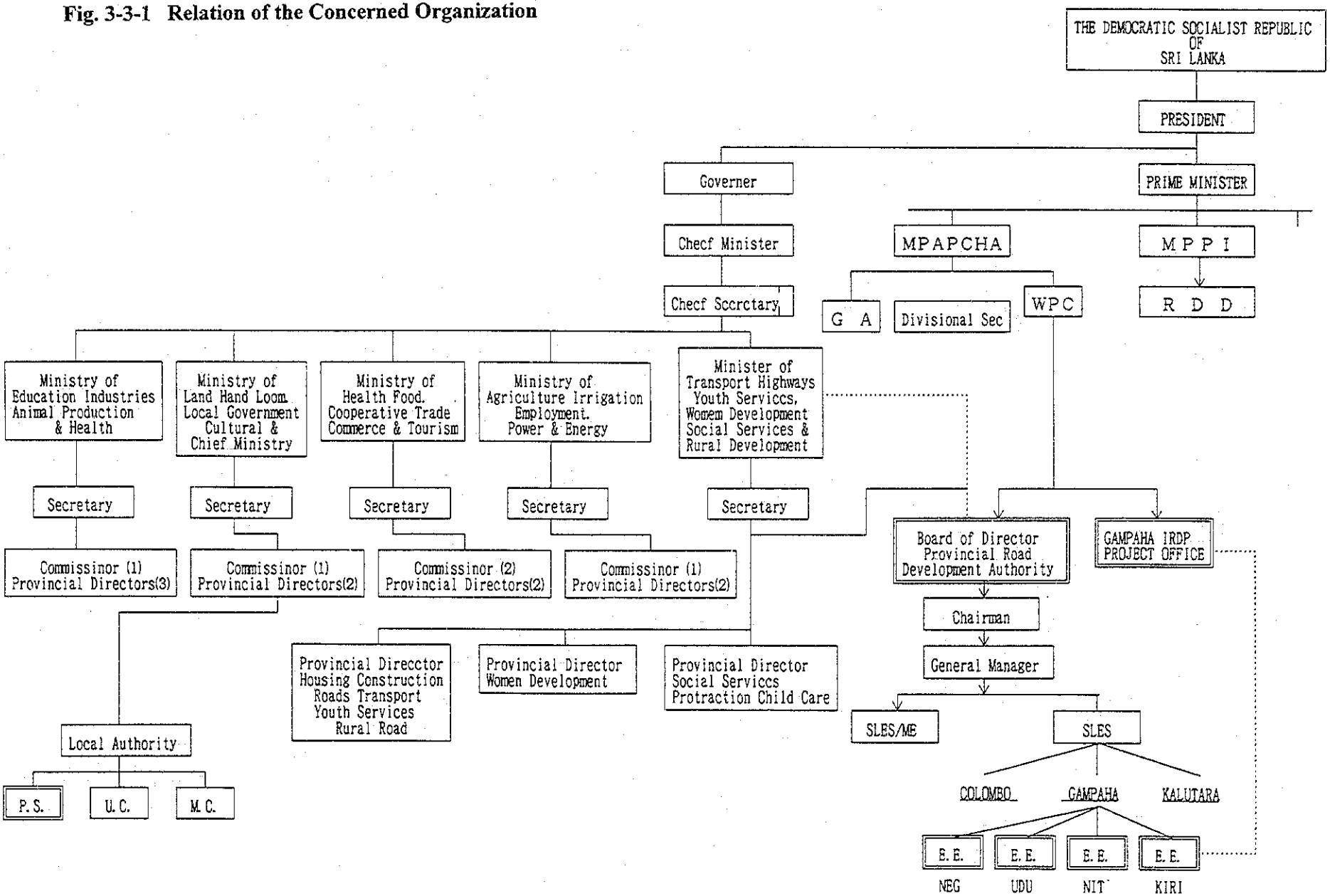
The equipment and bridge facilities to be provided under the project will be maintained and managed by the following organizations.

The followings are the concerned organizations:

①	Management and monitoring of the IRDP	MPPI Project Office, Gampaha District
②	Maintenance of bridges and farm roads: (C, D, and E class roads)	Road Development Authority, Western Province EEO, Gampaha Region,
③	Maintenance of farm roads (F class road)	District Office, Pradeshiya Sabha (Local Authority, Gampaha Region)

The above relationships are set out in the organigram below (Figure 3-3-1):

Fig. 3-3-1 Relation of the Concerned Organization



3-3-2 Project

The Project is to reconstruct bridges and to provide the equipment for the maintenance of farm roads within the Project area, as a part of the IRDP.

Reconstruction of bridges	-	16 bridges
Procurement of equipment for the maintenance of farm road	-	Procurement for 4 EEO's of PRDA
	-	Procurement for 12 District offices of Pradeshiya Sabhas

The implementation of the Project will improve the farm road network and the maintenance capability of the concerned organizations, and consequently strengthen the transportation capacity for agricultural products.

Present status of the road in the Project area is as follows:

	Farm Road (Class-C, D and E roads)		
EEO	Unpaved (km)	Paved (km)	Total
Nittambuwa	72.4	217.3	289.7
Negombo	56.5	131.8	188.3
Udugampola	48.3	193.1	241.4
Kirintiwela	42.7	242.1	274.8
Total	219.9	784.3	1,004.2

3-3-3 Location of Bridges

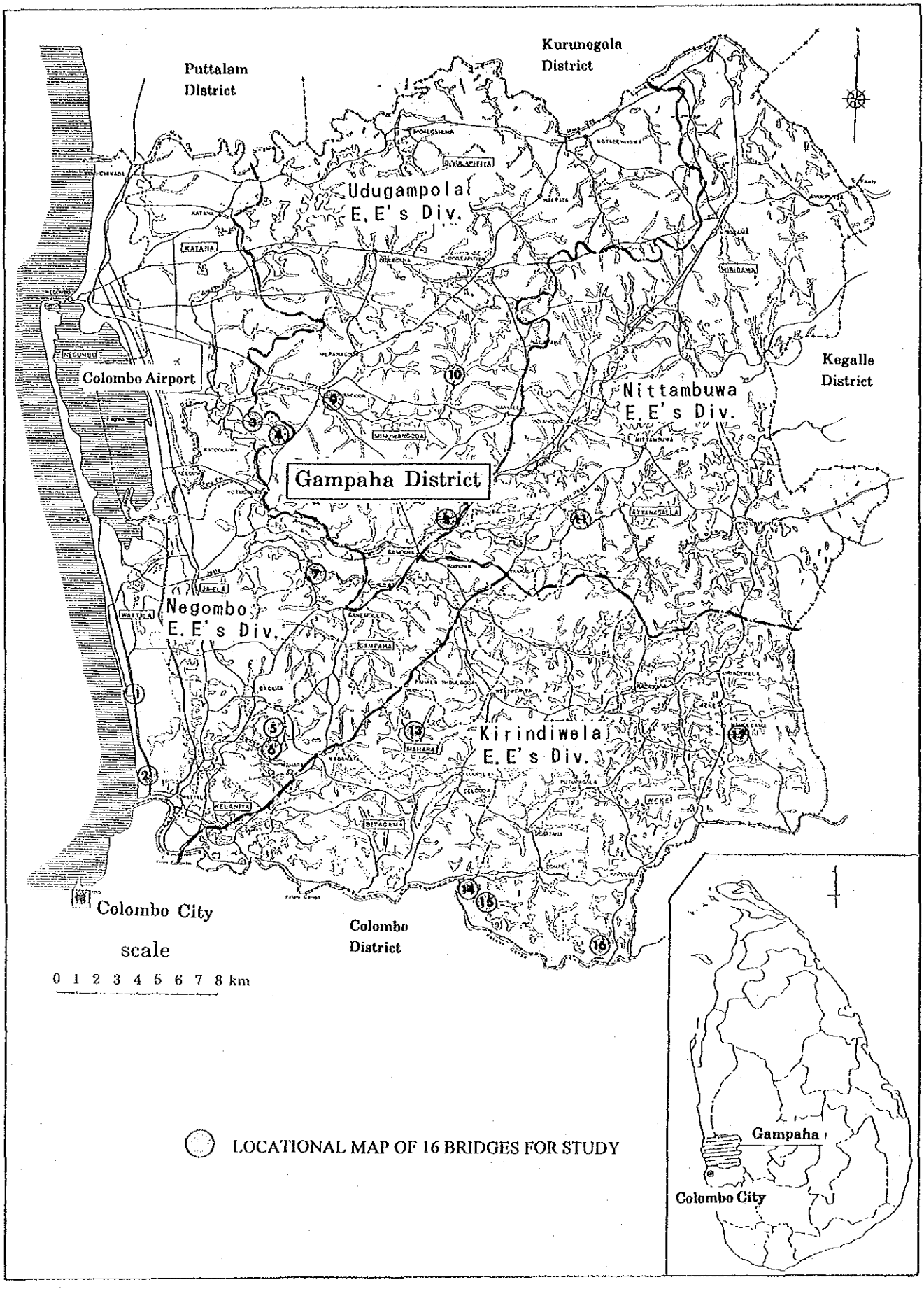
Sites for bridges to be reconstructed under the Project are along small rivers in low areas of Gampaha District, as indicated in Figure 3-3-2.

The Gampaha District consists of 13 Pradeshiya Sabhas. Projected bridge locations and concerned EEO's are as mentioned below:

EEO	Pradeshiya Sabha	Bridge No.
Negombo	Wattala	(1) (2) (5) (6)
	Ja-Ela	
	Katana	(3) (4)
	Negombo	
Udugampola	Minuwangoda	(8) (9) (10)
	Diulapitiya	
	Gampaha	(7)
Nittambuwa	Attanagalla	(11)
	Mirigama	
Kirintiwela	Kelaniya	
	Mahara	(13)
	Weke	(14) (15) (16) (17)
	Biyagama	

Majority of the bridges are inundated at the time of flooding (bridges No. 3,4,5,6,11,13,14,15,16,17 are inundated during flooding.)

Fig. 3-3-2 Locational Map for Study



3-3-4 Description of the Project

(1) Bridges

Due to severe deterioration, super and substructures for all bridges are to be reconstructed.

Bridge sites in most cases are inundated during small to medium floods. The relationship between bridge surface elevation and flood height is shown in Table 5-1-3. In the case of the 12 bridges for which flood records are available, only 3 due not experience inundation during flooding. The remaining 9 are subject to water height at 0.5~0.9 m above the bridge surface during flooding.

1) Design Criteria

① In the case of box culvert structure, the bridge is to be able to tolerate inundation during flooding.
② In the case of steel girder structure, a minimum clearance of 0.6 m above the flood water level is to be achieved to prevent bridge inundation.
③ In the case of all bridges, width is to be determined on the basis of existing road width and importance.
④ In order to maximize approach safety, access road alignment is to be straight for a minimal 20 m distance from each bridge end.

<Reasons for adopting steel girder type>

The 10 bridges considered for this type of superstructure are 17~32 m in length. Conventionally, a comparison of steel girder and post tension concrete girder superstructures is done in this case on the basis of existing conditions in site and number of spans. Where numerous spans occur in the case of the post tension girder type, diverting of erection equipment and savings on transport cost of girder materials reduce overall construction cost.

In order to adopt the post tension type superstructure for the 10 bridges under consideration, the following conditions must be met.

a. Girder manufacturing yard is to be established at 1 location with capability for manufacture, stock piling and transport of girders to the 10 sites. (yard area: 1.0 ha)
b. Materials for post tensioning the PC steel are required at all 10 sites.
c. For girder suspension following tensioning, 120 t truck crane, suspended arm, etc. are necessary. (according to construction cost standards for civil works, Ministry of Construction, Japan)
d. Transport of the above crane, and construction of access roads to site for the same greatly increase overall construction cost. Also, suspended arm equipment, etc. is necessary at all 10 sites.

On the basis of the above, since the subject 10 bridges are all single span, the advantages of the post tension type superstructure are not present. Accordingly, the steel girder type superstructure is overall cost effective.

2) Bridge Design Features

The followings are the basic design elements for each bridge:

Bridge no.	Road class	No. of lanes	Design span length (m)	Type of super-structure	Present bridge length
1	C	2	20.0	Plate girder	17.4
2	C	2 (w/ walkway)	23.0	Plate girder	15.2
3	C	2	32.0	Plate girder	23.7
4	C	2	23.0	Plate girder	15.4
5	C	2	8.0	Box culvert	3.5
6	C	2	4.6	Box culvert	3.8
7	C	2	14.7	Box culvert	13.2
8	E	1	30.0	Plate girder	-
9	E	1	32.0	Plate girder	26.9
10	C	1	10.0	Box culvert	13.6
11	C	1	32.0	Plate girder	19.0
12	Deleted				
13	C	1	8.0	Box culvert	8.3
14	C	2	22.0	Plate girder	18.9
15	C	2	5.7	Box culvert	4.8
16	C	1	17.0	Plate girder	2.2
17	C	2	23.0	Plate girder	9.6
Total			305.0		195.5

(2) Equipment for Farm Road Maintenance

The equipment are grouped into two, that for four EEO's of PRDA, which are listed in the equipment lists (I-I) [for basic road repair and maintenance] and (I-II) [for pavement repair], and that for Pradeshiya Sabha (PS), which are listed in the equipment list (II). The followings are the summary of specifications for each machine.

1) Equipment (I~I)

Item	No.	Usage/Others	Destination
A. 8 ~ 10 ton static roller	4	Compaction of subbase and road base	4 EEO's
B. Medium size motor grader	4	Compaction of subbase	4 EEO's
C. Low bed trailer	1	Transportation of heavy equipment	PRDA (workshop)
D. Bulldozer	2	Leveling	PRDA (workshop)
E. Backhoe loader	4	Excavation	4 EEO's
F. Mechanical grass cutters	8	Cutting grass and trees	4 EEO's (2 each)

PRDA: Provincial Road Development Authority
EEO : Executive Engineering Office
P.S : Pradeshiya Sabha

Equipment (I-II)

Item	No.	Usage/Others	Destination
G. 750 kg pedestrian vibrating roller	4	Compaction of subbase and road bed	4 EEO's
H. Medium size mobile premix plant	1	Mixing asphalt and aggregate (for pavement)	PRDA (workshop)
I. Dump truck	4	Transportation of construction materials and wastes	4 EEO's
J. Mechanical tamper	4	Compaction of subbase	4 EEO's
K. Mobile tar kettle with sprayer	4	Melting and spraying asphalt (for asphalt pavement)	4 EEO's
L. Cargo truck with crane	1	Transportation of equipment and materials	PRDA (workshop)
M. Mobile crasher unit w/ compressor, breaker, and generator	1	Production of crushed stone	PRDA (workshop)
N. 4W - Double Cab	1	Transportation of staff and materials	PRDA (workshop)
O. Survey Instrument Theodolite Leveling Set Electro Distance Meter	 2 4 1	Survey instrument of road rehabilitation	PRDA (workshop)
P. Mobile workshop	1	Site repairing car	PRDA (workshop)

Equipment (II)

Item	No.	Usage/Others	Destination
A. 750 kg pedestrian vibrating roller	12	Compaction of subbase and road bed	12 PS's
B. Tar boiler	12	Melting asphalt (for asphalt pavement)	12 PS's
C. 4W-tractor with trailer	12	The transportation of small volume of materials	12 PS's
D. 2W-tractor with trailer	8	Short distance and small volume transport materials	8 PS's*

[* This is not needed for Katana, Attanagal, Dompe, and Mirigama pradeshiya sabhas]

3-3-5 Maintenance Plan

(1) Bridges

The 16 bridges under the Project are located on C and E class roads. At present, maintenance of C, D, and E class roads and the bridges located on these is carried out by the 4 EEO's under the PRDA within whose jurisdiction they lie. Bridges currently under the jurisdiction of these EEO's total 55, with a total of 3,000 culverts. Bridges reconstructed under the Project will be maintained under the existing organizational setup. Bridges under the respective jurisdictions of EEO's are as shown in 3-3-3.

In maintenance of the bridges to be reconstructed, paint protection of the 10 steel girder bridges requires special attention. It will be necessary to repaint these bridges once ever 10 years, painting cost per time for all 10 bridges estimated at Rs 6.5 million. This computes to a cost of Rs 650,000 per year.

However, procurement of farm road maintenance equipment under the Project will enable a considerable reduction in outlays for road repair machinery rental and paving materials production, and these savings will be amply available for the above mentioned bridge painting. Accordingly, the plan is concluded to pose no problems either technically or in terms of available budget.

(2) Equipment for Farm Road Maintenance

Management of equipment procured under the Project will be performed by the RDD of MPPI, the provincial government and PS's. Equipment (I) is to be deployed to the EEO's and the equipment (II) to the PS's. Nevertheless, it will be necessary for the MPPI, EEO's, PS offices and the proposed workshop to coordinate closely in formulation of equipment usage plan to permit required flexibility for intensive deployment of equipment, where necessary, to work sites throughout the district regardless of the nominal deployment locations of items under the Project.

Inspection, maintenance and repair of equipment (I), and (II) is to be done at the Asgiriya workshop to be newly constructed by PRDA as described below.

Construction Plan for Asgiriya Work Shop

Objective :	The maintenance and repair work for equipment to be provided under the project and other related equipment.
Location :	At Asgiriya, Gampaha District, which belong to the Western Province; approximately one acre.

Facilities:
- Service area
- Sheet metal processing shop
- Painting shop
- Electrical work shop
- Tire maintenance shop
- Gauging and measurement shop
- Warehouse for spare parts
- Office

Manpower distribution:

(a) Mechanics	3
(b) Electricians	1
(c) Operators	16
(d) Driver	1
(e) Service Crews	5

The arrangements mentioned above will be carried out by using due budget of the PRDA. Necessary personnel to man the workshop are to be newly employed. Where necessary, skilled mechanics from the PRDA workshop at Borupana in Colombo will be dispatched to train personnel at the new workshop under the Project.

As reference, the followings are the list of workers at the Borupana work shop in Colombo:

	Type of worker	No.
(a)	Mechanical engineer	1
(b)	Technical officer	1
(c)	Mechanics	6
(d)	Machinist	1
(e)	Welder/tinker	3
(f)	Operators	25
(g)	Greaser	5
(h)	Crusher operator	1
(i)	Crusher labourer	4
(j)	Electrician	1

CHAPTER 4 BASIC DESIGN

4-1 Design Policy

The bridges subject to basic design are located on C and E class roads (in Sri Lanka roads are classified A~F; however, this is a rough classification based on perceived road importance rather than criteria of traffic volume, road width, road structure, etc.). Rather than a formal set of uniform standards, a combination of British Standards and internal standards of the PRDA are applied to bridge design.

Due to the foregoing, bridge and road standards of the Japan Road Association and design standards of the Ministry of Construction, Japan have been applied to the design of plate girder and box culvert bridges.

On the basis of discussions with PRDA during field survey, road width and vehicle load were determined as follows:

2 lane bridge	:	first class bridge load (TL-20)
1 lane bridge	:	second class bridge load (TL-24)

The access road is to have simple pavement structure with a sub base and a sub grade with 5cm upper base and 10cm lower base. The pavement is asphalt penetrating macadam.

4-1-1 Width Component for Bridges to be Reconstructed

Under basic design, the road width components of individual bridges were classified into three groups according to degree of importance, in due consultation with the members of the PRDA, the results of traffic survey and the findings of home office work. On the basis of the foregoing, the lane number was decided. All 15 bridges except one are to be straight bridges.

Elements of Road Width Component for Bridges to be Reconstructed

Road width component for bridges reconstructed	Load	Remarks		
	Skewed angle	Class	Bridge No.	Access road (Name of Bridge)
2-lanes (one lane for each side) Overall width, 9.0m (5.5m width carriageway and 1.5m width foot way)	TL-20 (First class bridge) θ = 90 ° Straight bridge	C	(2)	Paliyamatta ~ Lansiyawatte
2-lanes (one lane for each side) Overall width, 7.7m (5.5m width carriageway)	TL - 20 (First class bridge) θ = 90 ° Straight bridge	C	(1)	Uswetakeiyawa ~ Bopitiya
		C	(3), (4)	Averiwatte ~ Yagodamulla
		C	(5), (6)	Dalupitiya ~ Karagahamuna (box culvert)
		C	(7)	Ja-Ela ~ Oragolla (box culvert)
		C	(14), (15)	Malwana ~ Samanabedda ((15) box culvert)
		C	(17)	Pallegama~ Ranawalameethirigala
One lane Overall 6.2m (Carriageway 4.0m)	TL - 14 (Second class bridge) θ = 90 ° Straight bridge	E	(8)	Doranagoda ~ Udugampola (new bridge)
		E	(9)	Aswana ~ Minuwangoda (Kalawana)
		C	(10)	Wudamulla ~ Niwala (box culvert)
		C	(11)	Bonagola~Rukgahawala (Ogodapola)
		C	(13)	Gonahena ~ Ruppagoda (box culvert)
		C	(16)	Samanabedda ~ Walgama-Kahatagoda

4-1-2 Social and Natural Conditions Taken into Account in Bridge Design

(1) Uswetakeiyawa - Bopitiva bridge (C class): bridge no. 1

The bridge is located in a densely populated area and in the vicinity of Colombo city, crossing a channel in which there is heavy fishery boat traffic. On the one hand, allowance of girder height from high water level should not be less than the present one, and on the other hand, the road surface level also should not exceed the existing one if the surrounding conditions allow due to the existing being densely populated vicinity. Therefore, the type of superstructure to minimize the girder height is adopted.

(2) Paliyawatta - Lansiyawatta bridge (C class): bridge no. 2

This bridge is located at the southern vicinity of bridge no (1), and adopts the same design conditions. Bridge width should allow 2 lanes and a foot path, due to big traffic volume and many passers-by. As there are, on the sea side, not only many houses but also many important buildings such as hotel, factories, churches and social welfare facilities, a detour is needed during the construction period.

(3) Averiwatta - Yagodamulla (west side) bridge (C class): bridge no. 3

The bridge is located near the Colombo Airport, and a cotton mill factory and an air force base exist along the road. The road is thus anticipated to be a main district one in the future, based upon which the bridge width is for 2 lanes and the vertical slope of the access roads should be less than 6%.

(4) Averiwatta - Yagodamulla (east side) bridge (C class): bridge no. 4

The bridge is located near bridge no. (3), and the design condition is thus the same as bridge no. (3).

(5) Dalupitiya - Karagahamuna (north side) bridge (C class): bridge no. 5

The bridge is located in paddy field area near Colombo. The bridge width is for 2 lanes and a detour is needed because of a number of passenger buses. On the basis of home office analyses, bridge is to be box culvert type.

(6) Dalupitiya - Karagahamuna (south side) bridge (C class): bridge no. 6

The bridge is located near bridge no.(5), and the design condition is thus the same.

(7) Ja-Ela - Oragolla bridge (C class): bridge no. 7

The existing bridge is a straight bridge with 13m long span and the access roads have very moderate horizontal curve. In the present design, the bridge is a right bridge with the modification of the vertical curve of the access roads. On the basis of home office analyses, bridge is to be box culvert type.

(8) Doranagoda - Udugampola bridge (E class): bridge no. 8

Location is at the end of a farm road far from the main road, and coconut planks are placed across a stream in a very primitive way for the tentative use as a foot path. The bridge width is for one lane. The design should allow for workability during the construction period. The temporary access road for heavy machinery should be simple pavement, that would be utilized as the new access road after the construction to increase cost effectiveness. The length of access road on the left bank is estimated at approximately 0.6 km.

(9) Aswana - Minuwangoda bridge (E class): bridge no. 9

The bridge is located at the lower end of a steep and narrow road. The bridge width is for one lane due to the E class access road and rather small traffic volume. A new access road for heavy machinery is needed due to the incapability of such machinery to pass on the present access road.

(10) Wudamulla - Niwala bridge (C class): bridge no. 10

The access road is C class due to the small volume of traffic, though passenger buses pass by. The second class bridge with a single lane is adopted for design. Bridge structure is to be box culvert.

(11) Bonagola - Rukagahawila bridge (C class): bridge no. 11

As the river is wide and the direction of flow changes just past the bridge site at right angle, and river slope is steep, good bank protection is absolutely needed. To conform to the width of existing road, number of lanes is to be one.

(12) Mangalathiriya - Bogamuwa (C class): bridge no. 12

This bridge was eliminated from consideration under the Project.

(13) Gonahena - Ruppaoda bridge (C class): bridge no. 13

The bridge is located on a farm road far from the main road. A one lane, box culvert structure is adopted due to the small traffic volume.

(14) Walwana - Samanabedda (West side) bridge (C class): bridge no. 14

A detour is to be studied due to the large volume of traffic. Number of lanes is to be two.

(15) Walwana - Samanabedda (East side) bridge (C class): bridge no. 15

As the access road, just on the upstream of the bridge, curves to the right at a right angle, careful consideration must be given to road alignment. A one lane, box culvert structure is adopted due to the large traffic volume.

(16) Samanabedda - Walgamakahatagoda bridge (C class): bridge no. 16

Area around the bridge has been excavated for clay supply for brick production, and as a result the configuration of the area is complicated. Bank protection is needed on the right side above the bridge. Number of lanes is to be one.

(17) Pallegama - Ranwalameethirigala bridge (C class): bridge no. 17

Two lanes are planned due to large traffic volume. A detour is planned during construction.

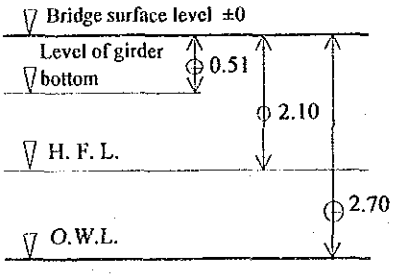
4-1-3 River Condition

The following explains the relational height among the design height of bridge surface, the present height of girder bottom, the H.F.L, the O.W.L, and the status at flood for each bridge:

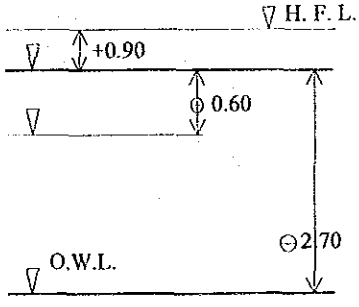
(unit: m)

Bridge No.	Bridge (1) surface level	(1) - Present girder bottom height	(1) – H.F.L	(1) – O.W.L	Status at flood
1	± 0	⊖ 0.51	⊖ 2.10	⊖ 2.70	No inundation at flooding
2	"	⊖ 0.27	⊖ 2.10	⊖ 2.70	No inundation at flooding
3	"	⊖ 0.60	+ 0.90	⊖ 2.70	Bridge surface is under water
4	"	⊖ 0.50	+ 0.90	⊖ 1.80	"
5	"	⊖ 0.59	+ 0.90	⊖ 1.20	"
6	"	⊖ 0.52	+ 0.90	⊖ 1.20	"
7	"	⊖ 0.10	No data	No data	No data
8	No bridge	——	"	"	"
9	Bridge collapsed	——	"	"	"
10	± 0	⊖ 0.34	"	"	"
11	"	⊖ 0.50	⊖ 0.15	⊖ 4.20	Girder is under water
13	"	⊖ 0.20	+ 0.50	No data	Bridge surface is under water
14	"	⊖ 0.70	+ 0.60	"	"
15	"	⊖ 0.40	+ 0.65	"	"
16	"	⊖ 0.35	+ 0.75	"	"
17	"	⊖ 0.70	+ 0.50	"	"

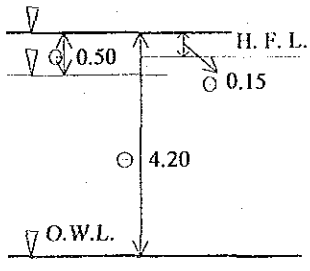
<Bridge No.1>



<Bridge No.3>



<Bridge No.11>



Flood level is an important factor for bridge design. However, data available for the bridge sites under the Project is not based on river training planning, and should be interpreted as simply representing past flood water levels. Furthermore, bridge sites are at locations on canals affected by tide, as well on rivers where the entire catchment area may be subject to inundation. As a result, long term analysis of the runoff mechanism is necessary.

The space allowance under girder, the flood level, and the river cross section area for water flow are computed allowing for the following, using the data locally obtained: (refer to bridge design comparison table)

① The design height of girder bottom should, at least, be higher than the present level. Girder structure and box culvert structure are to be as follows:

<Girder structure: for a total of 10 bridges>
- At H.F.L. + 60 cm (nos. 1,2,3,4,11,14,16,17)
- At existing bank protection height + 1.0 m (no. 8)
- At existing girder bottom height + 1.0 m (no. 9)

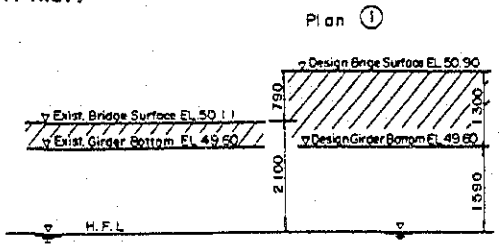
<Box culvert structure: for a total of 6 bridges>
- Above existing girder bottom height (nos. 5,6,7,10,13,15)

② All bridges have only a single span each, while maintaining enough space for water flow, without piers or protruded abutment/banks as seen at present.

— Alternative Plans for Bridge Design (1/2) —

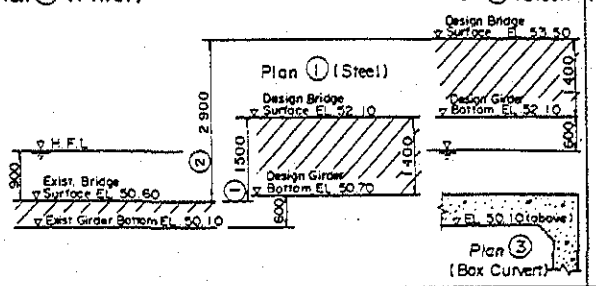
Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 1	20.0	Composite Girder	6.5 m (2 lanes)	First Class Road

Plan ① (Final)



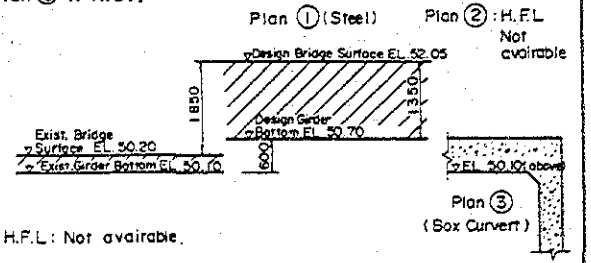
Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 4	23.0	Composite Girder or Box Curvert	Plan ①: 2 lanes Plan ②: 2 lanes	Plan ①: First Class Road Plan ②: First Class Road

Plan ② (Final)



Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 7	Composite Girder : 21.0m Box :	Composite Girder or Box Curvert	6.5 m (2 lanes)	First Class Road

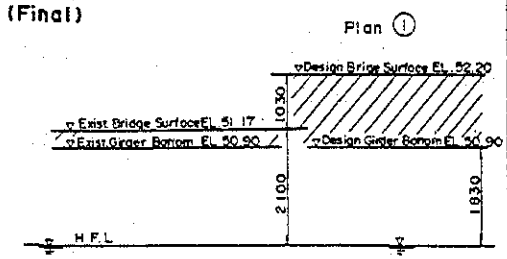
Plan ③ (Final)



H.F.L : Not avairable.

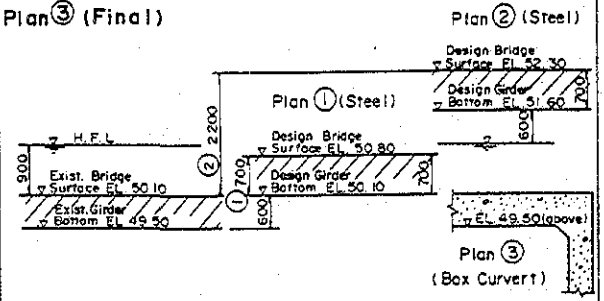
Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 2	23.0 m	Composite Girder	6.5m 2lanes (1.5m one side walke)	First Class Road

Plan ① (Final)



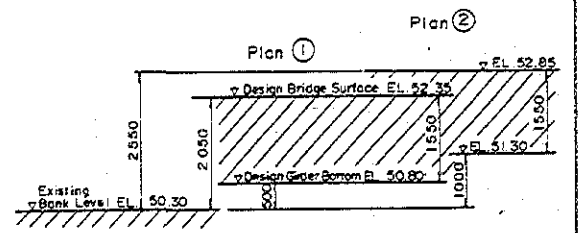
Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 5	PC slab : 12m Box :	PC slab or Box Curvert	6.5 m (2 lanes)	First Class Road

Plan ③ (Final)



Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 8	32.0 m	Composite Girder	5.0 m (1 lane)	Second Class

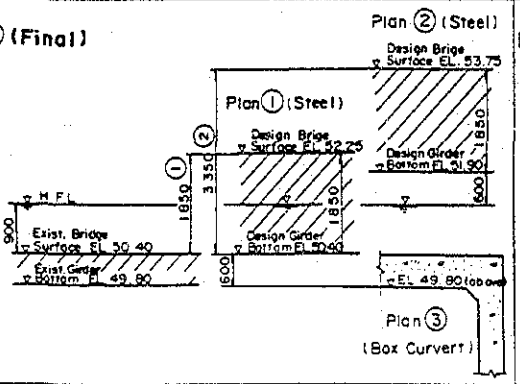
Plan ② (Final)



(H.F.L : Not avairable)
Design Girder Bottom = Existing bank (EL 50.3) − 0.50 m = 50.80 m

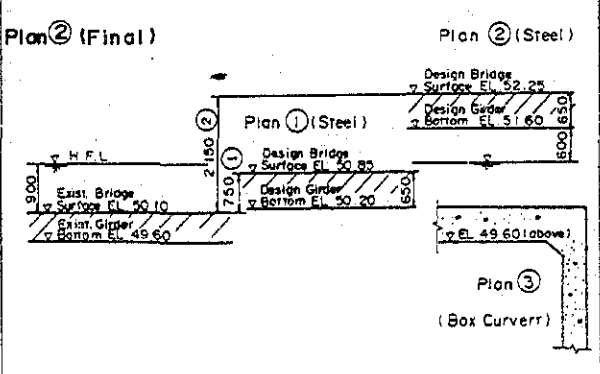
Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 3	32.0 m	Composite Girder or Box Curvert	6.5 m (2 lanes)	First Class Road

Plan ② (Final)



Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 6	PC slab : 8m Box :	PC slab or Box Curvert	6.5 (2 lanes)	First Class Road

Plan ② (Final)



Note

Plan ① : Submersible plan

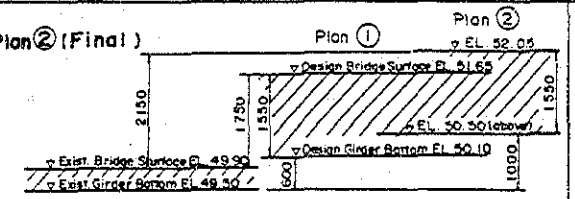
Plan ② : (H.F.L + 0.60 m) Non-submersible plan.

Plan ③ : Alternative submersible plan (Box Curvert).

— Alternative Plans for Bridge Design (2/2) —

Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 9	32.0	Composite Girder	5.0 m (1 lane)	Second Class

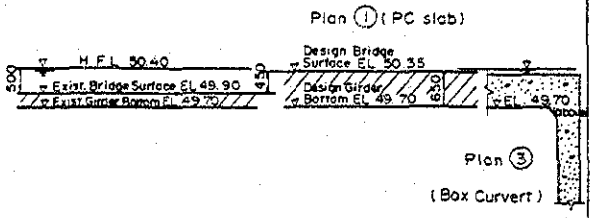
Plan ② (Final)



H.F.L : Not avairable

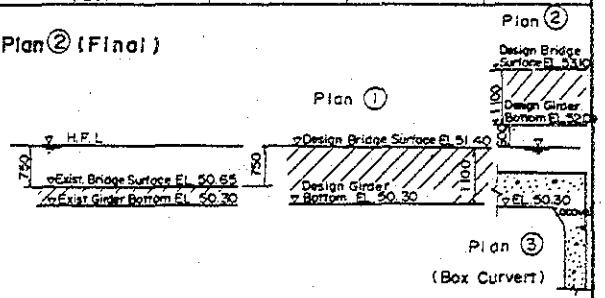
Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 13	PC slab : 12 m Box :	PC slab or Box Curvert	5.0 m (1 lane)	Second Class

Plan ③ (Final)



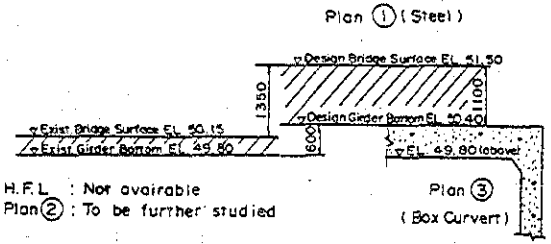
Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 16	Composite Girder : 17 m Box :	Composite Girder or Box	5.0 m (1 lane)	Second Class

Plan ② (Final)



Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 10	Composite Girder : 17.0 m Box :	Composite Girder or Box Curvert	5.0 m (1 lane)	Second Class

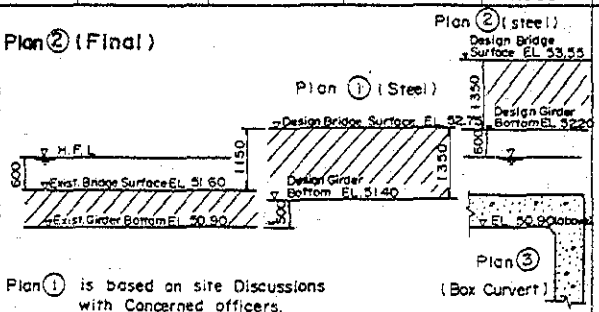
Plan ③ (Final)



H.F.L : Not avairable
Plan ② : To be further studied

Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 14	22.0 m	Composite Girder	6.5 m (2 lanes)	First Class Road

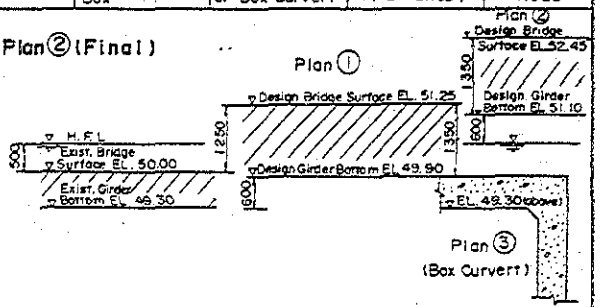
Plan ② (Final)



Plan ① is based on site Discussions with Concerned officers.

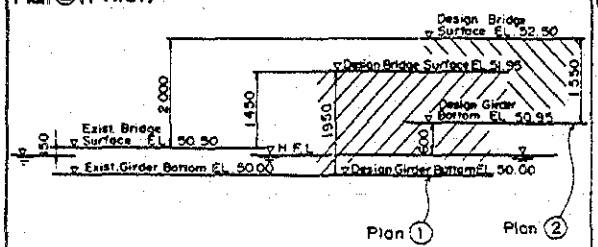
Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 17	Composite Girder : 23 m Box :	Composite Girder or Box Curvert	6.5 m (2 lanes)	First Class Road

Plan ② (Final)



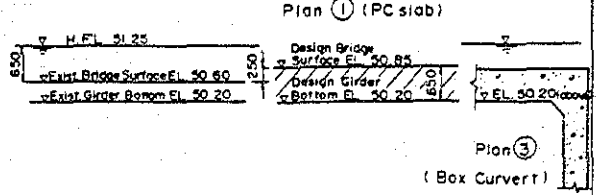
Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 11	32.0 m	Composite Girder	Plan ① : 2 lanes (6.5 m) Plan ② : 1 lane (5.0 m)	Plan ① First Class Road Plan ② Second Class

Plan ② (Final)



Bridge NO.	Span (m)	Type of Superstructure	Effective (m)	Grade
NO. 15	PC slab : 10 m Box :	PC slab or Box Curvert	6.5 m (2 lanes)	First Class Road

Plan ③ (Final)



Note

Plan ① : Submersible plan.

Plan ② : (H.F.L + 0.60m) Non-submersible plan.

Plan ③ : Alternative submersible plan (Box Curvert).

4-1-4 *Geological Condition Affecting the Bridge Design*

Gampaha district is covered throughout with lateritic sands and clays and, in general, granite stratum exists as a bed rock approximately 15 m below the ground level, with adequate bearing capacity as foundation. Boring was carried out at 23 points, totaling 389 m in depth, with standard penetration test performed and core samples recovered. The depth of prospective bearable stratum was confirmed in the process (see table below).

Upon the careful study of the test result, it was judged that direct foundations are not suitable and pile foundations have accordingly been adopted for all abutments. The same consideration should thus be taken in determining the foundation depth and cross section for temporary piers, bank protection and cofferdam in order to ensure the safety of work during the construction period.

Brdg. No.	Depth excavated	Type of bed rock	Remarks
1	21.75 (21.75)	Biotite (felspathic) gneiss	Executed on both banks (2 sites)
2	21.60	Ferrous biotite gneiss	
3	14.50 (17.5)	Granitic gneiss	Executed on both banks (2 sites)
4	14.50 (16.75)	Biotite (felspathic) gneiss	Executed on both banks (2 sites)
5	14.70	Granitic gneiss	
6	23.40	Biotite (felspathic) gneiss	
7	18.50	Biotite (felspathic) gneiss	
8	12.50	Biotite (felspathic) gneiss	
9	11.50	Granitic gneiss	
10	19.30	Biotite (felspathic) gneiss	
11	10.50 (14.5)	Biotite (felspathic) gneiss	Executed on both banks (2 sites)
12	14.25 (9.6)		Executed on both banks (2 sites)
13	20.75	Biotite (felspathic) gneiss	
14	18.50 (10.5)	Granitic gneiss	Executed on both banks (2 sites)
15	27.40	Biotite (felspathic) gneiss	
16	23.50	Biotite (felspathic) gneiss	
17	9.80	Granitic gneiss	

4-1-5 General Information and Strategy for Bridge Design

(1) Status of Construction Work

As Sri Lanka is a socialist republic, so far the Government has been the major participant in project planning, design control, procurement and deployment of machinery and equipment, and construction management for big scale public projects under the National Technology Corporation and the Architectural Department. This situation, therefore, did not encourage private construction firms to develop their capability, and most firms were relegated to simply supplying labourers. Though the Team observed several buildings of 50 m's height now under construction and that an emphasis has been placed on the improvement of construction technology as observed in the use of more construction machinery and batcher plants, the typical method is still adopting bamboo for scaffolding and timbering, and the use of small concrete buckets.

The steel truss bridges, which were built about 100 years ago during British colonial days across main rivers, are still being used, though all of them are extremely deteriorated. The shortage of funds and skilled workers, a number of who are working abroad, prevents the replacement with new bridges.

(2) Local Construction Firms

The following are top ranked contractors in terms of construction capacity on the basis of interview survey conducted locally.

(a) Maga Engineering Limited

Address :	200 Nawala Road Narahenpita Colombo 5 Sri Lanka Tel. :566306
Activity:	Civil engineering, buildings, roads, electrical & mechanical, transportation
Record :	Colombo Airport New Runway & Airport Civil Work Lot II Project
	Samanalawewa Hydropower Project Lot II
	5 star hotel for Eden Lanka, Ltd. at Beruwala
Engineers:	10
Owned machinery:	Bulldozer 1 unit, pull shovel 2 units, crane 4 units, Dump truck 11 units

(b) State Development & Construction Corporation

Address :	No.7 Borupana Road Ratmalana Tel. :632146
Activity:	Bridges, roads & highways, irrigation systems, dams
Record:	120 bridges
	Water Treatment Plant Ambatale.
	Canyon Power Project penstock

(c) Samuel & Sons Co. Ltd.

Address :	164 Messenger Street P.O. Box 46 Colombo 12 Tel. :432341
Activity:	Civil Engineering, Electrical Engineering, Accounts & General Administration Department
Number of worker:	Staff 200 Others 250
Record:	240 ft, high prilling tower for fertilizer factory, Water tower at Lady Ridgemay Childrens' Hospital
Owned machinery:	Pull shovel 8 units, crane 2 units

(d) Tudawe Brothers Limited

Address :	505/2 Elvitigara Mawatha Colombo 5 Tel. :583876
Activity:	Civil engineering, buildings
Record:	Duzury Apartment Complex Development of Sapugaskanda Industrial Estate
Owned machinery:	Pull shovel 1 unit, crane 1 units, truck 4 units

(e) Nawaloka Group

Address :	No.42 Negombo Road Peliyagoda Tel. :530752
Activity:	Civil engineering, buildings
Record:	1,100 nos. individual housing units Bambalapitiya Tower
Owned machinery:	Back hoe 9 units, pull shovel 7 unit, truck 9 units bulldozer 8 units

(3) Machinery, Materials and Labourers for Construction Work

No exclusive rental company for construction machinery exists. If needed, a request is sent to a local contractor which holds the machinery. Long term rental is, therefore, seemingly impossible. Visible is the small number of machines held by contractors with a low rate of operation due to the age, and the shortage of spare parts causing a long term for repairing work.

Among construction materials except cement, sand, gravel and timber, steel products, such as shaped steel and reinforcing bar, etc. are all imported. Since no firm dealing with general construction materials on a broad scale exists, investigation of delivery schedules and material quality will be necessary when purchasing such materials locally.

As for batcher plant, there are several in Colombo city. Quality control efforts are properly placed, but due to the rough gradation of river gravel, the workability of concrete is low. In comparison with Japan made cement, the local cement requires more volume for maintaining the same strength of concrete. In addition to the surplus cement, the high temperature of gravel raises that of the mixed concrete, requiring careful attention to

transportation and curing.

There are many workers but few skilled workers. Workers with the necessary tools and equipment for their work are extremely few.

Use of Construction Machinery by Local Contractors

Machine	A-company	B-company	C-company	D-company
Bulldozer	6 years × 1 unit	—	—	24 years × 1 unit
				12 years × 1 unit
Pull shovel	7 years × 1 unit	2 years × 5 unit	7 years × 1 unit	15 years × 1 units
	1 year × 1 unit	1 year × 1 unit		14 years × 1 units
				7 years × 4 units
				6 years × 1 unit
Wheel loader	7 years × 2 units	—	—	20 years × 1 unit
	5 years × 1 unit			13 years × 1 unit
	1 years × 2 units			12 years × 2 units
				10 years × 2 units
Crane	7 years × 1 unit	2 years × 1 unit	13years × 1 unit	12 years × 1 units
	4 years × 1 unit			? years × 6 units
	3 years × 1 unit			
	1 years × 1 unit			
Truck	6 years × 2 units	—	—	? years × 4 units
(over 8 tons capacity)	5 years ×10 unit			
Road roller	8 years × 1 unit	1 year × 1 unit	—	—
(over 10 tons capacity)	6 years × 1 unit			
	4 years × 1 unit			

A-company : Maga Engineering

B-company : Samuel Sons & Company Limited

C-company : Tudawe Brothers Ltd.

D-company : Nawaloka Group Of Companies

(4) Status of Batcher Plant

There are three large scale batcher plants in Colombo, and of these, the largest has a capacity of 45 to 50 m^3/hour and quality up to σ_{28} = 300 kgf/cm^2. However, transportation time should be limited within one hour, due to the fact that more cement per a unit volume of concrete is used, rough gradation causes lowering workability, the temperature of ready mixed concrete is high at 32 °C, and local meteorological conditions cause disadvantages.

(a) Main Record

1) Capacity of 45 to 50 tons/hour and having experienced 900m^3 of continuous operation proves the capability for the present project.

2) Compressive Strength:
The firm's records show a maximum compressive strength of 300 kgf/cm^2 is available. However, careful attention should be taken for placing the concrete, allowing for slump loss, lowered strength and workability that might arise from the temperature, 32°C at the beginning, and 34°C at the time of concrete placing (transport time: 20 min.). (refer to "Limit Temperature for Placing Concrete, T<35°C", RC criteria, Japan Society of Civil Engineering)

(b) Quality

1) Cement volume per unit volume of concrete:
18% ~ 27% more cement is used to make concrete with strength and slump equivalent to Japanese Industrial Standard.

2) Cement used:
Imported cement, which is seasonal in available brand, is used. At the time of local survey, the cement observed was not good in quality.

3) Aggregate
Fine aggregate is low quality with less content of finer gradation, thus the fresh concrete has low consistency and workability, which easily causes the segregation of concrete components.

The above mentioned implies that careful attention should be given to the transportation time and compressive design strength.

(Transportation Time Limit)

Unreasonably long transportation time will deteriorate the quality of ready mixed concrete in strength as a result of slump loss, segregation and temperature rise at placing. The transportation time of fresh concrete should be less than one hour, allowing for the effects of quality of cement and fine aggregate on fresh concrete, and local meteorological conditions (temperature, moisture). The following shows anticipated transportation time to each site from the prospective batcher plant, with the consideration of each access road condition. Accordingly, concrete mixed insitu will be used for bridges no. 10 and 17 as transportation time for the batcher plant exceeds one hour.

Anticipated Transportation Time of Ready Mixed Concrete
(Colombo ~ Each Site)

Driving Speed : Class A road = 40 km/h
: Class B, C, D road: 25 km/h

Bridge No.	Total Distance in Same Road Classifications. (km)					Required Time (min)
	A	B	C, D, E	B + C, D, E	Total Distance	
1	3.2	–	8.3	8.3	11.5	25
2	3.2	–	1.9	1.9	5.0	10
3	21.2	5.1	1.9	7.0	28.5	50
4	21.2	5.1	2.6	7.7	29.0	50
5	7.7	–	1.9	1.9	10.0	20
6	7.7	–	1.3	1.3	9.0	15
7	10.3	–	9.6	9.6	20.0	40
8	20.5	5.8	2.8	8.6	29.0	55
9	15.4	12.8	1.9	14.7	30.0	60
10	15.4	25.0	1.0	26.0	41.5	85
11	29.5	3.6	3.2	7.0	36.5	60
13	12.2	1.6	0.6	2.2	14.5	25
14	0.6	15.4	0.3	15.7	16.5	40
15	0.6	15.4	1.0	16.4	17.0	40
16	0.6	21.8	2.6	24.4	25.0	60
17	0.6	34.3	0.3	34.6	35.5	85

(Compressive Design Strength)

As aforementioned, it is difficult to maintain the concrete strength more than 300 kgf/cm^2. The bridges therefore have to be designed taking into careful consideration safety, durability, and cost effectiveness.

(5) Status of PC Concrete Plant

The only factory in Sri Lanka which produces pre-stressed PC concrete products as well is SD & CC Company, and it has the following record:

(a) Record for PS Concrete Bridge

The plant has so far produced PS concrete Beam with length ranging from 17' (5.18 m) to 53' (16.15 m). PC steel wire ϕ 6 mm is being used with wedge the method for the embodiment of the wire.

(b) Present Status of Pre-tension PC Beam

At the time of the survey, beams 52' (15.8m) long were being produced: compressive design strength was 6,000 psi (approx. 420 kgf/cm^2). 36 PC steel wires, size being ϕ 6 mm, were used.

(6) Road Condition

16 bridges of medium and small sizes will be constructed under the present Project, located on the C and E class roads and within 30 km from Colombo city. The road condition will consequently affect the construction work inevitably and seriously. The construction materials will be transported starting north from Colombo city, through the two Kandy roads, classified as A-class road, and to B-class road, and then to the bridge sites on the C, D, and E class roads.

Since A-class roads are well designed in terms of alignment (gradient, intersections, curve radius) and width, and are well maintained, there is no worry in transporting materials and machinery.

On B-class road, there are some places envisaged where the road alignment (curves) might pose a problem in carrying long material.

On C-class road, there are many places observed where road conditions such as road alignment, width and road surface are far from acceptable conditions and consequently would obstruct the transportation of long material. For instance, no.9 bridge has an E-class access road with 10% gradient, immoderate curve radius, road width of only 2~3 m, and rough surface.

Such conditions are visible more or less on all the access roads.

Though transportation constraints on the access roads are variable and thus depend upon the bridge, it is assumed that for designing and implementation planning that 10 m length, 3 m width, and 40 ton weight are the maximum limit for loads to be transported.

4-1-6 Construction Materials and Equipment

The following are required for Project implementation:

(1) Construction Materials

Materials	From Sri-Lanka	From Japan	Reason
1. Sheet pile		○	-
2. Rebar big size small size		 ○ ○	Not fully available in Colombo
3. Cement	○		Local procurement of imported product
4. Sand	○		River sand available
5. Gravel	○		Crushed stone available
6. Form Timber form Metal form		 ○ ○	As plywood are all imported, and not enough supply of timber locally; also controlled size is needed
7. Timbering Material		○	
8. Scaffolding Material		○	
9. Temporary Steel bridge		○	
10. Steel plate & shaped steel		○	
11. Concrete block	○		No serious problem, although no light block available
12. Vinyl tube		○	No suitably thick tube available.
13. Shuttering material		○	Not locally available
14. Girder material		○	do.
15. Bridge material		○	do.
16. Fuel	○		

(2) Main Construction Equipment

Machine	From Sri-Lanka	From Japan	Reason
1. Crawler crane		O	Difficulty in renting
2. Pile driver		O	do.
3. Vibro-hammer		O	do.
4. Truck crane		O	Major equipment governing overall construction schedule
5. Dump truck		O	Difficult to rent.
6. Truck	O		
7. Motor grader		O	Extremely difficult to rent
8. Asphalt distributor		O	do.
9. Road roller		O	Locally available ones are extremely deteriorated
10. Tire roller		O	do.
11. Vibrator roller		O	do.
12. Back-hoe	O	O	Partially local rental
13. Bulldozer	O	O	do.
14. Generator		O	Local product of low reliability with low rate of operation; needed for the support of major machinery

4-2 Study and Examination on Design Criteria

4-2-1 Design Bridge Span Length

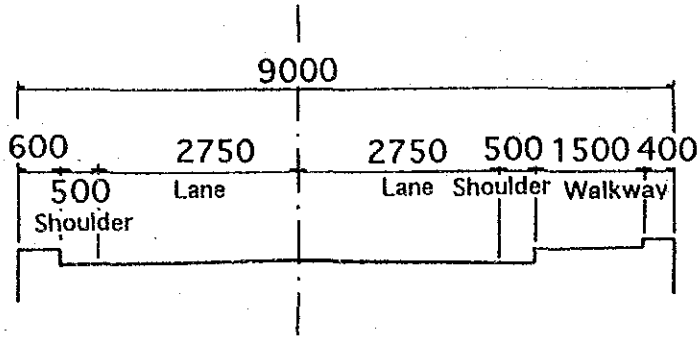
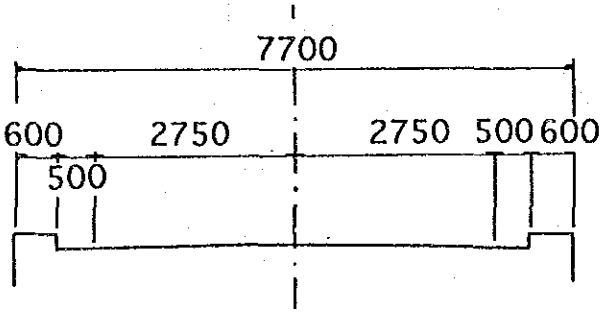
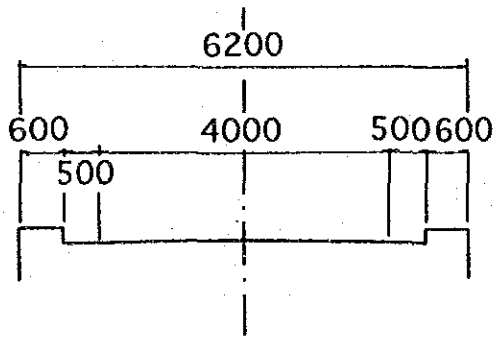
All the bridges are one span bridges.

The following are the basic design elements for each bridge:

Bridge No.	Effective Width (m)	Design span length (m)	Type of super-structure	Girder depth (mm)
1	6.5	20.0	Plate girder	900
2	6.5 (1.5 m of walkway)	23.0	Plate girder	912
3	6.5	32.0	Plate girder	1,400
4	6.5	23.0	Plate girder	912
5	6.5	8.0	Box culvert	300
6	6.5	4.6	Box culvert	300
7	6.5	14.5	Box culvert	350
8	5.0	30.0	Plate girder	1,100
9	5.0	32.0	Plate girder	1,100
10	5.0	10.0	Box culvert	350
11	5.0	32.0	Plate girder	1,100
13	5.0	8.0	Box culvert	300
14	6.5	22.0	Plate girder	912
15	6.5	5.7	Box culvert	350
16	5.0	17.0	Plate girder	700
17	6.5	23.0	Plate girder	912

4-2-2 Design Width and Road Load

The following have been agreed to in consultation with RDA (Road Development Authority)

Component of Road Width	Grade	Bridge No.
	1st class bridge	2
	1st class bridge	1, 3, 4, 5, 6, 7, 14, 15, 17
	2nd class bridge	8, 9, 10, 11, 13, 16

4-2-3 Free Allowance Under Girder

The following are adopted, being higher than the existing level.

Bridge No.	Level of Girder Bottom (m)		(B) - (A) (m)	Design level	
	(A) Remark	(B) Present level		Abailability of H.F.L. data	Type of superstructure
1	49.6	49.6	0	○	plate girder
2	50.9	50.9	0	○	plate girder
3	49.8	51.9	2.10	○	plate girder
4	50.1	52.1	2.00	○	plate girder
5	49.5	50.2	0.70	○	box culvert
6	49.6	49.7	0.10	○	box culvert
7	49.5	50.35	0.85	-	box culvert
8	(50.3)	Note 1) 51.3	1.00	-	plate girder
9	49.5	50.5	1.00	-	plate girder
10	49.8	49.95	0.15	-	box culvert
11	50.0	50.95	0.95	○	plate girder
13	49.7	50.25	0.55	○	box culvert
14	50.9	Note 2) 52.2	1.30	○	plate girder
15	50.2	50.75	0.55	○	box culvert
16	50.3	52.0	1.70	○	plate girder
17	49.3	51.10	1.80	○	plate girder

(A) Surveyed with reference to temporary bench mark, provided near each bridge.

Note 1) : No bridge exists, so the design height (51.3 m) is decided at higher than the present bank top level (50.3 m) by 1.0 m.

Note 2) : Upon local agreement with counterparts, the design height was put at 51.40 m; however, on the basis of home office analyses, this has been revised to HFL + 0.60 m = 52.20 m.

4-2-4 Substructure

(1) Foundation Type

As a result of test drilling survey, pile foundation is adopted for all the bridge foundations.

Pile Type	RC square pile
Length	L_{max} = 10.0 m (Jointed piles, if longer pile needed)

(2) Abutment Type

H≦5.0m	Gravity-type abutment
H> 5.0m	Reversed T-type abutment

4-2-5 Superstructure

The following shows the type of superstructure for each bridge.

Span range (m)	Type of superstructure	Bridge no.	Total no.
$4.7 < \ell < 15.0$	Box culvert bridge	5,6,7,10,13,15	6
$17 < \ell < 32$	Composite plate girder bridge	1~4,8,9,11,14,16,17	10

(1) Box Culvert

This is to be a submerged bridge type at H.F.L.

(2) Plate girder

Japan-made local assembling type by bolt is adopted for plate girder. Steel is to be finished with paint.

(3) Post-Tension Girder

Upon comparing the workability and cost effectiveness between this type and pre-tension concrete type, it was decided not to adopt the post-tension concrete type.

4-2-6 Comparison of Plate girder and Post-Tension Girder Type Bridges

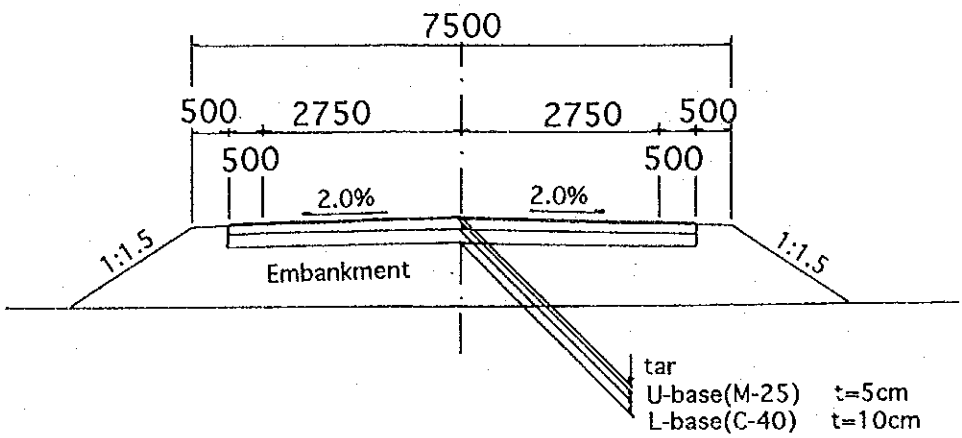
Overall comparison of plate girder and PC girder (post-tension) is given below.

Item	Steel girder	PC girder (post tension)
a. Girder manufacture	- As girder is made in Japan, manufacturing yard in field is not necessary	- 1.0 ha area is required for girder manufacturing yard - As girder is of local make, quality control is a concern
b. Erection facilities	- Overall load ratio for steel girder to PC girder is 1:7 - Accordingly, erection facilities for steel girder are cheaper - Erection crane requirement is less capacity than in the case of PC girder	-Weight of one girder is more than for steel girder, thereby raising the cost for erection facilities - Crane access to sites is difficult.
c. Marine transport	- As steel girder is to be manufactured in Japan, marine transport cost is higher	- Although girder itself is manufactured in the field, PC cable, sheathing, anchoring equipment, etc. would be shipped from Japan. Nevertheless, shipping costs are cheaper.
d. Quality control	- Girders are high quality, factory-made in Japan	- As girder is of local make, quality control is a concern
e. Construction period	- As transport is completely by ship, care is necessary to ensure timely shipment -Tightly scheduled construction period after arrival of equipment and materials in Colombo can be kept to	- Conditions are the same as for steel girder with regards to shipment of PC cable, sheathing, anchor equipment, erection equipment, etc. - As girder manufacture is done locally, precise production capacity is uncertain making it difficult to formulate exact production schedule
f. Total cost	- Cheaper than PC girder	- More expensive than steel girder

4-2-7 Access Road

(1) Composition of Cross Section

Simple pavement structure is adopted with asphalt penetrating macadam pavement for the access road and the dimensions of subbase and road bed are mentioned below. Grass should be planted on the backfilled slope.



(2) Road Alignment

Road gradient should be less than 6% on run-off distance to existing road. Access road segment connecting to bridge is to be straight, with 20 m minimum length.

4-3 Basic Plan

4-3-1 Site and Layout Plan

(1) Bridge Design Information

Superstructure, substructure, temporary facilities, bank protection works, geological conditions, public facilities present at site, etc. for each bridge under the Project are indicated in Tables 4-3-1~16.

(2) Project Office Plan

① Consultant office
To be established at the contractor's office.

② Head office of contractor
The Government of Sri Lanka shall provide land for the office. Temporary office will be prepared during the office construction.

③ Individual site office
All sites will have simple prefabricable site offices.

(3) Stock Yard Plan

① Center yard
The Government of Sri Lanka will provide and prepare the land for a center yard at which main equipment and materials will be kept and maintained, and abutment foundation piles will also be produced.

② Site yard
The Government of Sri Lanka will provide the land, approximately 200 m^2, for each site for temporary storage of rebars, forms and girders, etc.

Table 4-3-1 Plan for Bridge Design and Implementation

Bridge Name	No. 1 (Uswetakeiyawa ~ Bopitiya)				Distance from Batcher Plant		L=11.5km
Super-Structure	Type	Composite Girder bridge Number of Girders : 4		Span Length	L= 20.0 m	Width	B=7.7 m
	Manner of laying girder	By crane (assembled girder at one time) Crane capacity : 45 tons, (W=6.2t/ girder)					
	Remark	Design	Affixing of city water pipe to bridge Sri Lanka side is to remove the pipe.				
		Work execution	Left side road is used for ground assembly and hoisting girders. Boat traffic is closed while laying girders. Boat pass made under the bridge while placing concrete for deck slab.				
Sub-structure	Abutment type	Gravity type	Foundation type	R.C square pile	L=10.0m (right bank, follower length 4.0m) L=15.5m (left bank, follower length 4.0m)		
	Execution	Open cut on the right bank (H=4.0m). Steel sheet piles on the left bank for retaining wall. (L=5.0m)					
	Remark	Design	Steel sheet piles are to be used on the left bank for maintaining the present traffic volume.				
		Work execution	Road on the left side is to be widened for the pass of vehicles prior to the pile driving.				
Temporary work	Earth retaining	Steel Sheet Pile Type III (Total length=20.0 m)		Temporary Cofferdam	No		
	River crossing	For passage	Structure	H-beam temporary bridge	Location	Down-stream	Length L= 19 m
	Remark	Careful study should be made for path location and execution procedure.					
Retaining wall	Structure	Wet stone masonry as it is.		Total length	L=40m	Height	H=3.5 m
	Execution	Coursed masonry					
	Remark	Up to High Flood Water Level					
Geological condition	Depth to bearing stratum	GL 12.45 (Left) ····· 12.00 (Right) m	Ground water level	GL 2.45 (Left) ····· 1.25(Right) m	Soil to be excavated	Medium sand (N≒10) Loose and Medium sand (N =4~14)	
Public service facilities	Electric	240V	Yes (upstream)		33000V	Yes	
	W.Pipe	Yes (φ250) downstream			Telcom	Yes (crossing)	
Others	For Design	The free allowance under girder should be compared with No.2 Bridge.					
	For execution	Minimize the demolition of the existing retaining wall.					

Table 4-3-2 Plan for Bridge Design and Implementation

Bridge Name	No. 2 (Paliyawatte ~Lansiyawatte)					Distance from Batcher Plant		L=5.0km
Super-Structure	Type	Composite Girder bridge Number of Girders : 5			Span Length	L= 23.0 m	Width	B=9.0 m
	Manner of laying girder	By crane (assembled girder at one time). Crane capacity : 45 tons (W = 7.6t/girder)						
	Remark	Design	Setting of walkway was made based upon discussion with conserned local agency. (B=1.5m)					
		Work execution	Left bank road is used for ground assembly and hoisting girders. Boat traffic is closed while laying girders. Boat pass made under the bridge while placing concrete for deck slab.					
Sub-structure	Abutment type	Gravity type	Foundation type	R.C square pile	L=12.5m (both bank, follower length 4.0m)			
	Execution	Open cut on the right bank (H=4.0m). Steel sheet piles on the left bank for retaining wall. (L=6.5m)						
	Remark	Design	Steel sheet piles are to be used on the left bank for maintaining the present traffic volume. Location of the sheet piles and the distance from existing city water line should be taken into account.					
		Work execution	Road on the left side is to be widened for the pass of vehicles prior to pile driving.					
Temporary work	Earth retaining	Steel Sheet Pile Type III (Total length = 22.0m)		Temporary Cofferdam	Steel Sheet Pile Type III (Total length= 7.5m)			
	River crossing	For passage	Struc-ture	H-beam temporary bridge	Location	Upstream	Length	L= 16 m
	Remark	Careful study should be made for path location and execution procedure.						
Retaining wall	Structure	Left bank : Wet stone masonry Right bank : Wet stone masonry		Total length	Left bank :L=22m Right bank:L=28m		Height	H=4.0 m
	Execution	Left bank : Coffering by Steel Sheet Pile Right bank : Slope to be gabion with 1:0.3						
	Remark	Careful study is needed for the joint portion between the existing and the newly built banks.						
Geological condition	Depth to bearing stratum	GL -12.45 m (Right)	Ground water level	GL -1.25 m (Right)	Soil to be excavated	N = 5 (loose sand and cray)		
Public service facilities	Electric	240V	Yes (upstream and crossing)		33000V	Yes (up and downstream)		
	W. Pipe	Yes (ϕ 250) downstream			Telcom	Yes (downstream)		
Others	For Design	Shift of bridge center line should be considered at D/D stage.						
	For execution	Minimize the demolition of the existing retaining wall.						

Table 4-3-3 Plan for Bridge Design and Implementation

Bridge Name	No. 3 (Averiwatte ～ Yagodamulla)				Distance from Batcher Plant			L=28.5km
Super-Structure	Type	Composite Girder bridge Number of girders : 4		Span Length	L= 32.0 m		Width	B= 7.7m
	Manner of laying girder	By two cranes (assembled girder at one time). Crane capacity : 45 tons×2 units (W = 9.2 t/girder)						
	Remark	Design	Shift bridge center line to the down stream by 10m for adequate holizontal allingment.					
		Work execution	Assemble main girder on the temporary bridge and hoist into the place one girder by one girder.					
Sub-structure	Abutment type	Reversed T-type	Foundation type	R.C square pile	L=7.0 m (right bank, follower length 3.5 m) L=8.0 m (left bank, follower length 3.5 m)			
	Execution	Open cut (H=3.5m).						
	Remark	Design	Foundation of access road due to shifting of bridge center line should be considered at D/D stage.					
		Work execution	Backfilling to proceed parallel with banking work.					
Temporary work	Earth retaining	No		Temporary Cofferdam	Steel Sheet Pile Type III (Total length= 7.5 m for left side)			
	River crossing	For passage and construction work	Structure	H-beam temporary bridge	Location	Downstream	Length	L= 30 m
	Remark	Launching erection is adopted, with the provision of a 6m width of temporary bridge.						
Retaining wall	Structure	Wet stone masonry & steel sheet piles to be remained.			Total length	L=113m	Height	H=4.0 m
	Execution	Coffering with steel sheet piles.						
	Remark							
Geological condition	Depth to bearing stratum	GL 8.45 (Left) / 8.00 (Right) m	Ground water level		GL 1.60 (Left) / 0.70 (Right) m	Soil to be excavated	N = 3 (loose sand) / N = 1 (loose clay)	
Public service facilities	Electric	240V	Yes (upstream)		33000V	Yes (upstream)		
	W. Pipe	No			Telcom	Yes (downstream)		
Others	For Design	To include gabion and sheet pile works for bank protection. Standing length of sheet pile is high, requiring study at detailed design stage.						
	For execution	Access road is needed due to simultaneous execution of No. 3 and 4.						

Table 4-3-4 Plan for Bridge Design and Implementation

Bridge Name	No. 4 (Averiwatte ～ Yagodamulla)					Distance from Batcher Plant		L=29.0km
Super-Structure	Type	Composite Girder bridge Number of Girders : 4		Span Length		L=23.0 m	Width	B=7.7 m
	Manner of laying girder	By crane (assembled girder at one time). A crane capacity : 45 tons (W = 7.9 t/girder)						
	Remark	Design						
		Work execution	Ground assembly and laying of girder will be done on the left side bank.					
Sub-structure	Abutment type	Reversed T-type	Foundation type	R.C square pile	L= 6.0 m (right bank, follower length 3.0 m) L= 6.5 m (left bank, follower length 3.0 m)			
	Execution	Open cut (H = 3.0m)						
	Remark	Design	--					
		Work execution	Demolition of the existing bridge should be made after completion.					
Temporary work	Earth retaining	No		Temporary Cofferdam	Steel Sheet Pile Type III (Total length= 6.5m for both sides)			
	River crossing	For construction work and passage	Struc-ture	H-beam temporary bridge	Location	Upstream	Length	L= 30 m
	Remark	Launching erection is adopted, with the provision of temporary pier. (W=6 m)						
Retaining	Structure	Wet stone masonry		Total length	L = 44 m	Height	H = 3.0 m	
	Execution	Coffering with steel sheet piles.						
	Remark	---						
Geological condition	Depth to bearing stratum	9.00 (Left) GL------ m 9.00 (Right)	Ground Water Level	2.30 (Left) GL------ m No data (Right)	Soil to be excavated	N = 3 (hard cray) N =14(midium sand)		
Public service facilities	Electric	240V	Yes (upstream)		33000V	Yes (upstream)		
	W.Pipe	No			Telcom	Yes (downstream)		
Others	For Design	A laundary facility, on the right bank upstream, should be preserved as it is.						
	For execution	Accesss is needed due to simultaneous execution of No.3 and 4.						