(2) Description of the area of the proposed deviations

1) Physical Environment

i Existing Drainage Pattern Across the Proposed Deviation

The storm water in the deviated trace flows into Kelani river via "Maha Ela" (the one of main drainage stream), left bank tributary of Kelani river about 400 meters upstream of the Kaduwela bridge. About 73% of the deviated trace runs parallel to the Maha Ela. In the deviated trace Maha Ela has two major right bank tributaries meeting the Maha Ela at stations 19+800 and 20+600 and one left bank tributary meeting the Maha Ela at station 20+300. On its way to Kelani river the Maha Ela meets another major stream called "Hettige Ela" about 1 km upstream of the confluence point with the Kelani river.

The Fig.7.2.4 shows the existing drainage pattern across the proposed deviation. At present the section of the Maha Ela from station 21+800 up to 19+200 is in a marsh state due to poor drainage conditions in the deviated trace and the Maha Ela lower areas. In this stretch clear demarcation of the Maha Ela is not visible due to existing marsh conditions. The Maha Ela drains a catchment area of about 12.6km^2 at station 19+200 turns in a north easterly direction away from the proposed road trace.

7.2.3. Anticipated Environmental Impacts

(1) Hydrological Impacts

1) Erosion, Siltation and Sediment Runoff

Erosion, siltation and sediments runoff are considered the major impacts of the construction of the OCH in the deviated trace.

Due to low elevation of the ground levels in the deviated trace, the road goes on heavy filling except in the section 17+940 to 18+260, where Malambe – Kaduwela Road crossing the proposed OCH. The height of filling vary from 7.5m at 21+800 to about 8.7 meters at station 19+180. The average height of filling is about 7.5 meters. This shows that large quantity of earth is required for the formation of road embankment. In addition as the deviated trace goes through the paddy fields and marsh areas, removal of large quantity of unsuitable materials for road foundation will be required. Thus if the construction activities are not properly planned, it will lead to erosion of large quantity of material stock piled for road embankment construction or excavated material for foundation works leading to siltation of marsh area.

The siltation of the marsh area of Maha Ela will further aggravate the drainage problems in the area and rise of flood levels inconveniencing the people in the area. In addition, it is necessary to construct large number of culverts and bridges in the deviated trace to discharge flood waters safely into the marsh area. All these culverts, bridges need to be constructed in the main drainage stream of Maha Ela. The construction of such culverts and bridges will be required temporary diversion of storm water leading to erosion and siltation in the lower areas. As such, mitigatory measures are required to minimize the erosion, siltation and sediment run-off due to construction activities.

However during construction process, certain amounts of silt will be washed into the water ways and deposit in the marsh areas, even with strict mitigatory measures.

According to the Irrigation Officers the marsh area is already silted and people in the area are requesting dredging to improve the drainage for paddy cultivation. The construction activities will increase the sedimentation and blocking of existing drainage paths. It is therefore necessary to monitor the change in the bed levels of the Maha Ela to assess the extent of siltation due to construction activities.

The dredging of Maha Ela from station 19+200 up to confluence with Kelani river will greatly improve the drainage in the area and will encourage farmers to commence agricultural activities in the area.

2) Water Quality Impacts

The surface run off from cuts, fills and improper stock piling of construction materials in the low lying areas of the deviated trace could affect the water quality of the water bodies, mainly the marsh area of the Maha Ela, which in turn could affect the water quality of Kelani River. As the main water supply intake to Colombo City is located about 2 km down stream of Maha Ela confluence, mitigatory measures should be adopted to

minimize soil erosion during construction process. In addition, the unsuitable material excavated for road foundation need to be disposed properly without allowing to wash off loose materials to the waterways, which finally deposit in the marsh area changing the water quality and siltation.

As the deviated trace from 21+800 to 18+300 runs parallel to and close proximity to the Maha Ela, the construction of the OCH will change its flow pattern in the deviated trace area. However the impact on water quality due to the change in the flow pattern is minimal in view of the following:

- rise in the flood levels resulting from the construction of OCH embankment is small and around 0.2m
- areas on either side of OCH will be submerged under both pre-project and post project conditions and the flow velocities will be low (<1m/s).
- areas on either side of OCH are covered with paddy or grass.
- poor access and low ground elevations in the deviated trace area will not spur development close to the road embankment.

In order to monitor the impact of water quality during construction period continuous monitoring of water quality parameters are essential, especially the turbidity level and remedial measures need to be taken accordingly. In order to establish the benchmark conditions, the water quality testing (twice a year) should commence at least one year prior to commencement of the construction work. It is recommended to include water quality testing downstream of proposed bridge at station 19+200 to assess the impact of construction of OCH in the Maha Ela marsh area.

3) Surface Run off Pollution

On completion of the OCH, large number of vehicles will use this roadway. The surface run off from highways will contain petroleum drip page plus spilled materials which will flow directly into the waterways polluting the marsh and waterways. This aspect needs to be looked into at the design stage, and if necessary provide suitable arrangements to prevent such pollutions directly entering the waterways.

4) Impact on Irrigation and Flood Protection Works

There are no irrigation or flood protection structures within the ROW of the proposed deviation. The main flood control structure and bund are situated at the confluence of Maha Ela with Kelani River protecting the entire area with minor floods from Kelani river up to +5.64 m m.s.l.

The construction of the OCH in the deviated trace will have no impact on the present minor flood protection scheme. The present marsh area, (the area below +3m m.sl.) has not been cultivated with paddy for the last 15-20 years, due to drainage problems and flooding of Kelani River. However, the area above +3.00 m m.sl. is being cultivated intermittently at present and Maha Ela acts as the main drainage canal and man-made canals at the edge of the paddy area act as the canal diverting water to paddy fields. The paddy in the area is cultivated under the rain fed condition. According to the officers of the Department of Irrigation and Agrarian Services in the area, there are proposals to revive the agricultural activities in the area.

It is observed that the proposed OCH in the deviated trace with change in the direction of the main drainage stream from right side to left side via culverts provided across the road. In the areas where there is no road drainage, the farmers will not be able to drain excess water in their paddy fields and will create drainage problems and increase the marsh conditions in such areas. For eg. from station 21+600, the main drainage changes its direction from left side to right side and paddy fields in the left bank will have no drainage canal to drain their water from the paddy fields from station 21+600 up to 19+300. This aspect needs to be looked into and drainage provisions need to be provided on either side of the roadway.

In addition, some provisions also need to be made to provide opening in the main drainage canal along the toe of the road embankment to take cross drainage canals from the adjoining paddy areas.

5) Impacts on Flood Plains

Another major impact of the proposed deviation is the change in the flow regime of the main flood discharge channel (Maha Ela) along the deviated trace. Such changes and obstructions of flood ways due to proposed road embankment and reduction of flood detention capacity due to proposed OCH are the main causes for rise in flood levels. These aspects need to be studied carefully and mitigatory measures need to be incorporated into the drainage design to minimize the adverse impacts due to rise in flood levels.

6) Change in the Flow Regime

In case of absence of OCH in the deviated trace, the sheet flow conditions will exist in the main drainage stream with both sides getting inundated to cater for the flood discharge relevant to a particular rainfall event.

Due to proposed road alignment in the deviated trace, it will become necessary to change the flow direction of main drainage stream from one side of road embankment to other side with provision of cross drainage culverts of suitable sizes.

In the deviated trace, the main drainage stream on the right side of the road embankment cross the road embankment at 21+600 to change the direction to left side to fall in line with the existing drainage pattern and then cross again to flow in the north-easterly direction to Kelani river. If the required size culverts and drainage canals are provided based on accurate hydrological data along the deviated trace, then it will not cause significant rise in the flood levels.

In the OCH drainage design, the following design criteria has been adopted in sizing the culverts and drainage canal:

Drainage Culverts	50 year return period
Open Channels	10 year return period
Storm Event	both short deviation and long duration rainfall events taken into consideration.
Tail water level	Flood level due to Kelani river 50 year return

	period
The coefficient of run off (c)	Future development in the catchment is considered. The comments given by SLLRDC with regard to C values is taken into consideration in the design.
Obstructions along the road trace	Hydraulic Model (HEC-RAS)l has been used to assess the flood levels, due to obstructions such as roads and crossing, the deviated trace and obstruction due to road embankment at critical locations.

7) Reduction in Flood Detention Area

As the OCH in the proposed deviation stretch goes in the present flood detention area of the Maha Ela, rise in flood levels could be expected along the length of the deviated trace. The computation carried out using Hydraulic Model (HEC-RAS) to assess the rise in flood water levels for 50year return period flood event with and without road conditions are given in Table 7.2.24 below.

Table 7.2.24 Flood Level Rise in the Deviated Trace with and without Road for 50 year Return Period Flood 24 hr storm (without Kelani Floods)

Station	Flood Level (m m.s.l.)		Difference (m)
	With Road	Without Road	
19+500	3.46	3.26	0.20
19+800	3.87	3.64	0.23
20+100	4.44	4.41	0.03
20+500	4.51	4.45	0.06
21+000	4.61	4.50	0.11
21+400	4.76	4.59	0.17
21+900	5.45	5.30	0.15
22+150	5.59	5.47	0.12
22+600	6.10	6.08	0.02

Source: JICA Study Team for OCH

The above rise in flood level in the deviated trace is mainly due to loss of storage or detention volume due to construction of OCH. The above computation indicates that the maximum rise in flood level due to the construction of road embankment is 0.23 at station 19+800. This is acceptable and will not cause adverse impacts in the area as dominant flood level in the area is due to Kelani floods which are much higher than anticipated flood level rise due to road embankment.

The computation carried out from Kelani river (16+300) up to Malabe – Kaduwela Road (station 18) and up to station 21+500 are summarized and given in Table 7.2.25.

Table 7.2.25 Volume of Fill and Available Storage

Reach	High water Level (m m.s.l.)	Area of Fill (km^2)	Volume of Fill up to H.W.L. (million m^3)	Remarks
16+300 – 18.000	8.2	0.11124	0.347	Storage volume available below 8m m.s.l is 3.126 MCM
18+000 – 21+500	8.3	0.2095	1.065	Storage volume available below 8m.m.s.l is 19.806 MCM in "Maha Ela" catchment

Source: JICA Study Team for OCH

This shows that the total of 1.412 million m^3 is lost from the total available storage / detention volume of 22.932 million m^3 which is about 6% of the available detention area up to 8m m.s.l. available in the Maha Ela and Kelani catchment from Malambe-Kaduwela Road up to Kelani river. Fig. 7.2.6 shows the available detention areas for 5m m.s.l. and 10m.m.s.l.

However any further development in the low lying area will increase the flood levels further. It is therefore essential to declare the lowest area of Maha Ela below station +20.000 up to Kaduwela – Homagama Road Bridge across Maha Ela as strict flood detention basin so that no further development is possible except converting the area for paddy cultivation. The proposed retention area reserved for flood detention in the Maha Ela catchment is given in Fig. 7.2.7.

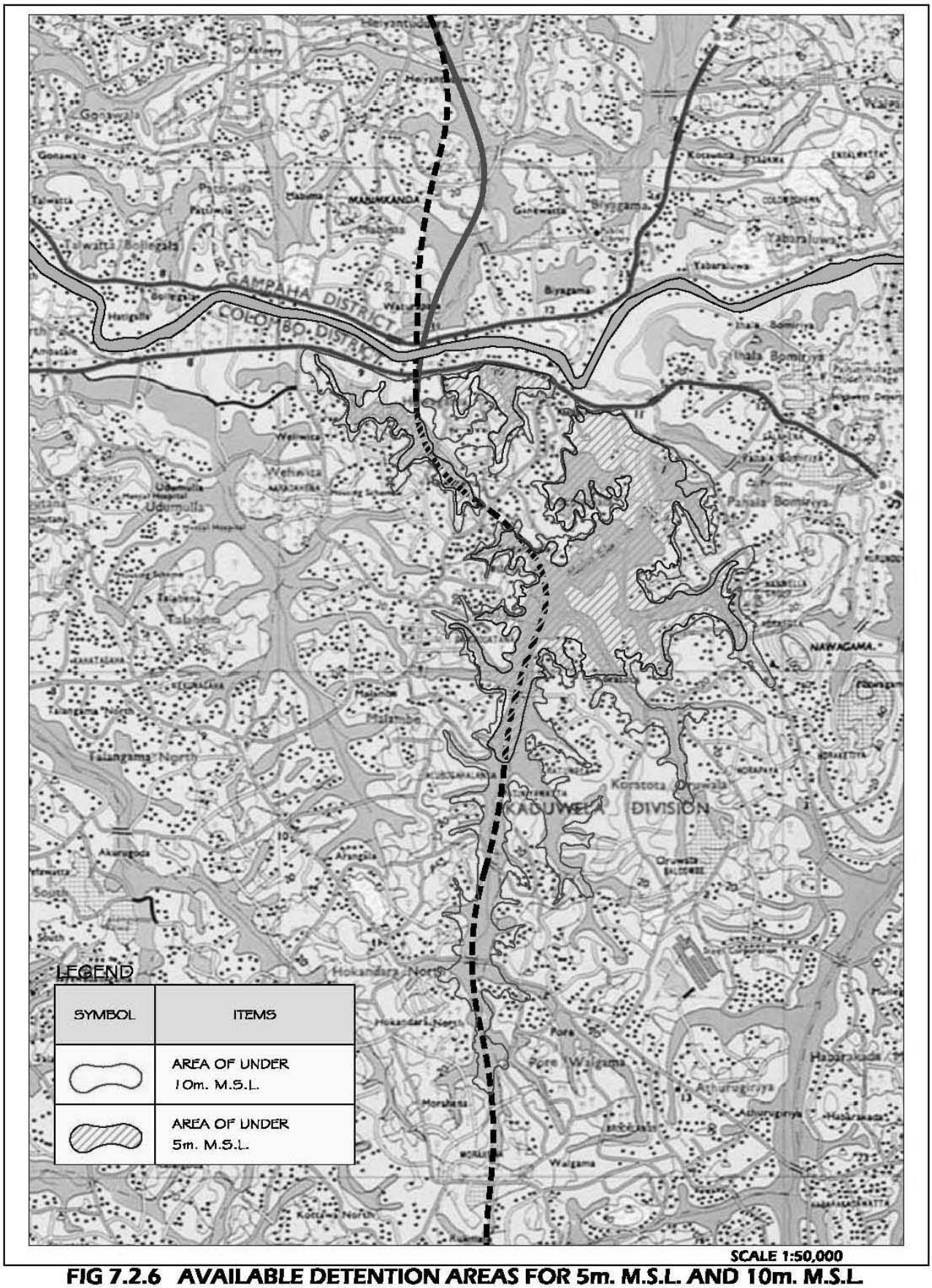

FIG 7.2.6 AVAILABLE DETENTION AREAS FOR 5m. M.S.L. AND 10m. M.S.L.

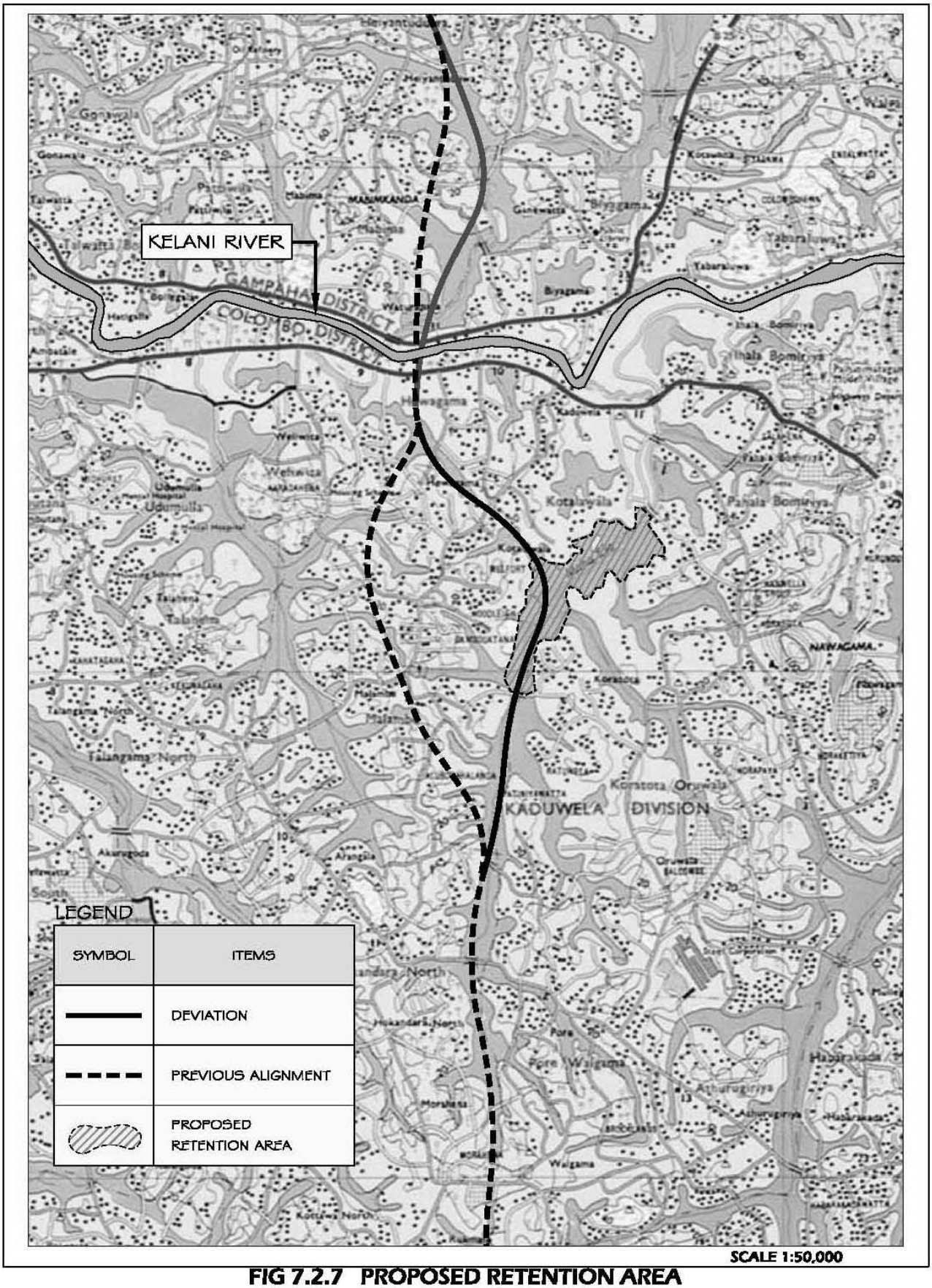

FIG 7.2.7 PROPOSED RETENTION AREA

8) Obstruction to Flood ways

The model studies have indicated, considerable rise in flood levels due to obstruction from the road embankment, especially in the section between station 20+000 and station 19+700; due to road alignment abutting the high grounds on either side in this stretch. Mitigatory measures such as provision of bridges instead of a cross drainage culvert could be considered in the design stage

(2) Ecological Impacts

1) Construction Phase

i Loss of Vegetation

Removal of vegetation due to clearing of ground cover, cutting embankments and filling low lying areas will remove aquatic and terrestrial vegetation from the project area.

The flora in a land area of approximately 24 ha in extent will be removed for the construction of the 4.8 km long ROW, at a width of about 50-80 m, in the proposed trace deviation. For about 10 % of the ROW, vegetation will be removed in home garden habitats, while for the rest of the ROW, vegetation will be cleared in wetland areas such as paddy lands and abandoned paddy lands. In these wetland areas, apart from paddy, the vegetation is mostly grasses, sedges and weeds. The terrestrial vegetation to be removed will be mostly trees and shrubs planted in the home gardens or grown at the edges of wetlands and in areas where the highway trace crosses the existing roads. Rubber, coconut and vegetable plantations and scrublands will not be disturbed at all by the deviated trace. Therefore, the volume of biomass to be removed for the highway is low.

Further none of the plant species recorded in the study area are to be threatened. The endemic plant species recorded in the present survey are also not confined to the study area and are widely distributed in other parts of the wet zone. Some species are found even in the dry zone. Therefore, the impacts due to loss of vegetation would not be significant when the biodiversity of flora is considered.

ii Habitats Destruction

Loss of vegetation reduces the terrestrial habitats available for fauna for their feeding, breeding, nesting and resting activities. In the study area, this will mainly affect terrestrial fauna including amphibian, reptile, mammal, insect and avian populations.

Reclamation of marshy lands will also result in loss of habitats for the animals such as amphibians, reptiles, birds, mammals and terrestrial and semi-aquatic invertebrates.

However, the area reclaimed or cleared is only approximately 24 ha and similar habitats are abundant in the area, there will be no significant impacts on fauna due to habitat destruction as a result of construction activities

iii Erosion

Due to removal of vegetation cover and other construction activities such as excavation, the potential for erosion of soil will be increased. This will be further enhanced by high intensity of rainfall in the area. This will cause siltation of water bodies and stagnation or pooling of water at some locations. Soil erosion and sedimentation can cause turbidity in the streams that are found along the trace. Fauna living in these streams will be adversely affected. Continuous built up of sediments, especially in the wetlands where there are no drainage outlets, will further degrade aquatic habitats. Water stagnation will provide breeding sites for vectors that transmit diseases such as filariasis, Japanese encephalitis and dengue haemorrhagic fever.

iv Noise Levels

Other construction activities such as excavation, cutting and filling, ditching, blasting, drilling and compaction require heavy machinery and vehicle operations which generate high noise levels and vibrations. It would force reptile, bird and mammal species living in areas closer to the construction sites to move away from their natural habitats. However this will only be temporarily as they gradually adapt to the high noise levels and vibrations.

v Quality of the Ecosystems

The proposed deviation of the OCH will be on elevated embankments in the low-lying areas, traversing along the edges of wetlands in some areas. Surface water flowing from adjoining highlands will only be discharged at selected locations where culverts and bridges are planned across the highway. Therefore, most of the wetland areas will not be able to maintain the present quality due to absence of regular inflow of water. This could assist the colonization by invasive plant species such as Annona glabra (Wel aaththa).

Open dumping of solid waste from construction camps will attract scavengers such as crows and stray dogs. If solid waste is not disposed properly this may cause a proliferation of crows, which may lead to decimation of other small mammals and birds, due to competition. Moreover, Solid waste and sewerage if not properly disposed could also contaminate the water bodies in the vicinity adversely affecting the aquatic fauna.

vi Fauna of the Area

Since there are no natural habitats along the ROW of the deviation route, construction activities and the presence of a large number of people and their movements during construction will not have a significant adverse impact on wild fauna. It should also be noted that the endemic and threatened animals recorded during the present survey are not confined to the study area and are found in other regions of the wet zone. Further, the natural terrestrial habitats in the study area are confined to about 1 ha. This will also be cleared in very near future for housing development. Therefore, loss of habitats due to the construction of the deviation route of the OCH will not have any significant adverse impact on the fauna in the area.

2) Post Construction Phase

i Impact on Fauna

During the operational phase, movement of vehicles at a high speed will disturb fauna with slow mobility. However, the impact on such fauna in the study area will be marginal when the quality and extent of the area of influence is taken into consideration. Although noise levels from the OCH during the operation period will rise significantly, most animals such as birds and mammals will move away from the source of noise or adapt to such situations. The impact of noise on amphibian and insects populations with short life spans will not be very significant.

ii Fragmentation of Habitats

The deviated trace that traverses through wetlands causes fragmentation of habitats of many ground-dwelling faunal species such as amphibians, reptiles and small mammals. However, this fragmentation of habitats is not expected to cause major impacts as these species have a wide distribution in the adjoining areas as well as in other wetlands found within the wet zone.

iii Vehicular Emissions

Operational phase pollutants generally associated with motor traffic, such as lead, cadmium, petroleum hydrocarbons, will pollute the nearby water bodies. This will be enhanced by oil and grease from runoff. Some of these substances, especially heavy metals, could accumulate along food chains and adversely affect fauna in the long term. This will make the top carnivorous fish such as *Channa* spp. (Snakeheads) unsuitable for human consumption.

iv Accidental Killing of Animals

Killing of animals often happens in highways where adequate underground crossings for small animals are not provided. Small mammals such as rats, amphibians, and reptiles are some of the animals that are often killed on roads. Bright headlights of the vehicles might disorient them while crossing.

v Encroachment by People

The trace itself has a scenic view as it mostly passes through wetlands. Construction of the highway and proposed service roads will encourage people to reclaim adjoining lands. Encroachers will also mushroom along the trace. This will disturb the view of road users. Uncontrolled ribbon development along the trace will also affect the aesthetic quality of the area.

vi Environmental Aesthetics

Impacts on environmental aesthetics that can be anticipated are obstruction and intrusion. Adverse visual impact due to obstruction is the blocking of the view by the road or any structure associated with it. Adverse impact of the road on the landscape of the area is intrusion. Visual obstruction and intrusion can be caused by the road itself and its

associated structures such as lampposts, signs and billboards. Many houses have been constructed recently facing the paddy fields. The houses close to the highway could be affected as the view from these houses could be completely obstructed by the trace. Other intrusive factors are glare from street lamps and headlights of the vehicles. The degree of visual intrusion is related to the length of the road. Neither obstruction nor intrusion is possible when the road and its traffic are not visible.

vii Impact on Fisheries and Other Beneficial Water Uses

There is no organized fishery in the study area. Fishing is carried out by about 25 people during the floods. The construction of the deviation route of the OCH in the study area will not adversely affect this activity. Therefore, there will not be any significant adverse impact on the fisheries.

Further, the people in the area do not use the Maha Ela and other water bodies along the ROW of the OCH for beneficial uses such as bathing, washing and drinking. Therefore, the construction of the deviation route of the OCH in this area will not have any significant impact also on other water uses.

If proper measures are not taken to mitigate the impact on drainage paths, the lowland areas will be inundated due to storm water. This will have some adverse impacts on the terrestrial fauna and flora of these areas. Their mortality will be increased due to inundations.

(3) Social Impact

1) Impacts on Land and Land Use:

- The most significant impact is expected on home gardens. 22 home gardens located inside the corridor. The size of these home gardens ranges from 15 to 120 perches each. The total land area that will have impact is 399 perches. The value per perch ranges from Rs. 40,000 to 90,000.
- Out of sample households studied 6 householders have highlands other than home gardens. The sizes of these land plots range from 10-80 perches. The values of a perch ranges from Rs 30,000 to 70,000.
- In every locations studied there are paddy lands. The size of each plot ranges from 40 to 200 perches. The total number of plots affected is 84. The total land area is about 35.5 acres. The value of land ranges from Rs. 1,500 to 3,500 per perch. Only about 30-35% of land is cultivated with paddy and the rest is abandoned.

2) Likelihood Impact on Crops:

- In home gardens banana, coconut and other fruit tress are found in all the locations except location 3. The area cultivated in each plot ranges from 4-10 perches. Only 13 home gardens out of 22 are cultivated with these crops. The annual income from one home garden ranges from Rs 600-1500.
- Only 2 households in locations 4 and 6 reported as households having other highlands with crops. Coconut is the main crop grown in these two highland plots. Plot size in location 4 is 180 perches and it is about 80 perches in location 6. The annual income from plot in location 4 is Rs.8,000 and other one in location 6 is about Rs. 3,500.

- Paddy cultivation is found in all the locations except location 3. About 29 plots are cultivated occasionally in the area around the entire road trace. The size of each cultivated plot ranges from 40-100perches. The annual gross income according cultivators is about Rs 3,000- 6,000 from a plot in extent of 40- 80 perches. But production cost is extremely high mainly due to high labor rate in the area.

3) Impacts on Social Relations:

Although there is significant number of migrants in the project area some householders have been in the area for long time and they have long standing relations (blood relationships and also relations developed through marriages and so on) and friends in the community (friends mean people with whom the affected families keep social contacts. They know each other and also help each other in distresses such as funerals and also get together in social functions such as weddings and so on).

These families have close ties and their social ties will get affected if the proposed road leads to separate the established community settlement. The information in Table 7.2.26 includes the number of relations and friends that each household keeps close social contacts.

Table 7.2.26 Number of Families of Relations and Friends That Sample Households Keep Contacts

Range (Number of families)	Relations		Friends	
	Number	%	Number	%
2-5	10	45	7	31
5-10	4	18	9	40
10-15	No	No	2	9
More than 15	1	4.5	2	9
Total	15	68	20	91

Source: HHS of SIA team

Note: the percentages are worked out on total householders surveyed in side the corridor (22 households)

The community members have established some community base organizations (CBOs) to carry out community-required activities. If the proposed road construction project separates community members of these organizations it will create negative impact on their social relations and also the benefits they derive from community organizations such as funeral association and so on. The types of CBOs established in each location and their functions are mentioned in Table 10 in Appendix 7.5.

4) Community Perceived Impact on Future Development:

The 65 householders interviewed perceived that the proposed road project might influence to create various industries and housing complexes in the area. Once the road construction is over investors and other developers may be interested to invest in the business activities in the area due to improved access facilities to other areas of the country. The nature of future developments perceived by communities is included in Table 2.7.27.

Table 7.2.27 Future Development Perceived by Communities

Future development	Number responded-yes	%
Industries:		
Garment	41	63
Timber based industries	3	5
Other various type of industries	8	12
Housing complexes:		
• Private	48	74
• Government	12	18

Source: HHS of SIA team

5) Impact on Changes on Properties:

Communities expect some changes on activities such as renting and selling houses, and also land market. Most of the community members interviewed expect value increase of these properties once the proposed road construction is completed. The communities do not expect changes on values of paddy lands that are abandoned. But their all other highlands will have beneficial impact. The current values of each property are shown in Table 7.2.28. All the community members we interviewed said that values would go up once the transportation is improved in the area.

Table 7.2.28 Current Values of Properties

Location	House rent-Average ranges (Rs)	House selling-Average ranges (Rs)
1	2,000-6,000	60,000-4,000,000
2	2,000-5,000	80,000-150,000
3	1,000-8,000	100,000-1,000,000
4	2,500-10,000	400,000-5,000,000
5	2,000-8,000	300,000-2,000,000
6	2,500-10,000	150,000-2,000,000

Source: Householders interviewed, Community leaders and GNs (Grama Niradharies) in the project area

Current values of land in the area are shown in Table 7.2.19. All the sample householders interviewed, 65 householders both inside and out side the corridor mentioned that value of all properties would increase once the road is completed but they did not mention the expected increases in figures.

6) Changes Expected on Various Aspects of Transportation:

Once the proposed road is constructed the communities expect changes on various aspects of transportation. These aspects include buses, commuters, bicycle riders and other type of vehicles and pedestrians and so on. The householders interviewed expressed the current situation of these aspects and the changes they expect. This information is included in Tables 11, 12, 13, 14 and 15 in Appendix 7.5. The communities perceive that there will be significant changes on the transportation system in the area.
The communities perceive that transportation facilities to different service delivery centers would get improved due to construction of proposed high way. At present due to

lack of vehicles and also due to poor road conditions access to service delivery centers such as hospitals, schools, religious paces, post office is not sufficient. Police, fire brigade, business centers and marketing centers are difficult to access. Table 16 in Appendix 7.5 includes the information on community perceived impact on transportation to various service delivery centers.

7) Relocation Impact:

In the six sample locations studied by the sociologist 22 households will be affected. Almost all the householders know about this situation. Therefore, they are mentally preparing to face the implication of relocation. They are flexible but they need to know the exact land in which each family is going to be resettled. This type of investigation was not carried in this survey. It should be carried out separately considering each family individually and also as unique case. Alternative lands available for relocation was inquired. In the practical resettlement stage of the project, developers should handle case-by-case and select the most suitable land acceptable to both parties and implement resettlement activities according to the government resettlement laws. The profiles of 22 households (families) that may have to be resettled are given in Table 17 in Appendix 7.5.

8) Impact on Industries and Businesses:

Three industries/business centers in location 4 and 6 would be negatively affected. The information on these affected 3 properties is included in Table 7.2.29.

Table 7.2.29 Affected Industries

Location	Type of business	Name and address of owner	Number of employees	Monthly income
4	Retail shop	HH. Perera, 144, Kotalawela, Kaduwela	3	60,000
4	Coconut timber processing center	INR. Perera, 49, Kotalawela, Kaduwela	2	18,000
6	Black smith's work shop	PA. Rohana, Rohana Mechanics, Kaduwela	2	30,000

Source: HHS of the SIA team

9) Land for Resettlement

In most of the home gardens there is no adequate spaces for onsite resettlement (on- site resettlement means that affected households are established in the same home garden). Therefore, it is required additional land for implementation of resettlement activities. Resettlement project should be carefully planned with the active involvement of affected communities and the agency officers in the project area. The potential lands available for exploring possibilities to obtain them for resettlement are shown Table 7.2.30. In the actual implementation stage of resettlement program the project developers should negotiate with the landowners and obtain them for resettlement.

Table 7.2.30 Potential Land for Resettlement

Location	Location	Distance from Corridor (m)	Present Land Use	Title	Possibility to obtain
1	Two-acre land – Located in Hokandara –east GN division. Located close to Malasingha goda road.	200	Rubber	Free hold -private	Rubber is neglected. There is possibility for negotiation to purchase
2	Land located near Bakmeegahawatta road in Hokandara-North GN division. Two acre land	200	Coconut and other fruits	Free hold -private	There is possibility to purchase
4	Four acre land in Kotalawela GN division (Thambige watta)	500	Mix crops	Free hold -private	The owner is willing to sell the land
6	Four acre land (called Disawatta) in Raggahawatta GN division	150	Coconut	Free hold -private	Should negotiate with the owner

Source: GNs (Grama Niradharies) in each GN division and the community leaders

According to information in Table 7.2.30 there are potential lands for resettlement in the local area itself. The project proponent can negotiate with the landowners with the involvement of householders of the affected families to purchase lands for resettlement.

10) Impact on Religious, Historical and Other Cultural Centers:

There are no significant centers located within the road corridor. But in the vicinity at every location studied religious centers are located. If the people's access to these locations gets disturbed due to the proposed road it will create some significant negative impact on the communities. The studied situation in each location is shown in Table 7.2.31.

Table 7.2.31 Impact on Religious, Historical and Cultural Significant Places

Location	Place	Distance from Corridor	Likelihood Impact
1	Hokandara Purana Viharaya (Buddhist temple)	100m	The increased noise due to traffic may create disturbances for religious activities
1	Buddhist cultural centre	200m	Difficulties to access
2	Dharmasoka Viharaya (Buddhist temple)	300m	There may be disturbances to relations between temple and the communities
3	Pittugala Viharaya (Buddhist temple)	1 km	Difficulties to access
4	Kotalawela Shankapitti Viharaya (Buddhist temple)	1 km	Difficulties to cross the high way
5	Hewagama Temple	1 km	Disturbances to relations between temple and the communities
6	Kaduwela Rankadu Viharaya (Buddhist temple)	1 km	Disturbances to relations between temple and the communities

Source: GNs (Grama Niradharies) and community leaders in each location studied.

7.2.4. Mitigation Measures for Anticipated Negative Impacts

(1) Hydrological Impacts

1) General

In order to minimize the unavoidable adverse impacts of the proposed deviation on hydrological aspects, the following mitigatory measures as given below are proposed. They are to be incorporated at three stages:

- Pre-construction Stage
- Construction Stage
- Post-project Implementation Stage

2) Mitigation Measures for Pre-construction Stage

In order to minimize the increased in flood levels along the deviated trace, the following design criteria should be adopted in the design of cross drainage structures and open drainage canals:

- The 50 year return period flood level of Kelani River upstream of Kaduwela Bridge should be established using mathematical approach and observed flood levels of 1967 and 1989 floods.
- Coefficient of runoff (c-value) should be established for each sub catchment based on existing land use and future urbanization of each sub catchment.
- In this aspect, the values recommended by Sri Lanka Land Reclamation and Development Corporation should also be considered.

- Both short duration and long duration rainfall events for 50 year return period should be taken into account and critical storm relevant to each sub catchment should be adopted in the design of cross drainage structures.
- Existing drainage pattern should be maintained as much as possible to maintain pre-project conditions.
- When flow pattern changes, sufficient width of culverts, or if necessary bridges should be included as cross drainage structures.
- Existing drainage pattern of paddy tracts should be investigated at the site and suitable provisions to drain excess water from paddy fields should be incorporated in the design.
- Access provisions should be incorporated at suitable locations in to the design for farmers to transport their agricultural implements from one side to other side.
- The marsh area below station 20+000 up to Kaduwela – Homagama Road Bridge should be declared as a retention area (85ha). This area has been recommended also by the Sri Lanka Land Reclamation and Development Corporation. The plan of the proposed retention area is attached (Fig. 7.2.7). This aspect need to be discussed by RDA, with agencies responsible such as Irrigation Department, SLLRDC ,UDA and Kaduwela Pradeshiya Sabah and necessary regulatory provisions should be formulated to restrict the development activities in this area.

3) Mitigation Measures During Construction Phase

The erosion, silt runoff during construction are the major impacts during construction stage. The following mitigatory measures are proposed.

- All disposable material should not be stockpiled in the paddy / marsh area of the deviated trace and should be disposed directly to designated disposal sites.
- All wet disposal material should be stockpiled away from the drainage streams and disposed to designated borrow areas when the water is drained off.
- It is recommended to provide suitable silt traps along the drainage paths and all silt collected in such silt traps should be removed periodically by the Contractor.
- The bed levels of the Maha Ela prior to commencement of construction activities should be established jointly with the Irrigation Department, and provisions should be made in the contract to dredge the main stream (Maha Ela) when silt accumulation creates drainage problems in the upstream area. This aspect needs to be discussed with the Irrigation Department.
- During construction of cross drainage structures and road drainage canals, the contractor should indicate the method of diversion of water to minimize soil erosion during temporary diversion works.
- Weather conditions should be taken into consideration in planning out construction activities mainly foundation preparation and cross drainage culvert construction works.
- Water quality parameters should be monitored periodically (monthly) at the following locations to assess the impact of construction activities on water quality.
    - Station 19+200:Downstream of proposed bridge structure
- The water levels below road at stations 20+000 and 19+200 should be

monitored at least one year prior to commencement of construction works to assess any increase in flood levels due to construction of OCH in the deviated trace.

- In the deviated trace the road goes on cutting in the section from station 17+920 to 18+260, the maximum depth of cutting is about 7.8 meters. Groundwater depletion may occur in this stretch of the deviated trace. Few wells should be selected in the area and groundwater levels should be monitored at least one year prior to commencement of construction. In addition, it is recommended to monitor one well close to Maha Ela marsh area to assess the changes in groundwater in the marsh area.

4) Mitigation Measures during Post Construction Phase

During this Phase it is necessary to continue the monitoring activities to monitor the water levels, flood levels, drainage problems and quality of water to check regarding any adverse impacts and to recommend remedial measures.

During this stage surface water may contaminate with spilled petroleum products and the measures proposed during design stage should be monitored for its effectiveness and remedial measures should be taken where necessary.

(2) Ecological Resources

1) Mitigation Measures for Pre-construction Stage

i Conservation of Vegetation

Although the impacts due to loss of vegetation in the proposed trace would not be significant from the viewpoint of conservation of vegetation, the comprehensive greenery plan for the project should be prepared considering natural environment along the trace.

ii Conservation of Habitats

It is necessary to consider hydrological impacts also during the detailed designs as any significant change in the hydrology will directly affect ecology of the aquatic habitats.

Precautions should be taken to prevent surface runoff as much as possible by introducing adequate openings at appropriate locations. This will not only mitigate the risk of inundation of low-lying areas or water logging, but also serve as “through passages” for small mammals, reptiles and amphibians. It will therefore minimize the risk of being run over by moving vehicles. These passages will also minimize fragmentation of populations.

2) Mitigation Measures During Construction Phase

It is necessary to minimize the clearing of vegetation cover as much as possible at borrow areas and in the areas of other development activities. This would minimize loss of vegetation. Stripped vegetative topsoil should be piled and re-spread to an adequate depth to ensure growth of land cover in borrow areas.

Marshes on either side of highway should not be used to dispose solid waste. Waste disposal sites should be selected carefully avoiding water bodies and wetlands as much as possible. Excavated earth or other discarded material should not be stockpiled near waterways. Debris shall also not be left in places where it may be carried by water to downstream flood plains.

Machinery used in construction activities should be properly maintained to minimize oil leakages. Construction machinery with such leakages should not be used near waterways in order to avoid possible contamination of waterways. Precautions should be taken to prevent discharge of asphalt, oil and cement in to aquatic habitats such as water bodies and marshes during the construction period.

3) Mitigation Measures During Post Construction Phase

Vehicular emissions should be controlled by strict enforcement of relevant regulations

(3) Socio-economic Aspects

Though many activities have been taken place according to the communities (studies, visits of various parties) the communities do not have clear understanding on correct right of way of the proposed road. Therefore, as the basic mitigation measures for social impacts the communities should be provided with correct information on this aspect. Also proper information on compensation should be convened to the affected communities prior to acquisition of their lands and houses. The mitigation measures for specific issues in terms of social aspects are considered as follows.

1) Relocation of Houses

It was found through the Study that 22 households in 6 sample locations. There are no possibilities for on site relocation of these families due to lack of land once the road is constructed across their home gardens. They also have no other highlands for resettlement. Therefore, the project proponent should look for alternative land for resettlement of these affected families. Most of the householders and also the GNs (Grama Niradharies) indicated that there are such highlands available in the area (refer to Table 7.2.30).

2) Relocation of Business/Industrial Establishments:

Three business establishments as shown in Table 7.2.29 need relocations. There are no enough spaces in existing lands for on site relocation of these establishments. Therefore, alternative lands should be sought to relocate these business centers. According to the affected persons there are alternative lands available in the area for reestablishment of their business places. The project proponent should make arrangement with the involvement of affected parties to find out alternative lands acceptable to affected people for relocation of these centers.

3) General Suggestions of Communities for Mitigation of Negative Impacts

The communities on each aspect of the impact made the following general suggestions. The suggestions and the number of householders responded and the percentage are

mentioned below:

4) Likelihood Separation of Lands:

- Providing alternative lands – 42 (number of householders) -64%
- Make all possible attempt to avoid home gardens- 34 householders 52%
- Pay compensations in money- 45 householders 69%

5) Impact on Crops:

- Pay compensation in money- 42 householders 64%
- Avoid home gardens that have crops- 31 householders 47%
- Provide alternative lands- 38 householders 58%
- Attempt to construct road through abandoned paddy lands as much as possible-30 householders 46%

6) Impact on Social Relations:

- Attempt to reduce disturbances to sub-roads existing in the area- 31- householders 47%
- Provide possible crossing facilities for the people who use sub-roeds-32 householders 49%
- Resettlement of affected communities in the same area- 29 householders 44%
- Use abandoned paddy lands for the road and avoid settlements-21 householders 32%

7) Impact on Decreasing Value of Properties:

- This will be a problem only till final road trace is demarcated. Once the road is completed there will be value increase of the properties in the area

8) Impact of Service Delivery Centers:

- Attempt to avoid disturbances to sub-roads in the area- 37 householders 56%
- Provide crossing at all possible locations- 39 householders 60%

9) Impact on Resettlement:

- Resettlement in the area it self- 34 householders 52%
- Provide alternative land and houses- 37 householders 56%
- Provide location for relocations where all the infrastructure facilities are available-35 householders 53%
- Settle in an environment that is acceptable to the affected parties-32 householders 49%
- Pay reasonable compensation where necessary-30 householders 40%

7.2.5. Conclusions and Recommendations

(1) Hydrological Aspects

- The changes in flooding conditions and water quality in the deviated trace could be minimized if sufficient cross drainage culverts / bridges of required sizes, based on accurate hydrological computations are provided at proper locations.
- In order to assess the effectiveness and to make any remedial measures continuous monitoring of water levels and water quality should be established with benchmark conditions at least one year prior to commencement of construction works.
- Although the construction of the OCH in the deviated trace do not affect the existing minor flood protection scheme at "Bomiriya", the siltation of "Maha Ela" marsh during construction phase may affect the drainage of "Maha Ela" paddy tract. It is therefore recommended to conduct dredging of "Maha Ela" stretch where necessary during construction phase and on completion of the construction works in consultation with the Sri Lanka Land Reclamation & Development Corporation (SLLRDC)/Irrigation Department as a remedial measure.
- The construction of the road embankment in the deviated trace will cause drainage problems to drain excess water from the paddy fields due to non-availability of drainage canal on either side of road embankment. This aspect needs to be carefully studied in consultation with the Agrarian Development Department Officers at Pittugala and the farmers in the area and suitable remedial measures such as provision of toe drain along the road embankment where necessary and minor structures to accommodate minor cross drainages as required in the field based on such finding.
- The construction of the OCH in the deviated trace will reduce the existing flood detention capacity of the Maha Ela catchment by about 6%. Although rise in flood levels are minimized due to provision of cross drainage culverts and bridges any section further reduction of flood detention area will cause problems for upstream of the Maha Ela catchment. It is therefore recommended to declare the marsh are below station 20+000 as a strict flood detention basin for the Maha Ela catchment.

(2) Ecological Aspect

- The deviation route of the OCH does not pass though any natural forest, scrubland or any protected area. Although the length of the ROW of the proposed deviation is longer than previous one, if the mitigation measures recommended are implemented, the impacts on the ecology of the wetland would be not significant.
- From the viewpoint of the diversity of fauna and flora, the impacts due to proposed deviation route are not significantly high.

(3) Social Aspects

- Except small number of houses in each location studied no significant and sensitive religious, historical or cultural places are affected due to construction of the proposed road.
- Since the road trace has been mostly designed to run through abandoned paddy lands people have no serious objections for the road in these locations.

- The most important decisions that community need are final conclusions on the road right of way, houses that will be exactly demolished and the time frame of the project implementation. They argue that this information is required for them to plan their own property development activities such as construction of new houses, selling of their lands etc.

- All sub-roads in the area are important for local communities, however it is not possible to provide access for each one. Therefore, access will be provided at strategic locations to ensure that minimum requirement of access for local communities were met.

7.3 Environmental Management Plan

Subsequent to the findings of the EIA 2000, further studies were conducted on the specific environmental impacts of the project and the required mitigation measures. The Environment Management Plan (EMP) for the Outer Circular Highway (OCH) Project has been formulated based on these additional considerations and EIA findings.

The EMP for the OCH Project presents the implementation details of the environmental protection measures recommended for the pre-construction, construction and operational phases of the Project. The Environmental Monitoring Action Plan (EMAP), presented as a constituent part of EMP, will assist in monitoring the implementation of EMP and its effectiveness.

RDA and the contractor should execute the environmental management plan with proper planning, coordination and management of all recommended environmental protection measures and activities

7.3.1 Pre-Construction Stage

In the pre-construction stage the Project related environmental issues are mainly the social impacts caused by land acquisition activities.

In addition, it is necessary to establish a base line for monitoring changes in ambient air quality, water quality and noise levels as a result of the OCH. The EIAR 2000 has established the air and water quality and noise levels before the project.

Further, the potential hydrological impacts will have to be mitigated by including the recommendations of the Hydrological Study to be conducted by the RDA.

(1) Social Impacts

The objectives of the EMP with regard to social aspects are:
- To ensure that adverse impacts on community is avoided, mitigated or compensated
- To ensure better living conditions for project affected persons (PAPs)
- To ensure smooth and timely land acquisition

The mitigation measures recommended are:
- Prepare an inventory of PAPs and extent of damage to properties after the final ROW is identified
- Formulate a comprehensive Resettlement Action Plan (RAP), based on the national policy on resettlement and conduct validation of the RAP
- Conduct public consultations on the compensation package and relocation process
- Implementation of RAP plan to the satisfaction of the affected families

(2) Hydrological Impacts

The objective of the EMP in managing hydrological impact is:
- To minimize hydrological and drainage impacts such as flood levels and fluctuations of ground water table.

The mitigation measures recommended is:

- Incorporating into the design the mitigation measures recommended in detailed Hydrological Study required by the CEA.

7.3.2 Construction Stage

(1) Orientation for Contractor and Workers

The objective of orientation for contractor and workers is:

- To ensure that the contractor and the workers understand the environmental requirements and implementation of mitigation measures.

The mitigation measures proposed in this regard is:

- Conducting special briefing and/or on-site training for the contractors and workers on the environmental requirement of the project

(2) Water Quality

The objective of the EMP with regard to water quality management is:

- To ensure adverse impacts on water quality caused by construction activities are minimized

The mitigation measures proposed in this regard are:

- Proper construction management including, training of operators and other workers to avoid pollution of water bodies by the operation of construction machinery and equipment
- Storage of lubricants, fuels and other hydrocarbons in self contained enclosures
- Proper disposal of solid waste from construction activities and labour camps
- Cover the construction material and spoil stockpiles with a suitable material to reducing material loss and sedimentation.
- Avoid stockpiling of materials close to water bodies
- Stripped materials shall not be stored where natural drainage will be disrupted.

(3) Air Quality/Dust

The objective of the EMP in relation to air quality management is:

- To minimize the air borne particulate matter released to the atmosphere

The mitigation measures recommended to achieve this objective are:

- All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations.
- Stockpiled soil and sand shall be slightly wetted before loading, particularly in windy conditions
- Fuel efficient and well maintained haulage trucks shall be employed to minimize exhaust emissions
- Vehicles transporting soil, sand and other construction material shall be covered
- Damping the expose areas

(4) Noise/ Vibration

The objective of the EMP in relation to noise and ground vibration management is:
- To minimize noise level increases during construction operations.
- To minimize/avoid the ground vibration due to construction operations

The mitigation measures recommended in this regard are:
- All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations.
- As a rule, the operation of heavy equipment shall be conducted in daylight hours.
- Hammer-type pile driving operations shall be avoided during night and close to residential areas.
- Construction equipment, which generates excessive noise shall be enclosed
- Well maintained haulage trucks will be used with speed controls

(5) Soil Erosion/Surface Run-off

The objectives of the EMP in relation to soil erosion/surface run-off management are:
- To minimize soil erosion
- Minimize carry over of eroded soil particles by surface run-off

The mitigation measures recommended include:
- Back-fill should be compacted properly in accordance with design standards.
- In the short-term, either temporary or permanent drainage works shall protect all areas susceptible to erosion.
- Measures shall be taken to prevent ponding of surface water and scouring of slopes. Newly eroded channels shall be backfilled and restored to natural contours.

(6) Handling and Storage of Construction Materials

The objective of the EMP in relation to handling and storage of construction material management is:
- To minimize contamination of the immediate surroundings

The mitigation measures recommended includes:
- Hazardous materials shall be stored on impervious ground under cover. The area shall be constructed as a spill tray to avoid spread of accidental spills.
- Safe ventilation for storage of volatile chemicals shall be provided.
- Access to areas containing hazardous substances shall be restricted and controlled.

(7) Spoil and Construction Waste Disposal

The objectives of the EMP in relation to spoil and construction waste disposal management are:
- To minimize the generation of spoil and construction waste
- To optimize the reuse of spoil and construction waste
- To ensure safe and proper disposal of spoil and construction waste

The mitigation measures include:
- Estimating the amounts and types of spoil and construction waste to be generated by

the project.
- Investigating whether the waste can be reused in the project or by other interested parties.
- Identify potential safe disposal sites close to the project. Investigate the environmental conditions of the disposal sites and prepare recommendation of most suitable and safest sites.
- Designated disposal sites to be used in the project.
- Unsuitable excavated materials should be systematically carried away from the areas prone to erosion.
- Incorporate reuse of waste materials and use of designated disposal sites
- Used oil and lubricants shall be recovered and reused or removed from the site in full compliance with the national and local regulations. Oil wasted must not be burned.

(8) Work Camp Operation and Location

The objective of the EMP in relation to work camp operation and location is
- To ensure that the operation of work camps does not adversely affect the surrounding environment and residents in the area

The mitigation measures recommended in this regard are:
- Identify location of work camps in consultation with Grama Niladaris (GNs). The location shall be subjected to approval by the RDA. If possible, camps shall not be located near settlements or near drinking water supply intakes.
- Cutting of trees shall be avoided and removal of vegetation shall be minimized.
- Water and sanitary facilities shall be provided for employees.
- Solid waste and sewage shall be managed according to the national and local regulations. As a rule solid waste must not be dumped, buried or burned at or near the project site, but shall be disposed of to the nearest sanitary landfill or site having and complying with the necessary permits.
- The Contractor shall organize and maintain a waste separation, collection and transport system.
- The Contractor shall document that all liquid and solid hazardous and non-hazardous waste are separated, collected and disposed of according to the given requirement and regulations.
- At conclusion of the project, all debris and waste shall be removed. All temporary structures, including office buildings, shelters and toilets, shall be removed.
- Exposed areas shall be planted with suitable vegetation.
- The RDA supervising engineer shall inspect and report that the camp has been vacated and restored to pre-project conditions.

(9) Loss of Vegetative Cover of the Areas for Temporally Yard

The main objectives of the EMP in relation to loss of vegetative cover are:
- To minimize the loss of vegetation cover due to land clearing and construction related operations and undertakings
- To restore the loss of vegetation cover due to construction related operations and undertakings

The mitigation measures recommended in this regard are:

- To minimize cutting trees and other important vegetation during construction.
- Landscaping the road verges
- Planting of trees/shrubs/ornamental plants to contribute to the aesthetic value of the area and to compensate for the lost capability of the area to absorb carbon dioxide.
- At conclusion of the project, all debris and waste shall be removed. All temporary structures, including office buildings, shelters and toilets, shall be removed.

(10) Safety Precautions for the Workers

The objective of the EMP in relation to safety precautions of the workers is:
- To ensure safety of workers

The mitigation measures recommended include:
- Providing adequate warning signs
- Providing workers with skull guard or hard hat
- The Contractor shall instruct his workers in health and safety matters, and require the workers to use the provided safety equipment.
- Establish all relevant safety measures as required by law and good engineering practices

(11) Traffic Condition

The objective is to minimize disturbances to vehicular traffic and pedestrians during haulage of construction materials, spoil and equipment and machinery

The mitigation measures recommended are:
- Formulation and implementation of a construction related traffic management plan
- Installation of traffic warning signs, and enforcing traffic regulations during transportation of materials, equipment & machinery
- Conducting awareness programmes on safety and proper traffic behavior in densely populated areas near the construction sites
- Assign traffic control personnel

(12) Impact on Wetlands

The objective of the EMP in relation to wetlands is:
- To ensure that damage to wetlands and its ecosystem is minimized during construction

The mitigation measures recommended are:
- Avoid disposal of wash water, solid waste as discarded packings etc., on wetlands
- Avoid temporary structures or stockpiling on wetlands

(13) Social Impacts

The objectives of the EMP in relation to social impacts management are:
- To ensure minimum impacts from construction labor force
- To ensure minimum impact on public health

The mitigation measures proposed include:

- Conflicts with local community should be avoided
- Potential for spread of vector borne and communicable diseases from labour camps shall be avoided
- Competition with locals for resources will be avoided

7.3.3 Operation Stage

In order to achieve sustainability of the development works, it is necessary to ensure the effectiveness of mitigation measures even after construction, as some adverse environmental impacts may result from the operation of the Project facilities.

(1) Air Quality

The objective of the EMP in relation to air quality management is
- To minimize air pollution from road usage.

The mitigation measures proposed are:
- Establishing a national policy on vehicle imports-exhaust emission levels increase with age of vehicles
- Promoting mass transport and traffic management
- Establishing vehicle emission regulations and standards
- Strict enforcement of the regulations subsequent to an awareness programme
- Provision of a vegetative barrier to arrest the spread of air borne particles to residential areas

The first four mitigation measures should be considered in the transportation policies at national level.

(2) Noise / Vibration

The objective of the EMP in relation to noise /ground vibration emission management is:
- To minimize and/ or avoid the noise level enhancement resulting from road traffic.
- To avoid and/or minimize the ground vibration resulting from the vehicles.

The mitigation measures recommended for this purpose are:
- Establishing standards and regulations for noise level / vibration emanating from vehicles
- Strict enforcement of regulations, subsequent to an awareness programme
- Establishing a national policy on vehicle imports-noise levels, too, increase with age of vehicles
- In sensitive areas such as schools, places of worship, hospitals and libraries, sound barriers including tree linings will have to be employed.

The first three mitigation measures should be considered in the transportation policies at national level.

The complete Environmental Management Plan for OCH is summarized as Table 7.3.1.

Table 7.3.1 Environmental Management Plan on OCH Project (1)

ISSUES	OBJECTIVES	MITIGATION MEASURES	RESPONSIBLE
<Pre-Construction Stage>			
Social Impacts	- To ensure that adverse impacts on community is avoided, mitigated or compensated - To ensure better living conditions for project affected persons (PAPs) - To ensure smooth and timely land acquisition - To minimize disturbances and bad effects	● Prepare the inventory of losses of PAPs and extent of damage to properties after the final ROW is identified ● Check whether impacts on PAP can be avoided/minimized through changes in the design or construction method. ● Formulate a comprehensive Resettlement Implementation Plan (RIP), based on the national policy on resettlement and conduct validation of the RIP ● Conduct public consultations in groups or individually on the special compensation package and relocation process ● Implementation of RIP plan to the satisfaction of the affected families	RDA& Ministry of Land
Hydrological Impacts	- To minimize hydrological and drainage impacts such as flood levels and depletion of ground water	● Incorporating into the design the mitigation measures recommended in detailed Hydrological Study required by the CEA	RDA
<Construction Stage>			
Orientation to Workers and Contractor	- To ensure that the contractor and the workers understand the environmental requirements and implementation of mitigation measures	● Conducting special briefing and/or on-site training for the contractors and workers on the environmental requirement of the project	RDA
Water Quality	- To ensure adverse impacts on water quality caused by construction activities are minimized	● Proper construction management including as training of operators and other workers to avoid pollution of water bodies by the operation of construction machinery and equipment ● Storage of lubricants, fuels and other hydrocarbons in self contained enclosures ● Proper disposal of solid waste from construction activities and labour camps ● Cover the construction material and spoil stockpiles with a suitable material to reducing material loss and sedimentation. ● Avoiding stockpiling of materials close to water bodies ● Stripped material shall not be stored where natural drainage will be disrupted.	The Contractor & RDA
Air Quality/Dust	- To minimize the air borne particulate matters released to the atmosphere	● All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations. ● Stockpiled soil and sand shall be slightly wetted before loading, particularly in windy conditions ● Fuel efficient and well maintained haulage trucks shall be employed to minimize exhaust emissions ● Vehicles transporting soil, sand and other construction material shall be covered ● Spraying of bare areas with water	The Contractor & RDA
Noise / Vibration	- To minimize/avoid noise level/vibration increases during construction operations.	● All heavy equipment and machinery shall be fitted in full compliance with the national and local regulations. ● As a rule, the operation of heavy equipment shall be conducted in daylight hours. ● Hammer-type pile driving operations shall be avoided during nighttime and build up areas ● Construction equipment, which generates excessive noise shall be enclosed ● Well maintained haulage trucks will be used with speed controls	The Contractor & RDA
Soil Erosion/Surface run-off	- To minimize soil erosion - Minimize carry over of eroded soil particles by surface run-off	● Back-fill should be compacted properly in accordance with design standards. ● In the short-term, either temporary or permanent drainage works shall protect all areas susceptible to erosion. ● Measures shall be taken to prevent ponding of surface water and scouring of slopes. Newly eroded channels shall be backfilled and restored to natural contours.	The Contractor
Handling and Storage of Construction Materials	- To minimize contamination of the immediate surroundings	● Hydrocarbons and hazardous materials shall be stored on impervious ground under cover. The area shall be constructed as a spill tray to avoid spread of accidental spills. ● Safe ventilation for storage of volatile chemicals shall be provided. ● Access to areas containing hazardous substances shall be restricted and controlled.	The Contractor
Spoil and Construction Waste Disposal	- To minimize the generation of spoil and construction waste - To optimize the reuse of spoil and construction waste	● Estimating the amounts and types of spoil and construction waste to be generated by the project. ● Investigating whether the waste can be reused in the project or by other interested parties. ● Identify potential safe disposal sites close to the project. Investigate the environmental conditions of the disposal sites and prepare recommendation of most suitable and safest sites.	RDA and the Contractor

Table 7.3.1 Environmental Management Plan on OCH Project (2)

ISSUES	OBJECTIVES	MITIGATION MEASURES	RESPONSIBLE
	- To ensure safe and proper disposal of spoil and construction waste	● Designated disposal sites to be used in the project. ● Incorporate reuse of waste materials and use of designated disposal sites in the detailed design. ● Unsuitable excavated materials should be systematically carried away from the areas prone to erosion. ● Used oil and lubricants shall be recovered and reused or removed from the site in full compliance with the national and local regulations. Oil wasted must not be burned.	
Work camp operation and Location	- To ensure that the operation of work camps does not adversely impact the surrounding environment and residents in the area	● Identify location of work camps in consultation with Grama Niladaris (GNs). The location shall be subject to approval by the RDA. If possible, camps shall not be located near settlements or near drinking water supply intakes. ● Cutting of trees shall be avoided and removal of vegetation shall be minimized. ● Water and sanitary facilities shall be provided for employees. ● Solid waste and sewage shall be managed according to the national and local regulations. As a rule solid waste must not be dumped, buried or burned at or near the project site, but shall be disposed of to the nearest sanitary landfill or site having and complying with the necessary permits. ● The Contractor shall organize and maintain a waste separation, collection and transport system. ● The Contractor shall document that all liquid and solid hazardous and non-hazardous waste are separated, collected and disposed of according to the given requirement and regulations. ● At conclusion of the project, all debris and waste shall be removed. All temporary structures, including office buildings, shelters and toilets, shall be removed. ● Exposed areas shall be planted with suitable vegetation. ● The RDA supervising engineer shall inspect and report that the camp has been vacated and restored to pre-project conditions.	RDA and The Contractor
Loss of Vegetation Cover of the Areas for Temporary Yard	- To minimize the loss of vegetation cover due to land clearing and construction related operations and undertakings - To restore the loss of vegetation cover due to construction related operations and undertakings	● To minimize cutting trees and other important vegetation during construction. ● Landscaping the road verges ● Planting of trees/shrubs/ornamental plants to contribute to the aesthetic value of the area and to compensate for the lost capability of the area to absorb carbon dioxide.	The Contractor
Safety and Precaution for the Workers	- To ensure safety of workers	● Providing adequate warning signs ● Providing workers with skull guard or hard hat ● The Contractor shall instruct his workers in health and safety matters, and require the workers to use the provided safety equipment. ● Establish all relevant safety measures as required by law and good engineering practices	The Contractor
Traffic Condition	- To minimize disturbances to vehicular traffic and pedestrians during haulage of construction materials, spoil and equipment and machinery	● Formulation and implementation of a construction related traffic management plan ● Installation of traffic warning signs, and enforcing traffic regulations during transportation of materials and equipment & machinery ● Conducting awareness programmes on safety and proper traffic behavior in densely populated areas near the construction sites ● Assign traffic control personnel	
Impacts on Wetland	- To ensure that damage to wetlands and its ecosystem is minimized during construction	● Avoid disposal of wash water, solid waste as discarded packings etc., on wetlands ● Avoid temporary structures or stockpiling on or close to wetlands	The Contractor
Social Impacts	- To ensure minimum impacts from construction labor force - To ensure minimum impact on public health	● Conflicts with local community should be avoided ● Potential for spread of vector borne and communicable diseases from labour camps shall be avoided ● Competition with locals for resources will be avoided	RDA
< Operation Stage>			
Air quality/Dust	- To minimize air pollution from road usage.	● Strict enforcement of the regulations subsequent to an awareness programme ● Provision of a vegetative barrier to arrest the spread of air borne particles to residential areas	CEA RDA
Noise / Vibration	- To minimize the noise level/ vibration enhancement resulting from road traffic.	● Strict enforcement of the regulations subsequent to an awareness programme ● In sensitive areas such as schools, places of worship, hospitals and libraries, sound barriers including tree linings will have to be employed.	RDA

7.4 Environmental Monitoring Action Plan

The mitigation measures proposed in the environmental management plan will be carried out by the responsible agencies. Among the environmental parameters considered in the environmental management plan, the items mentioned below were prioritized for inclusion in the monitoring plan:

-Groundwater levels
-Water quality (surface water and ground water)
-Air quality
-Noise levels
-Social impacts

Regarding sampling locations for monitoring, the consultation with CEA, Environmental Monitoring and Assessment (EM&A) Div. is necessary. In this EMP, the sampling locations for monitoring in the detailed design section have been determined through consultation with related agencies..

7.4.1 Ground Water Level

(1) The objective for monitoring ground water level is

- To assess the negative impact on ground water level caused by construction activities especially in the adjacent areas where cutting are planned. Cutting might induce decreasing the level of ground water.

(2) Parameters to be monitored are:

- Ground water level

(3) Monitoring Location

No.	Locations
1	Malambe-Kaduwela road crossing

Sampling locations is referred to **Fig. 7.4.1**

(4) Frequency

- Two times during dry and wet seasons before construction (Pre-construction)
- On complaints during construction
- Two times with an interval of six months during operation stage for one (1) years

(5) Responsible agency

Contract under RDA with independent laboratory

7.4.2 Water Quality (surface and ground water)

(1) The objective for monitoring water quality is

- To avoid contamination of water by construction and related activities as accidental oil spills, disposal of solid waste, spoil, construction material and domestic wastewater

(2) Parameters to be monitored are:

- pH
- Electrical Conductivity (EC)
- Dissolved Oxygen (DO)

- Biochemical Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Suspended Solids (SS)
- Nitrate
- Phosphate
- Chloride
- Oil/Grease
- Zinc
- Lead
- Total coliform
- E. coliform

(3) Monitoring Locations

<Surface Water>

No.	Locations
1	Kaduwela, Hewagama, (Near Colombo- Hanwella road crossing)
2	Near the 1st Bridge on the Kaduwela- Athurugiriya road
3	Kottawa – Athurugiriya road crossing

<Ground Water>

No.	Locations
1	Kaduwela, Hewagama, (Near Colombo Hanwella road crossing)
2	Thuanada Hena road crossing
3	Bakmeegahawatta road crossing
4	Malambe- Athurugiriya road crossing

Sampling locations are referred to Fig 7.4.1

(4) Frequency

- Two times during dry and wet seasons before construction (Pre-construction)
- On complaints during construction
- Two times with an interval of six months during operation stage for one (1) years

(5) Responsible agency

- Contract under RDA with independent laboratory

7.4.3 Air Quality

(1) The objective of monitoring air quality is

- To minimize the air pollution in both construction and operation phases.

(2) The following Parameters have been selected for monitoring air quality:

- Carbon monoxide
- Sulphur dioxide
- Nitrogen dioxide
- Ground level ozone
- pM10- particulate matter

(3) Monitoring Locations

No.	Locations
1	Kaduwela, Hewagama, (Near Colombo Hanwella road crossing)
2	Malambe- Athurugiriya road crossing

Samplings locations are referred to Fig. 7.4.1

(4) Frequency

- One time for 24 hour monitoring at dry weather condition before construction
- Only Suspended Particulate Matter (SPM) for 8 hours on complains during construction
- Every six months during operation stage for one (1) year

(5) Responsible agency

- Contract under RDA with independent laboratory

7.4.4 Noise/ Ground Vibration

(1) The objective of noise and ground vibration level monitoring is

- To minimize the noise emission
- To minimize and /or avoid ground vibration

(2) Parameters

- For major interchanges- 24 hours measurements L_{Aeq} and L_A 90, 15 min (Day/Night)
- For other locations- Three (03) hours measurements L_{Aeq} and L_A 90, 15 min (Day/Night)

(3) Monitoring Locations

<Noise for 24hrs)

No.	Locations
1	Kaduwela, Hewagama, (Near Colombo Hanwella Road)
2	Malambe- Athurugiriya Road crossing

<Noise for 3hrs)

No.	Locations
1	Malambe-Kaduwela road crossing
2	Thunanda Hena road crossing
3	Bakmeegahawatta road crossing
4	Kottawa – Athurugiriya road crossing

Sampling locations are referred to Fig. 7.4.1

(4) Frequency

- Back ground noise levels (before construction) - One time with identification of noise barriers requirement locations. Every six months during construction
- During construction, noise levels (one (01) hour L_{Aeq} for day time and 5 minutes for night time) and ground vibration should be carried out on the complains from residents.
- Every six months during operation stage for 1 year

(5) Responsible agency

- Contract under RDA with independent laboratory

7.4.5 Social Impacts

Monitoring of social impacts will be carried out based on the Comprehensive Resettlement Implementation Plan (RIP) to be prepared by the RDA by the end of the Detailed Designs.

The objectives of monitoring social impacts are:
- To ensure that PAPs are settled in a similar or a better environment
- To ensure that PAPs are adequately compensated
- To avoid adverse direct and indirect impacts of resettlement of PAPs
- To identify residual adverse impacts of relocation

The items to be monitored are:
- Payment of compensation and resettlement
- Adverse social effects of relocation as disruption of cultural ties, access to social infrastructure etc.
- Impact on income levels and sustainability
- Impact on female headed families and disadvantaged PAPs
- Availability of employment opportunities for daily wage earners
- Potential conflict situations

Monitoring will commence as soon as relocation is started in the pre-construction phase and continue till the third year after resettlement.

Monitoring will be assigned to an organization with institutional capabilities to conduct social impact monitoring as detailed above. Responsible agency should be RDA.

7.4.6 Baseline Data

The baseline conditions of existing water quality, air quality and noise levels should be established before commencement of the construction as requested by CEA, Environmental Monitoring and Assessment (EM&A) Div. Note that it is necessary to collect the baseline data for water quality (ground water and surface water) for dry and rainy season respectively.

The monitoring activities are summarized in Table 74.1.

Table 7.4.1 Monitoring Activities

Items	Parameters	Responsible	Responsible	Frequency
		Construction	Operation	
Ground water levels	- Ground water levels	RDA	RDA SLLRDC CEA	Two times during dry and wet period before construction, On complains during construction and Every six months during operation stage for one year
Water quality	- pH - EC - DO - BOD - COD - SS - Nitrate - Phosphate - Chloride - Oil/Grease - Zinc - Lead - Total coliform - E. coliform	RDA	RDA/CEA	Two times during dry and wet period before construction, On complains during construction and Every six months during operation stage for one year
Air quality/Dust	- Carbon monoxide - Sulphur dioxide - Nitrogen dioxide - Ground level ozone - pM10	RDA	RDA/CEA	One time 24 hour monitoring at dry weather before construction, Eight (8) hours SPM only on complains during construction and every six months during operation stage for one year
Noise/ground vibration	Mean sound level (Leq (24)) Day-night sound level (Ldn)	RDA	RDA/CEA	Back ground noise levels (before construction) - One time with identification of noise barriers requirement locations. Every six months during construction During construction, noise levels (one (01) hour LA eq for day time and 5 minutes for night time) and ground vibration should be carried out on complains from residents. Every six months during operation stage for 1 year
Social Impacts	- Payment of compensation and adequacy of compensation paid - Adverse social effects of resettlement as	RDA & Ministry of Land	RDA	Pre-construction phase and continue till the third year after resettlement

Items	Parameters	Responsible	Responsible	Frequency
		Construction	Operation	
	social disruption of cultural ties, access to social infrastructure etc. - Impact on income levels and sustainability - Impact on female headed and vulnerable families and disadvantaged PAPs - Availability of employment opportunities for daily wage earners, share croppers and Ande farmers. - Potential conflict situations			

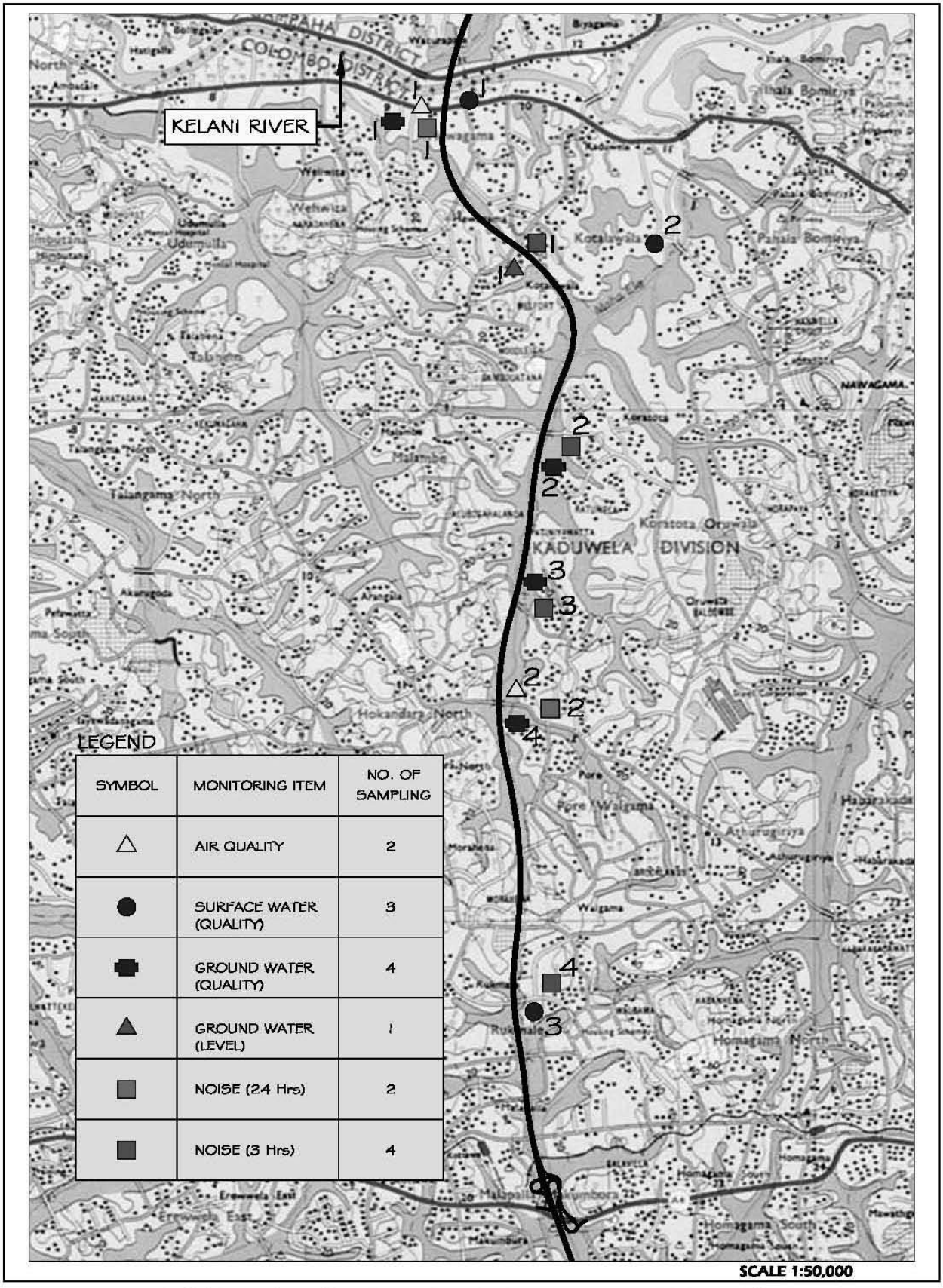

FIG 7.4.1 Sampling Location for Environmental Monitoring

7.5 Resettlement Implementation Plan

7.5.1 General

Recently involuntarily resettlement has been considered critical issue for road construction Project. Basic Resettlement Implementation Plan (Basic RIP) for the OCH Project was prepared under the responsibility of RDA. In this chapter, the review of the preparation activities had been conducted in the course of environmental study.

7.5.2 Resettlement Experiences in Sri Lanka

The Colombo – Katunayake Expressway (CKE) and the Southern Transport Development Project (STDP) were the main expressway development projects which involve involuntary resettlement.

RDA will have to acquire 945.54 ha of land (8745 Lots) for the entire section of STDP. Current estimate show that 5,683 households (HHs) of all categories have been affected. Moreover 1,488 structures, which include 1,315 homesteads and 151 commercial establishments, will also be affected. Of these, 214 HH are considered vulnerable and special income restoration strategies have been designed for them.

The original RIP prepared in July 1999 set out the resettlement policies to be adopted for the STDP. These policies conform to those of the ADB and this RIP sets out the policies, procedures, responsibilities, entitlements, and financing and implementation schedule in greater detail. Entitlements under the STDP go beyond normal compensation under the Land Acquisition Act (LAA). In particular, the STDP resettlement policy recognizes the need to pay replacement rates and to restore/improve living standards of APs. It also provides for adequate compensation of APs who do not have title to land. Income restoration programs are being provided for vulnerable APs. Relocation sites with basic infrastructure are being provided to those APs who choose to relocate. The project has also benefited from the national policy on involuntary resettlement that was approved by the government in May 2001.

Land acquisition commenced in July 2000 and resettlement implementation is scheduled from October 2002 to December 2005. Relocation of the APs for the 1st phase of ADB section will be completed by 30th December 2002. The resettlement cost is estimated at approximate 2,600,000,000 Rs. with 10% contingency equivalent to US$ 27 million. This includes sufficient budget for updating the RIP based on complete the data of Inventory of Loss (IOL), administrative costs, and to cover entitlements for additional APs identified when the RIP is updated during implementation.

The RDA through its Resettlement Division is responsible for implementing the RIP. It has been working through four Resettlement Units each having a Resettlement officer and 7-8 graduate Sociologists and office support services. Community Consultative Groups (CCG) assists APs to make their claims and deal with any grievances. They also assist in income restoration programs. Extra legal Grievance Redress Committees (GRC) will resolve disputes relating to land acquisition, compensation and resettlement at the grassroots level to avoid the need for lengthy bureaucratic procedures. The Divisional Secretaries will pay the compensation for land and other assets and the

resettlement entitlements will be paid by the STDP. The Resettlement division will monitor relocation of APs to the respective resettlement sites or host villages.

RDA will be responsible for ensuring adequate monitoring and evaluation of resettlement in the STDP. Internal monitoring will track the delivery, use and effects of entitlements provided by the Project. The baseline data on each AP is being entered into a database and will be used as the benchmark against which progress will be measured based on clearly defined indicators. RDA has also appointed a consulting firm to monitor resettlement. APs will be actively involved in the monitoring process. Evaluation of resettlement implementation will be carried out through an international resettlement specialist. RDA will make required improvements to the resettlement program based on periodic reviews of monitoring and evaluation reports.

The Proposed income restoration program of the STDP has proposed employment and income generation activities to the APs. The program has delayed for several years and the RDA has recently published advertisements calling application for the above training program. The subsequent programs such as revolving fund are still not materialized. Delaying of the implementation of the RIP and the proposed income restoration program has created unrest among the PAPs.

7.5.3 Present Condition of RIP Preparation for OCH Project

The preparation of the RIP for the OCH project also has commenced in 2004. The steps followed by the team preparing of RIP are:

1. Socio-economic survey for the entire 28 km trace
2. Preparation of Basic RIP including the entitlement matrix

The socio-economic survey has completed for the Maharagama, Kaduwela, Biyagama and Wattala DS divisions except Mahara DS division. The socio-economic survey for the DS division will be completed by the end of this year.

The RIP of the OCH will be replicated that prepared for the STDP and the relevant information will be substituted for the OCH. The entitlement matrix of the OCH will includes most recently approved entitlement matrix for the affected community due to land acquisition approved by the cabinet of Ministers in 2004.

The RIP preparation team has organized several community consultative meetings and the participatory discussions with the government officers, NGOs to collect the information for the RIP. The PAPs were mostly concerned over the delay of compensation and the present system of valuation of the properties.

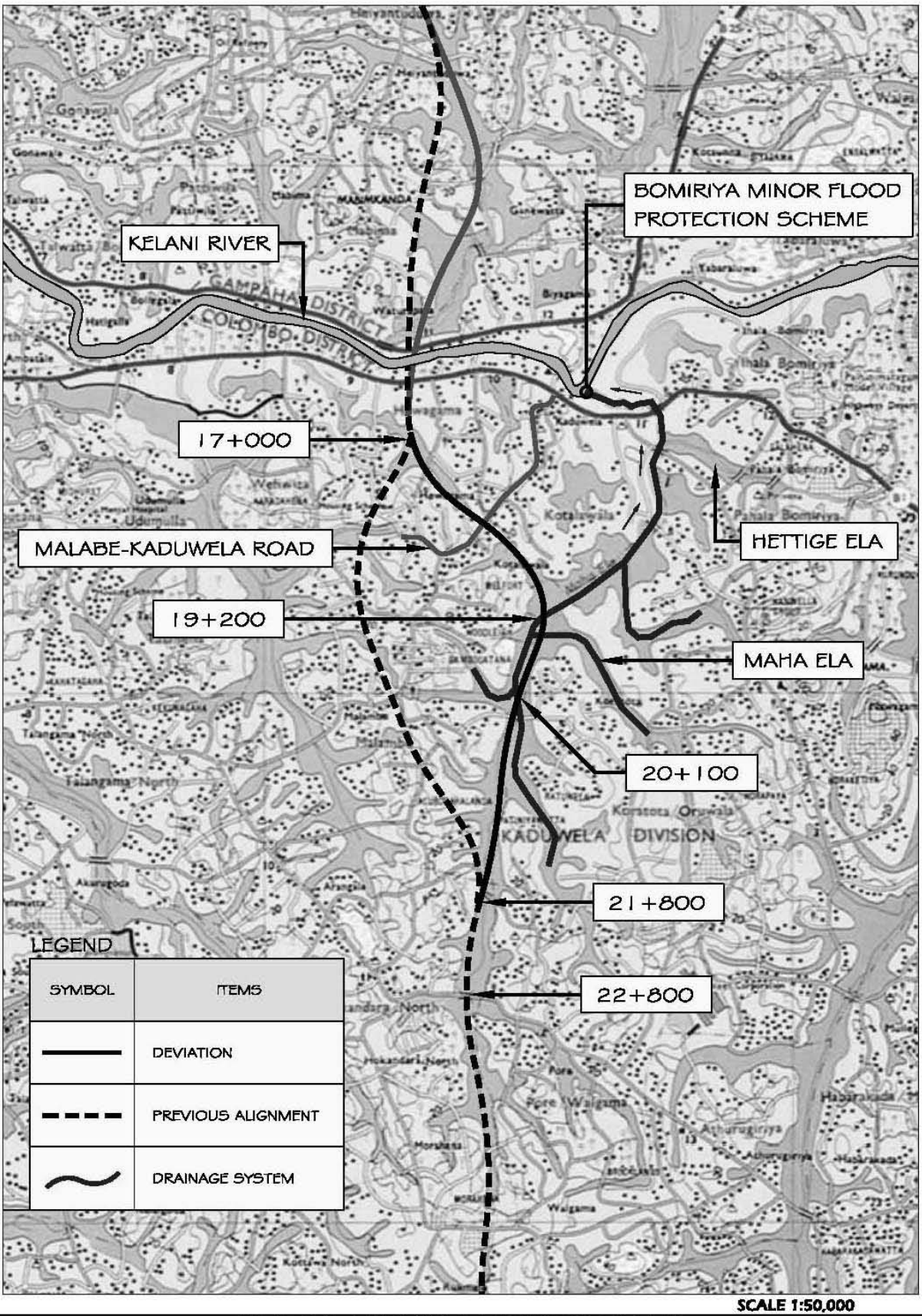

FIG 7.2.4 EXISTING DRAINAGE SYSTEM

ii Flood Peak Values, Inundation Levels, Inundation Periods for Different Rainfall Events

The flood peak values in the deviated trace area are mainly dependent on the Kelani river flood levels. The Kelani flood levels observed for 1947, 1967 and 1989 are given below:

1947[1]	11.2 m m.s.l.
1967	7.4 m m.s.l.
1989	7.9 m m.s.l.
	(m.s.l. : mean sea level)

The frequency analysis carried out using distribution function (extreme value distribution type – Gumble) for observed flood records at Glencourse upstream of Kelani river (maintained by Irrigation Department) indicates that 1967 floods is close to 20 year return period and 1989 close to 35 year return period.

Based on model studies and observed flood values, the flood level of Kelani river for a 50 year return period is estimated to be 8.3m m.s.l. in the deviated trace area and 8.2m m.s.l. below Kaduwela Bridge.

Modelling also indicate that, 50 year return period flood simultaneously occuring in both the Maha Ela and Kelani river will not significantly increase (about +10cm) the flood level in the deviated trace area due to domination of flood level by the Kelani river.

The Maha Ela sub catchment was modeled by hydrological model (HEC-HMS model) for flash storms and long duration storms. For flash floods, 3 hr storm duration was considered as the time of concentration in the sub catchment is about 3 hours. However for long durations flood storm, standard 24 hr storm duration was taken into account.

The hyetographs for 3 hour and 24 hour storms for different return periods were derived using Intensity Duration – Frequency curves (IDF Curves) at Colombo and design storm hyetographs used in the "Study on Storm Water Drainage Plan for Colombo Metropolitan Region 2003" by JICA Study are given in Appendix 7.1 and A.7.2.

The peak discharges along OCH deviated trace obtained from HEC – HMS modeling is given in Table 7.2.1

[1] The 1947 flood levels recorded from people hearing would not be very realistic and the topographic conditions and river cross sections are quite different from the present configuration and therefore not taken in the high water level analysis.

Table 7.2.1 Peak Discharges along OCH Deviated Trace

Return Period	Station	Flash Flood (3hr) m^3/s	Long Duration Flood(24 hr) m^3/s	Remarks
10 year	21+600 20+700 19+800	27.6 44.5 49.9	34.8 56.5 63.4	Stations given here are close to the start of deviation(21+800), up stream of road crossing the Maha Ela" at 20+100 and Maha Ela marsh area19+800
25 year	21+600 20+700 19+800	35.4 57.3 64.2	50.9 84.5 92.4	
50 year	21+600 20+700 19+800	41.3 66.9 74.7	69.1 112.2 123.0	

Source: JICA Study Team for OCH

According to above results, long duration (24hr) storms are the critical storms. Hydraulic Model (HEC-RAS) was used to evaluate the inundation depths for different return periods for existing conditions are given in Table 7.2.2 below.

Table 7.2.2 Inundation Levels for Existing Conditions

Return Period (Years)	Station	Flash Flood (3hr) m m.s.l.	Long Duration Flood (24 hr)m m.s.l.	Remarks
10 year	21+800 20+100 19+500	4.88 4.19 2.98		-21+800 start of deviation trace -20+100 Road crossing point in the deviation trace -19+500 about 300m upstream of Maha Ela turning point.
25 year	21+800 20+100 19+500	5.09 4.31 3.13		
50 year	21+800 20+100 19+500	5.29 4.41 3.26	8.31 8.30 8.30	

Source: JICA Study Team for OCH

- **Inundation Depths**

The inundation depths due to the Kelani flooding for 50, 25 and 10 year return periods in the deviated trace at station 21+800, 20+100 and 19+200 are given in Table 7.2.3.

Table 7.2.3 Inundation Depths for Different Return Period Floods

Return Period	Station	Existing Ground Level (m m.s.l.)	Inundation Depth (m)	Flood Level (m m.s.l.)
50 Year	21+800	5.00	3.30	8.3
	20+100	2.67	5.63	
	19+200	2.30	6.00	
25 Year	21+800	5.00	2.70	7.7
	20+100	2.67	5.03	
	19+200	2.30	5.40	
10 Years	21+800	5.00	1.30	6.3[2]
	20+100	2.67	3.63	
	19+200	2.30	4.00	

Source: JICA Study Team for OCH

- **Inundation Periods**

The inundation period for Kelani floods is generally about 3-5 days depending on the downstream conditions of the Kaduwela Bridge.

During local flooding in the Maha Ela area, the existing road in the deviated trace at station 21+750 goes under water for about three hours due to inadequate drainage provision across the road.

iii Retention Areas, Marsh Lands, Water Bodies

Due to low ground elevation along the deviated trace from station 22+500 to 18+500, and the stretch along Maha Ela from station 19+200 to up to (Kaduwela-Homagama Road Bridge), the area below +5.00 m m.s.l. contour acts as a retention basin for the storm water in the Maha Ela catchment, prior to discharge into Kelani River. This area thus acts as a flood detention basin of the area from station 25+000 to station 18+500 about 6.5 km stretch of the OCH in the Kelani river basin.

- **Marsh Lands and Water Bodies**

According to people in the area the low areas referred above were cultivated with paddy about 15-20 years before. However, due to stagnation of water and construction of access roads without adequate drainage provisions has created marsh conditions specially the area below station 21+800. According to the Irrigation Engineer, Colombo limited dredging has been carried out in this area on request made by farmers in the area. The inquiries made during recent inspection reveals that the limited paddy cultivation carried out near station 21+800 area in 2004 were not successful due to poor drainage conditions in the area below.

There are no water bodies except this marsh area along the deviated trace.

iv Existing Irrigation / Drainage / Flood Protection Schemes

There are no irrigation schemes or structures encountered along the deviated trace. The

[2] As per LHI Study for Kelani Conservation Barrage – 2003 September

paddy tracts along the deviated trace in the past have been cultivated under rain fed conditions. This area has been abandoned for the last 15-20 years. However, paddy cultivation is being done in the upper reaches. The Maha Ela is being considered as the main drainage canal for draining of excess water during paddy cultivation period.

The paddy tracts in the Maha Ela and the Hettige Ela are being protected by a minor flood protection scheme with two rows of eight flap-gated structure at the confluence point maintained by the Irrigation Department. According to the Irrigation Department, the total extent protected under this scheme is 3,000 acres with 2,400 acres under the Hettige Ela and 600 acres under the Maha Ela. This flood protection scheme is named as "Bomiriya – Koratota" minor flood protection scheme and has been designed to protect the area from Kelani floods up to a level of +5.64 m m.s.l. According to Regional Director of Irrigation, Colombo, proposals have been made to improve the drainage conditions in the lower areas and people in the area are keen to commence the agricultural activities. During the survey one irrigation canal coming above the Malambe – Athurugiriya Road near station 22+700 was observed.

v Drainage Capacity of the Existing Waterways and Flood ways Across Proposed Deviation

At present the Maha Ela acts as the waterway discharging floods in the Maha Ela catchment along the deviated trace. The existing sheet flow conditions will change with the proposed road and flood waters will be diverted through culverts to one side of the road as per the proposed road alignment and to maintain the existing drainage pattern.

The existing flood discharge of the Maha Ela due to short duration rain events (3hr) for different return periods along the deviated trace are given in Table 7.2.4 below:

Table 7.2.4 Flood Discharge of the Maha Ela

Station	Flood Discharge m^3/s		
	50 year	25 year	10 year
21+600	41.3	35.4	27.6
20+700	66.9	57.3	44.5
19+800	74.7	64.2	49.9

Source: JICA Study Team for OCH

As the Maha Ela turns north-easterly direction at station 19+200, this point will act as the flood way across the proposed deviation to discharge flood waters to Kelani river.

vi Present Flood Detention Capacity on Either Side of the Roadway

The entire extent of the OCH in the deviated trace from station 22+500 to station 18+300 the ground levels are less than +5m m.s.l. and act as the flood detention area of the Maha Ela catchment (12.6 km^2)

The total length of the Maha Ela catchment along the deviated trace is 7.2 km. Out of which about 3500m is in the deviated trace and the flood waters are detained in the lower areas of the Maha Ela. In the event of a 50 year return flood of Kelani river, the flood waters extend beyond the Malabe – Athurugiriya Road Bridge (Station 22+800).

The total retention area available in the OCH from station 16+300 to 25+000 (from Kelani to start of Maha Ela catchment) up to +5.00 m m.s.l. and +10 m m.s.l. is shown in Fig. 7.2.4 and the areas computed are given below:

Up to +5.00 m m.s.l.	410 hectares
Up to +10.00 m m.s.l.	813 hectares

The total area lost in the deviated trace due to OCH is 21 hectares out of total of about 410 hectares of lowlands (up to +5 m m.sl.) in the area. Thus existing retention area of about 5% is lost due to construction of the OCH along the proposed deviation.

vii Existing Flood Problems on Either Side of the Road

The floods in the deviated trace are dominated by flood levels of Kelani River. The deviated trace area is protected by a minor flood protection scheme at Bomiriya on the left bank of Kelani river. The minor flood protection level in the Maha Ela area is about +5 m m.s.l. The flood protection level as maintained by the Irrigation Department is +5. m m.s.l. When the Kelani river water level goes above this level, the entire low-lying area in the "Maha Ela" catchment including the deviation trace area goes under water. During such flooding, the existing culverts provided across roads crossing in Maha Ela are not effective and all low level roads including two roads crossing the deviated trace area goes under water restricting access to residents on both sides. During local flooding due to high rainfall in the Maha Ela catchment, these roads will go under water for about three hours due to inadequate drainage provisions provided.

viii Present Uses of Groundwater, Groundwater Quality and Groundwater Levels

The groundwater in the deviated trace area is used mainly by the residents living in the area for drinking purposes. The quality of water is found suitable for drinking and the groundwater levels are dependent on the water level in the Kelani river and that of the marsh around the Maha Ela. The groundwater levels fluctuate during the year with the rainfall.

ix Present Uses of Surface Waters including Water Supply Intakes

The surface waters in the area are mainly used for paddy cultivation. However, as the paddy cultivation is presently limited to the high-elevated areas (above +5m m.s.l.), the use of surface waters are marginal. The surface waters are used at present to maintain the ecological balance in the Maha Ela marsh area.

There are no water supply intakes in the deviated trace area. The water supply intake at Ambatale supplying water to the city of Colombo is located about 2.5 km downstream of the proposed road crossing location of Kelani River.

x Surface Water Quality of the Water Bodies along the Trace

The objective of the establishment of surface water quality parameters in the Maha Ela marsh area is to estimate the potential impacts on surface water quality due to construction of OCH in the deviated trace during construction stage and subsequent operational stage.

The water quality of the Kelani river at Kaduwela Bridge analyzed by CEA in June, July and August 2004 is given in Table 7.2.5. The sampling point is at immediately below the confluence point of "Maha Ela" with Kelani River. It is necessary to establish the water quality parameters in the marsh area to assess the direct impact of OCH in the deviated trace.

Table 7.2.5 Water Quality of the Kelani River at Kaduwela Bridge

Parameter	Unit	June 2004	July 2004	August 2004
pH		7.8	7.4	7.4
EC	mS/cm	0.04	0.09	0.04
Turbidity	NTU	27	24	31
Temperature	^{O}C	27.2	27.8	27.7
Dissolved Oxygen	mg/l	7.6	7.1	5.2
COD	mg/l	12	15	03
BOD_3	mg/l	03	01	20
Chloride	mg/1	3.7	4.0	4.0
Dissolved Chromium	mg/1	<1	<1	1
Dissolved Lead	mg/1	<1	<1	<1
NO_3 as N	mg/1	0.32	0.35	0.32
PO_4 as P	mg/1	0.93	<0.01	0.58
Total Coliform	MPN/100 ml	3500	9000	3000
Faecal Coliform	MPN/100 ml	P	P	P

Source: Central Environmental Authority

<Abbreviations>

EC	Electrical Conductivity
NO_3 as N	Nitrate as Nitrogen
PO_4 as P	Phosphate as Phosphorus
COD	Chemical Oxygen Demand
BOD_3	Bio Chemical Oxygen Demand

xi Soils and General Geology of the Area

■ Soil Type of the Area

Generally the deviated trace area could be divided into three types of landscape facets.

- **Gently undulating to undulating and rolling terrain**

Generally this area consists of soft and hard laterite soil which is the sub group of the red yellow podzolic (RYP) soils. This type of soils is available in the deviated trace near Malabe – Kaduwela road crossing from station –18+000 to –18+300.

- **Flat or nearly level plan**

Generally this area consists of low humic glay (LHG) soils, associated with alluvial soils. This type of soil is available in most parts of the deviated trace, mainly from station 21+800 to 18+300.

- **Flood plains**

These areas mainly consist of alluvial soils of variable textures. Alluvial soils mainly occur along the flood plains of Kelani river and its tributary Maha Ela within the deviated trace area from station 21+800 to 19+200.

The groundwater levels are high and almost close to ground level except near Malambe – Kaduwela road crossing area where groundwater level is about 6 meters below the ground level. In the marsh area, south of Malambe – Kaduwela road, the borehole data indicates that organic clay is available to a depth of about 0.5 m and thereafter consists of sand clay (alluvial soils) and the rock level is shallow and is about 3 to 5 meters below the ground level. It is observed that peat soils are not available in the Maha Ela marsh area. The groundwater level is low and is about 0.5 meters below the ground level indicating that the groundwater level is dependent on the water level of the marsh.

The type of soils available in the deviated trace of OCH area described below:

- **Yellow Podzolic Soils**

Soils of this group should have hard laterite formed in situ within the depth of 125 cm and soft laterite within the depth of 250 cm.

The soils of this sub group are well developed and the weathered zone is deeper. The deeper subsoil of this category contains soft laterite, which gets hardened massively or gravely. In locations, which were subjected to erosion activities, laterite gravels could be seen on the surface.

- **Low Humic Gley (LHG) Soils**

LHG soils could be located within valleys adjoining the highland area along the paddy areas of the deviated trace.

The surface soils of LHG are usually dark grey to dark greyish brown in colour. The textures are either sandy loam or sandy clay loam. The sub surface horizons have heavier textures than the surface horizon such as sandy clay, clay loam or clay and colours are greyish to yellowish. Water movement through these soils is very slow.

Generally, these soils remain in a saturated condition with water, for a greater part of the year.

- **Alluvial Soils**

The alluvial soils usually occur within the flood plains of the rivers and tributaries. With the overflowing process coarser material is deposited on levees and finer textured material in back swamps and basins. Within the same valley, texture may vary according to the physiographic positions. This type of soil is available along the major drainage stream “Maha Ela” in the deviated trace.

■ General Geology of the Study Area

The geology in the study area essentially consists of unconsolidated deposits of Quaternary age overlying metamorphic bedrock of Precambrian age.

The tabulation below shows the main types of deposits and rocks and their relative age:

Age	Lithology
Quaternary	Laterite Alluvium Littoral Sands Sand Stone
Palaeozoic	Banded gneiss
Precambrian	Charnockite

Metamorphic rocks [gneiss] form the most extensive rock type in the study area. They appear light in colour [shares of black and white] with noticeable banding and veins of granite and quartz.

Lastly, but not less importantly, is the secondary product called laterite and represents the "in-situ" weathering of the underlying metamorphic rocks. Due to the nature of these bedrocks and the variability of the alternation process as the laterite is extensive but non-uniform in both nature and thickness. The typical laterite material grades downward from a hard brown ironstone crust at the surface, via a hard cellular red zone containing noticeable cavities, to a soft, variegated clayey mass which overlies the crystalline parent material. The profile may attain thicknesses in excess of 25m, but has suffered considerable erosion.

Structural features of direct geological significance to the project is the availability of laterite while river alluvium and peat would necessitate special engineering considerations for the design of highways / roads.

xii Mineral Resources in the Deviated Trace Area

The inquiries made from the people in the deviated trace area revealed that no minerals of any significant value are encountered along the 4800 km length of the deviated trace area. However the clay available in the area is used for manufacture of bricks.

2) Ecological Resources

i Methodologies

■ Literature Survey

A literature survey was conducted initially to collect the available secondary data on flora and fauna of the area encompassing the deviation trace of the proposed OCH to the City of Colombo. The applicable report was the Environmental and Social Impact Assessment Study on the Outer Circular Highway to the City of Colombo prepared in February 2000 (JICA study team 2000). According to the report, the project area and its vicinity within 2 km range have been surveyed along the entire trace for identification of

ecological habitats and resources. However, this survey has been done about three years ago and many changes to some terrestrial habitats had taken place. Therefore, the secondary information available in these reports is limited in use. In this context, collection of primary data was a prerequisite in reporting the existing situation with regard to present ecology of the environment.

■ Field Surveys

The study area considered for the ecological survey was a 2 km wide corridor which includes an area of 1 km on either side of the deviation route extending from the interception point on Malambe–Athurugiriya road at Pore to Kelani river. The deviation route is 4.8 km in length and the total area studied was 9.6 km^2.

The methodology employed to assess the ecology of the study area was based on the reconnaissance surveys, field observations and the interviews held with people in the area. These were carried out in July-August 2004. The 1:50000 land-use map produced by the Survey Department and the 1:10000 map prepared by OCH project in 1999 using aerial photographs were also used for the survey. Field surveys were carried out to collect primary data on flora and fauna and their habitats to complement the existing data available in the former report prepared for the deviation route in 2001. Site-specific information was collected during these field surveys carried out in the study area.

The ecological habitats in the study area were identified during the field surveys following the map prepared by the OCH project using aerial photographs in 1999. The variations in the habitats recorded in 1999 were noted and the extents of different habitats were approximately determined using a planimeter.

Floral diversity in each ecosystem was identified during these surveys. The plant species in different habitats were listed for each ecosystem separately. The floral species were identified in the field as much as possible using available literature and experience.

Amphibians, reptiles, birds and mammals in the area were identified and recorded in the field surveys conducted in evenings and early mornings. The fish from the aquatic habitats of the study area were collected using a cast net of 1.5 cm stretched mesh. Macro-invertebrates, amphibians, reptiles, birds and mammals were identified by visual observations and rechecked and verified using Dutta and Mamamendra-Arachchi (1996), Kotagama and Fernando (1995), Pethiyagoda (1991) and Phillips (1980-1984). Community consultations were also helpful to gather information on the presence of mammals, reptiles and fish in the study area. The degree of threat of fauna and flora in these habitats were determined using Ekaratne *et al.* (2003).

ii Existing Ecosystems in the Study Area

Several types of ecosystems, both terrestrial and wetland, exist in the study area. These are as follows.

Terrestrial ecosystems

- Home gardens
- Rubber plantations
- Coconut plantations
- Vegetable plots

-
- Scrublands

Wetland ecosystems
- Paddy fields
- Marshy areas
- Aquatic habitats

Table 7.2.6 gives the relative extents of these ecosystem types within the study area.

Table 7.2.6 Relative Extents of Ecosystems Found within 2 km Belt along Proposed Deviation

Type of Ecosystem	2km Wide Corridor			Along the Highway route	
	Extent (ha)	Cover as a % of Terrestrial Ecosystem extent	Cover as a % of Total Extent	(km)	Cover as a % of Total Extent
Terrestrial Ecosystems	**738**				
Home gardens	697	94.4	72.6	0.5	10.4
Rubber Plantations	18	2.4	1.9	-	-
Coconut Plantations	16	2.2	1.7	-	-
Scrub lands	1	0.1	0.1		
Vegetable plot	6	0.8	0.6		
Wetland Ecosystem	222		23.1	4.3	89.6
Total	960		100.0	4.8	100.0

Source: SEIA Survey 2004

The study area does not include any protected area such as wildlife reserves, conservation forests, RAMSAR sites, man and biosphere reserves, world heritage sites, forest reserves or proposed forest reserves declared under Forest Ordinance or Fauna and Flora Protection Acts. The deviation route traverses through man made ecosystems such as home gardens and wetlands such as paddy fields and abandoned paddy fields.

At the northern end of the trace deviation close to Rajasinghe Mawatha, there is a housing scheme in close proximity. Then, the trace deviation traverses through the edge of Pannagure paddy field up to Gemunupura 3rd Lane, which is a residential area. The trace again runs through an abandoned paddy field near Isurupura. This abandoned paddy field known as "Mahawela", is a semi natural ecosystem as paddy has not been grown there for nearly two decades. The highway runs through the edge of Mahawela and crosses the Malambe -Kaduwela Road and Kahantota - Arangala Road after passing through a paddy field.

The proposed deviation lies in the floristic region 5 identified in the Strategy for the Preparation of Biodiversity Action Plan for Sri Lanka, Ministry of Transport, Environment and Women's Affairs. The natural climax vegetation of this region is tropical wet evergreen forest. Although this region has been identified as one of the

least represented floristic regions, the combination of climate, topography and geological history has resulted in a diversity of species rich associations.

Natural vegetation of the study area is adapted to high rainfall. Most of the plant species in the study area have pointed leaf tips with prominent mid ribs and secondary veins. Most of the trees have dark green foliage with brightly coloured flowers, fruits and young leaves. However, the natural habitats have been decimated from most of the study area due to settlement expansion geared by rapid urbanization. The natural vegetation has been cleared and replaced with mixed vegetations associated with home gardens. A few wild plant species have been observed in undisturbed habitats such as scrublands, large home gardens and roadsides in the area.

■ Terrestrial Ecosystems

A total of five terrestrial ecosystem types were recorded in the study area during field survey. These are home gardens, rubber plantations, coconut plantations, vegetable plantations and scrublands.

Along the highway route only home gardens and wetlands were recorded. About 10% of the route passes through home gardens and the rest passes through abandoned paddy fields. Of the study area, nearly 73% are home gardens, about 1.7% is a coconut plantation and about 1.9% is a rubber plantation. Vegetable plots and scrublands contribute to 0.1% and 0.6% of the study area respectively. No coconut plantations, rubber plantations, scrublands and vegetable plots are present along the deviation route.

- Home gardens

According to the land use map prepared in 1982, only 55% the study area consisted of home gardens. However, the field survey revealed that most of the rubber plantations had been converted into home gardens. Home gardens contribute to about 73% of the total extent of the study area, which is about 94% of the total extent of land of the terrestrial ecosystems in the study area. Along the highway route, all terrestrial habitats present are home gardens (Table 7.2.6).

In the study area, there are two types of home gardens, i.e., newly established home gardens and traditional home gardens. The average land extent of a newly established home garden varies between 10 to 15 perches, whereas the traditional home gardens are larger and their land extent varies within a range of 20 to 40 perches.

The home gardens are rich in floral diversity. These home gardens are not only ecologically important for *ex-situ* conservation, but also economically important to support subsistent cultivation. They are ecologically important as feeding, nesting and roosting areas of many species of birds, some species of small mammals and few species of reptiles. Home gardens provide timber, food, fuel and medicinal plants for domestic use and the excess of these products is often sold to neighborhood service centers. A total of about 150 species of plants were recorded in the home gardens during the present survey. They are listed in Appendix 7.3.

Most of the recently established home gardens have emerged due to subdivision of land, especially rubber plantations, by property developers. The small plot size only allows

growing few plant species, which are useful as fruits, medicines, vegetables or ornamental plants. These home gardens are often found at locations where accessibility and land value are high.

No threatened plant species were recorded in these home gardens. Of the plant species listed in Appendix 7.3, six species are endemic. None of these endemic plant species are rare or threatened. All plant species recorded in home gardens, including the endemics are widely distributed throughout the wet zone of the country.

- **Rubber Plantations**

The other major terrestrial ecosystem in the study area is rubber plantations. According to the land use map prepared in 1982, nearly 19% of the total extent of the study area was under rubber plantations. According to the aerial photographs taken in 1999, this has declined to about 10% of the total land extent. The field survey indicates that rubber plantations are now confined to about 1.5% the total study area (Table 7.2.6). All other areas of rubber plantations, which existed in 1999 are cleared, blocked out and auctioned for residential development. Therefore, these areas are now small home gardens.

The deviation route does not pass through any rubber plantation. Most of the rubber plantations in the study area belong to smallholders. The plots of smallholder plantations are smaller in extent. During the field visits, young rubber plantations were not observed and most of the existing plantations were old.

Rubber plantations in the undulating lands of the study area play a significant role in conserving soil. It also maintains a green cover. These mono-cultured plantations are not rich in floral diversity. However, it was noted that the ground is covered with grass and a few plant species grown in the wild could be noticed at the hedges and as undergrowth vegetation. The thick canopy formed by rubber trees and the grass cover performs important functions such as soil conservation.

These rubber plantations also provide habitats for large number of bird species. They use these trees for roosting and some use these for nesting too. Several species of reptiles, few species of amphibians and some small mammal species inhabit these rubber plantations.

- **Coconut Plantations**

Another major ecosystem in the study area is coconut plantations. According to 1982 land use map about 3.4% of the study area had been coconut plantations. However, according the survey carried out in July-August 2004, the coconut plantations cover only about 1.7% of the study area. These are mainly located in the Ratuwela estate.

These ecosystems are poor in biodiversity. The ground of these lands is covered with grass. Few species birds, reptiles and small mammals inhabit these habitats.

- **Scrublands**

A scrubland of about 1 ha in extent is found in Pathiniyawatte area. In addition, scrubs are found along hedges of home gardens, rubber plantations and coconut plantations. It is important to note that the plant species found in these scrub areas are the plants available in the secondary forests of the wet zone. Although these scrublands are found within the 2 km corridor of the proposed deviation of the OCH, these habitats do not fall on the ROW of the highway (Table 7.2.6).

These scrublands are rich in biodiversity. A total of 110 species of plants were recorded in these habitats during the present survey. These are listed in Appendix 7.3.

A total of 10 endemic plant species were recorded in these habitats. None of these species are rare, threatened or endangered. These plant species are found in other parts of the wet zone of the country and some are found in the dry zone too.

The scrublands are rich in animal diversity too. Many species of birds, several species of reptiles, especially the serpentoid reptiles, several species of amphibians and few species of mammals were recorded in these habitats. Of the reptile species recorded in these habitats, five species are endemic and four species are threatened (Appendix 7.4). None of the mammal species recorded in these habitats are endemic but for species are threatened. One species is listed in the Vulnerable category of the 2003 IUCN Global red list of threatened species (IUCN 2004) (Appendix 7.4). Of the amphibians recorded in these scrublands, three species are endemic. Of these endemics, two species are listed as threatened animals (IUCN 2000). These two species are and also protected under FFPA (Ekaratne *et al*. 2003).

- **Vegetable plots**

In some low lying lands adjoining the marshy areas, paddy fields and abandoned paddy fields of the study area, vegetable cultivation is carried out by some people. The total extent of vegetable plots was around 6 ha which is about 0.6 % of the total extent of lands in the study area (Table 7.2.6). The plant species grown in these vegetable plots are *Cucumis sativus* (Cucumber), *Melanagromyza hibisci* (Okra), *Momordica charantia* (Karawila), *Solanum melongina* (Brinjal), *Trichosanthes anguina* (Pathola) and *Vigna cylindrical* (Maa karal).

■ Wetland Ecosystems

The wetland are defined as the areas of marsh, fen, peat land or water, whether natural or artificial, temporary or permanent, with water that is static, flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed 6 meters (RAMSAR Convention 1987). Accordingly, paddy fields, abandoned paddy fields, marsh areas and the small stream which flows into the Kelani river in the study area fall into the category of wetlands.

In the study area, the wetlands have become ecologically important ecosystems as surrounding highlands have been converted to built-up areas. They absorb and retain pollutants, sediments and nutrients in the surface runoff. Therefore, these ecosystems in the study area play a significant ecological role. They are also important because they

retain storm water and act as storage areas for sudden influxes of surface runoff during the rainy season. These wetlands also serve as buffer areas to detain overflows of the Kelani River as well.

Wetlands in the study area occupy about 23% of the total land area. That is nearly 222 ha. However, the ROW of the deviation of the OCH passes only through 4.3 km of these wetlands. If a stretch of about 50 m is to be reclaimed for the construction of the ROW, only about 21.5 ha have to be reclamated.

- **Paddy Fields**

Some paddy fields are environmentally sensitive as they assist in the detention of floodwater in the area. These paddy fields are located along the streams and canals. They are also economically important as they provide some income to farmers. The ecological function that such lands play is important to keep the environmental balance in a flood plain with high intensity of rainfall.

Paddy fields along the deviated trace are found at close proximity to the Rajasinghe Mawatha and Kahantota-Arangala Road. They are linked with one another as a network. These paddy fields are cultivated mainly during the Yala season under rain fed conditions. As such, the rainfall often becomes a determinant factor for the production of paddy. Increase or decrease of rainfall affects negatively resulting in a decrease in the paddy yield. Hybrid varieties of paddy are cultivated in these fields. Application of agrochemicals for the cultivation of paddy affects the fauna and flora in these habitats.

The paddy lands also serve as feeding and resting grounds for many species of birds. Small canals, which run through the rice fields, provide habitats for several species of fresh water fish including two endemic species too (Appendix 7.4). However, the most of the paddy fields in the study area are abandoned due to various reasons, the main reason being high cost involved and the less income generated compared to the cost involved. Some of the areas are abandoned due to poor drainage.

The main abandoned paddy field, which is known as “Mahawela”, spreads through a large area. Since Mahawela is situated in the flood plain of the Kelani River, it detains overflow of the river during heavy rains. It was revealed at the interviews with the local residents that this low-lying area has been abandoned for the last 20 years due to poor drainage. High water levels during the rainy seasons and prolonged inundation periods do not allow paddy cultivation in this low-lying area.

In some locations, people intentionally abandon the paddy fields. The small paddy fields closer to the main roads are frequently reclaimed for the expansion of residential and commercial activities. The forcing factor for such reclamation is high demand for land that is indicated through high land value. Some of the abandoned paddy fields serve as grazing grounds for cattle.

Many species of plants are found along the edges of paddy fields and also in abandoned paddy fields. These plants, which grow on the edges of paddy fields and abandoned paddy fields provide feeding and roosting grounds for many bird species. Grasses and weeds are found on the edges of these paddy fields both cultivated and abandoned. These weeds and grasses, which have a short lifecycle, colonize paddy fields during

shorter fallow periods. There are no threatened, rare or endangered plant species recorded in these abandoned paddy fields. The recorded species are also available in large numbers in the adjoining areas and in the wetlands of both wet and dry zones of the country.

These paddy fields both cultivated and abandoned, also harbour few species of amphibians, reptiles and small mammals. None of the mammal and amphibian species recorded in these habitats are endemic or considered as threatened animals. Of the reptile species recorded in these habitats, four speciesare endemic and four species are listed in the 1999 IUCN list as threatened animals (IUCN 2000) (Appendix 7.4). Five species of reptiles recorded in the paddy field habitats namely *Xenochrophis asperrimus* (Diya naya)*, Varanus salvator* (Water monitor)*, Varanus cepidianus* (Land monitor)*, Lissemys punctata*(Soft shelled terrapin) and *Melanochelys trijuga (Rock terrapin)* are protected by FFPA (Ekaratne *et al.* 2003)

- **Marshy Areas**

The marshy lands in the study area are rich in faunal and floral diversity. True marsh species such as *Phragemitis karka* (Nala bata), *Cyperus corymbosus* (Gal eha) and *Lepironia articulata* (Elu pan) are occasionally found in these marshy areas. In these marshy areas where water is stagnated, species such as *Cryptocoryne* (Ketala) and *Aponogeton crispus* (Kekatiya) and invasive aquatic weeds such as *Pistia stratiotes* (Water lettuce*), Eichhornia crassipes* (Water hyacinth) and *Salvinia molesta* (Japan pasi), are found. Grasses and sedges form a dense cover in the shallow areas of these marshy lands.

In the marshy lands, water stagnant areas as well as areas with slow flowing water are also found.

Plant species such as *Nelumbo nucifera* (Nelum), Nymphaea lotus (Olu), *Aponogeton natan* (Kekatiya) and *Salvinia molesta* (Salvinia) are found in lentic habitats. *Vallisneria spiralis* was recorded from lotic habitats. On the edges of the marshes, several species of plants were recorded. These are also listed in Appendix 7.3. None of the plant species recorded from the marshes and edges of marshes are endemic or considered to be threatened.

- **Aquatic habitats**

The main natural aquatic habitat in the study area is the Maha Ela, which is a stream that flows through the marshy lands northward and joins the Kelani River slightly east of Kaduwela junction. It drains water that run off from the neighbouring terrestrial habitats as well as from paddy fields. The aquatic plants recorded from these habitats are listed in Appendix 7.3).

In some places, the water remained as non-flowing stagnant water bodies. None of the plant species recorded from aquatic environments in the study area are endemic or threatened.

Many species of fish inhabit these aquatic ecosystems. They include two endemic species, which are also listed as nationally threatened species (IUCN 2000) (Appendix

7.4). Some bird species also frequent these aquatic habitats. None of the bird species recorded in these habitats are endemic or threatened.

Three species of reptiles that inhabit these habitats, namely *Varanus salvator* (water monitor), *Xenochrophis asperrimus* (Diya naya) and *Xenochrophis piscator* (Checkered keelback) are endemic. Four species of reptiles that are listed as threatened species inhabit these habitats (IUCN 2000) (Appendix 7.4). These species are also protected under FFPA (Ekaratne *et al*. 2003).

Several species of toads are also associated with these aquatic habitats (Appendix 7.4). All amphibians, which are listed in Appendix 7.4 have to come to water for breeding as their larval stage is aquatic. These include three endemic species, which are threatened in the national context (IUCN 2000) (Appendix 7.4). These three species are also protected by FFPA (Ekaratne *et al*. 2003).

One mammal species, which inhabit these aquatic habitats, namely *Lutra lutra* (Eurasian otter), is threatened in the national context (IUCN 2000) and listed in the 2003 IUCN global red list in the Vulnerable category (IUCN 2004).

iii Flora

High diversity of flora was observed in the study area during the present study. The highest diversity was noted in home gardens followed by scrublands. A total of 150 species of plants were recorded in the home gardens and 110 species were recorded in the scrublands (Appendix 7.3). In the abandoned paddy fields 43 plant species were recorded and in the edges of wetlands, 22 plant species were noted. The number of plant species recorded in the marshes and aquatic habitats were 29.

No threatened plant species as well as protected species under FFPA (Ekaratne *et al*. 2003) were recorded in the study area. However, a total of 10 species of endemic plant species were recorded in the home gardens, scrublands and edges of wetlands (Appendix 7.3). These endemic plants are also abundant in other parts of the wet zone while some are found in the dry zone too.

No endemic plants were recorded along the ROW of the OCH.

Some plant species recorded in the study area are economically important. The two main species important economically are *Havea brisiliensis* (Rubber) and *Cocos nucifera* (Coconut). These plants are grown as plantations in the study area. In addition, coconut is also grown in home gardens.

About 40 species of plants in home gardens bear fruits that are edible. Some plants grown in the home gardens are used as vegetables and many species are used in indigenous medicine. Some species including *Artocarpus altilis* (Breadfruit) and *Artocarpus heterophyllus* (Jak) are important as timber species.

iv Fauna

High diversity of fauna was also noted in the study area. The diverse ecosystems in the

study area provide habitats for many faunal species.

A list of the animals found in these habitats is given in the Appendix 7.4. It is clear that the animals recorded in the study area are also found elsewhere in the wet zone and many are found even in the dry and intermediate zones of the country.

- **Mammals**

A total of 25 species of mammals are found in the corridor of the deviated trace. Their scientific names and common names are given in Appendix 7.4. Of these, four species are threatened in the national context (IUCN 1999) (Appendix 7.4). Two species, namely *Loris tardigradus* (Slender loris) and *Lutra lutra* (Eurasian otter), are also listed in the vulnerable category of 2003 global red list (IUCN 2004) Appendix 7.4 and are protected under Conservation on the International Trade in Endangered Species of wild fauna and flora (CITES) (Ekaratne *et al*., 2003). These two species are found in different parts of the wet zone and other climatic zones of the country.

A total of five species of bats were also recorded in the study area during the survey carried out in July–August 2004 (Appendix 7.4). Bats are one of the nocturnal mammal species that play a significant ecological role to maintain the balance of the biological environment. Most of the abundant bats are insectivores and they control nocturnal insect population. They also act as pollinators. In addition, they play the role of dispersants of seeds as the frugivorous bats carry fruits. One species of bats recorded in the study *area,* namely *Pteropus giganteus (*Flying fox*)* is protected under FFPA (Ekaratne et al. 2003).

None of the species of mammals recorded in the study area are endemic.

- **Reptiles**

A total of 18 species of snakes, two species of terrapins and eight species of lizards were recorded in the study area during the present survey carried out in July-Auguat 2004 (Appendix 7.4). Five species of reptiles recorded in the study area are endemic. Four species of reptiles including two endemic species are included in the 1999 national list of threatened fauna (IUCN, 2000) (Appendix 7.4).

Five species, namely *Xenochrophis asperrimus* (Diya naya), *Lissemys punctata* (Soft shelled terrapin, *Melanochelys trijuga* (Rock terrapin), *Varanus salvator* (Water monitor) and *Varanus cepidimus* (Land monitor) are protected under FFPA. One species, namely *Naja naja* (Cobra) is protected by CITES (Ekaratne *et al.* 2003).

The reptiles present in the study area, including endemic, threatened and protected species are found in other regions of the lowland wet zone and dry zone of Sri Lanka.

- **Amphibians**

A total of 12 species of amphibians were recorded in the study area (Appendix 7.4). Amphibians are present mainly in wetland habitats such as paddy fields and marshes. But some species are also found in terrestrial habitats such as home gardens. Three species of amphibians recorded in the study area are endemic to Sri Lanka While two species are listed as threatened species in the national context (IUCN 2000) (Appendix

7.4). These two threatened species are protected under FFPA too (Ekaratne *et al.* 2003). However they are not confined to the study area and are found also in other areas of the wet zone.

- **Avifauna**

The study area is rich in avifauna**.** A total of 58 species of birds was recorded from the study area during the present survey. These are also listed in Appendix 7.4. Of these, 17 species are water birds. None of them are endemic. None of these birds are forest dwellers, but they live in close association with human habitats and activities. Water birds could be observed in the marshy areas associated with Mahawela and abandoned paddy field. These marshy areas provide breeding and foraging habitats for coots, egrets and storks. A considerable number of egrets, white-breasted water hens, purple coots and cormorants were found in these habitats.

None of the bird species recorded in the study area are listed as threatened species. All the bird species recorded in these habitats are abundantly found elsewhere in the wetlands of the lowland areas of Sri Lanka.

- **Invertebrates**

All species of invertebrates that are present in both aquatic and terrestrial habitats in large numbers could not be identified during the present survey. The most diverse and dominant group of invertebrates present in the study area is insects, which occupy almost all the habitats. In the aquatic habitats of the study area, rotifers, crustaceans, insects and molluscs are the most abundant invertebrate groups. The species of invertebrates recorded in the study area during the limited period of the present survey are listed in Appendix 7.4. None of these species are endemic and considered to be threatened.

- **Fish**

A total of 22 species of freshwater fish were recorded in the streams and irrigation canals in the study area during the present survey. Of the species recorded, *Clarias brachysoma* (Walking Catfish) and *Aplocheilus dayi (*Day's killifish) are endemic. These two species are also listed in the 1999 IUCN list as threatened species (IUCN 1999). The information provided by the fishermen in the area indicated that about 25 people catch fish in the Mahawela area after floods. However, their income from fishing is irregular, as it is seasonal. They engage in fishing as a part time economic activity.

3) Socio-economic Aspects

i General

The objective of the social impact study is to identify the likelihood impacts due to construction of proposed stretch of the outer circular road on the communities and the other properties of the socio-economic environment in the project area. The project area includes 200m corridor of the proposed road and about 100m belt from both sides of the 200m corridor. The area falls under these 100m wide two belts is defined as immediate vicinity of the road corridor. In this report this area is considered as project

influential area while 200m road corridor is considered as project impact area. The project influential area or the immediate vicinity of the road corridor is referred as out side corridor though out in this report.

- **Methodology of the study**

Six sample locations on the proposed road deviation were studied to evaluate the likelihood impacts. The main criterion used for selecting 6 locations was degree of environmental sensitiveness (from the social point of view) in each location. These locations have access and therefore, communities have established houses and other social infrastructure facilities needed to manage their livelihood activities. Evaluation of 6 sample locations provides opportunity to conduct comprehensive assessment. The properties available in 200 meter corridor and in the immediate vicinity of the corridor (out side corridor) were looked in to in each study point:

- Houses
- Land
- Businesses and industries
- Other service delivery and significant centers (schools, religious places, historically significant locations, health centers, roads, and so on)

In each location sample households were selected for the study. The 6 sample locations are found in six Grama Niladhari divisions (GN divisions) in which the proposed road deviation falls. (refer to Fig.7.2.5)

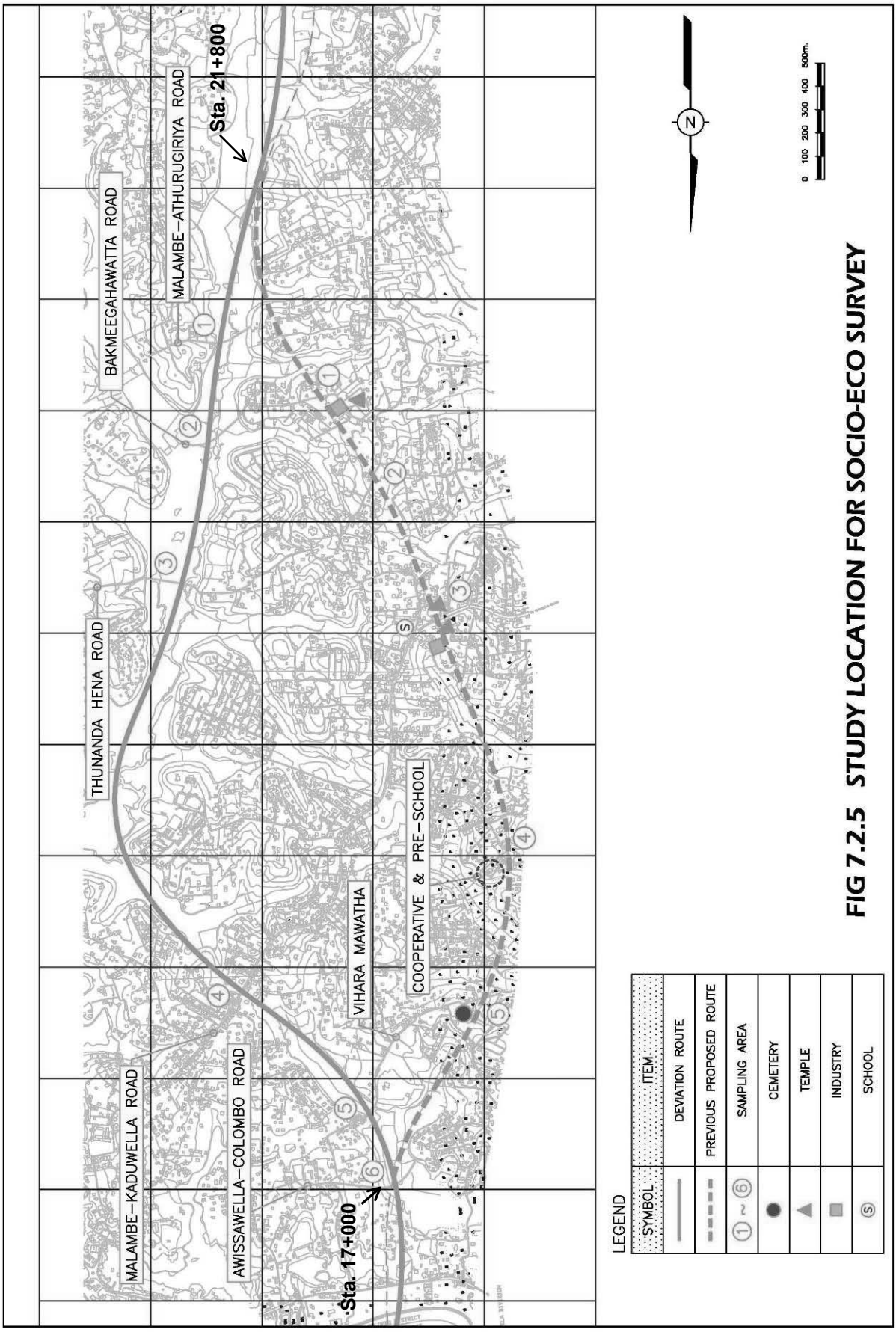

FIG 7.2.5 STUDY LOCATION FOR SOCIO-ECO SURVEY

The GN divisions, the locations selected for the study and sample households are shown in Table 7.2.7.

Table 7.2.7 GN Divisions, Study Locations and Sample Households

No.	Location	GN division	Households in corridor	Houses out side corridor	Total sample households
1	Pore wela on Malambe -Athurugiriya road	Hokandara-East	None	10	10
2	Bakmeegahawatta road	Hokandara-North	1	9	10
3	Mahawela on Thun anda hena road	Malabe-east	None	8	8
4	Mahila samithiya on Kaduwella –Malambe road	Kotalawela	5	7	12
5	Vihara Mawatha	Hewagama	3	5	8
6	1st lane on Ramahera road- near Awissawella –Colombo road	Raggahawatta	13	4	17
	Total		22	43	65

Source: Social impact study team (SIA Team)
Note: In locations 1 and 3 there are no houses found within 200 m corridor.

In each point 58% of houses within corridor and 47% of houses out side corridor was selected for the study (significantly larger percentage). Table 1 in Appendix 7.5 shows this information. The other properties such as industries and other significant centers were also studied. The availability of such centers in and out side of the road corridor is shown in Table 2 in Appendix 7.5.

During the field study many community members informally made comments on the proposed road but the sociologist formally interviewed 6 Grama Niladharies (GNs) of sample locations and 7 community leaders.

- **Justification of the proposed deviation**

Five representative locations (most are parallel locations on both road traces old and new) from each road trace were studied to evaluate the nature of properties that will be affected if the road is constructed. The sociologist found that more socio-economic properties such as houses and economic activities would be affected if the old road trace were chosen for implementation. But in terms of other infrastructure such as roads, electricity and telecommunication distribution lines there are no significant differences between two traces as shown in Table 7.2.8.

Table 7.2.8 Infrastructure Facilities in Two Traces

Location and the GN divisions		Roads and electricity lines run across the road trace	
Old trace	New trace	Old trace	New trace
1.Malambe-North- Hokandara road	Hokandara-North-Malambe -Athurugiriya road (Pore wela)	Koshena road electricity line	Malambe-Athurugiriya road-Electricity and telecommunication lines
2.Malabe-North -I. Jothipala Mawatha	Hokandara- North-Bakmeegahawatta road	Kahantota road, I Jothipala Mawatha, Electricity and telecommunication lines	Bakmeegahawatta road
3.Malambe-west- Pittugala Junction (near Amawathura Asapuwa)	Malambe –East-Thun anda hena road (Mahawela)	Kaduwela- Malabe road- Electricity and telecommunication lines	Thun anda hena road-Electricity line
4.Weliwita Suhada Mawatha (Weliwita road)	Kotalawela-Kaduwella-Malabe road (Near Mahila samithiya)	Weliwita road-Electricity and telecommunication lines	Kaduwela-Malabe road- Electricity and telecommunication lines
5.Hewagama Vihara Mawatha	Hewagama Vihara Mawatha	Etambagaskanda Vihara Mawatha – Electricity and telecommunication lines	Vihara Mawatha-Electricity and telecommunication lines

Source: Observations of SIA team and Grama Niladharies of each location

In terms of roads affected there are no significant differences between two traces. In location 2 one road is affected in new trace but not other infrastructure; in location 3 also no telecommunication lines get affected in new trace. In general there are no significant differences between two traces.

The Information on houses, industries, other significant locations and land affected in two traces clearly shows that the negative impact in old trace is more significant than the new trace. This information is shown in Table 7.2.9.

Table 7.2.9 Houses, Economic Activities, Other Significant Centers and Lands Directly and Indirectly Affected in Two Traces

Location	Houses Number		Industries		Religious and other places		Agriculture land- Acers		Service delivery centers	
	Old	New	Old	New	Old	New	Old	New	Old	New
1	30	None	Nilwala Factory-150 employees	No	No	No		10	No	No
2	28	1	No	No	No	No			No	No
3	35	None	Paint factory-350 employees	No	Amawathura Asapuwa-Sudarsanaramaya	No			Retail shops-5, Medical ceres-2 and SANASA-1	No
4	30	10	No	No	No	No			Coop-1, Pre-school-1	Mahila samithiya-1
5	24		No	No	No	No			Retail shops-1, Cemetry-1	No

Source: Observations of SIA team and Grama Niladharies of each location

The lands affected in old trace are highlands where as in new trace most of the lands are abandoned paddy lands. Some paddy lands have not been cultivated for about 20 years in new trace.

ii Existing Socio-economic Environment

Although the project area is close to Colombo town in general it can be categorized as rural area. Significant numbers of people from original residents of these areas are farmers. (Not the new migrants from other places of the country who have migrated to Colombo for employments and have constructed houses in these areas). The composition of employed persons in 6 GN divisions in which road corridor falls is shown in Table 3 in Appendix 7.5.

■ Existing Settlements and Other Land Use:

The proposed deviations of the road runs across less populated villages where negligible number of coconut lands and mostly abandoned paddy lands are found. The names of the villages and the nature of land use in the proposed road corridor area are shown in Table 7.2.10.

Table 7.2.10 Villages and Land Use

Location	Villages	Land use in the road trace area (acres)			
		Coconut	Rubber	Paddy	Other
1	Bogahawatta- Malasingha goda road and area close to Athurugiriya-Malabe road	No	No	10	No
2	Bakmeegahawatta road- Kahantota	No	No	7	No
3	Thun anda hena road	No	No	No	No
4	Kotalawela	1	No	3	No
5	Vihara Mawatha	No	No	3	No
6	Ramahera road	1.5	No	2.5	No
Total		2.5	No	25.5	No

Source: Observations of SIA team and Grama Niladharies of each location
Note: The sizes of the paddy lands through which road trace runs are shown in the Table 7.2.10.

The entire extent of these paddy lands will not be affected due to interventions under the proposed road. The land use of the households interviewed (both of within the road trace and the vicinity of the trace) indicates that negligible percentage of householders has paddy lands. All have home gardens where houses are constructed but only few have other highlands (other highland means land suitable for construction of houses that each family owns other than their home gardens).

In 55% home gardens some perennial crops are found. Only 12% of the sample householders have highlands other than home gardens. Even these land lots are small in size (less than 25 perches). Only 5% of the other high lands are grown with some trees even it is not so significant. Only 4 householders of the sample have paddy lands. Two lands are less than 25 perches in size and out of other two one is about 80 perches and the other is about little more than 100 perches. Occasionally some of these paddy plots are cultivated. But most are abandoned. The sizes of the home gardens are shown in Table 4 in Appendix 7.5

■ Demographic Characteristics

The proposed road deviation runs through 6 GN divisions. The population in each GN divisions through which the road trace runs is shown in Table 7.2.11.

Table 7.2.11 Population of GN Divisions

Location	GN division	Male	Female	Total
1	Hokandara-East	1,817	1,925	3,742
2	Hokandara-North	1,756	1,796	3,552
3	Malabe-east	2,342	2,683	5,025
4	Kotalawela	2,241	2,264	4,505
5	Hewagama	1,735	1,795	3,530
6	Raggahawatta	1,771	1,877	3,648
Total		11,662	12,340	24,002

Source: Office of Grama Niladhari (GN) in each location

Significant feature of population is female population is little more than the male. This is a new trend in the country and it reflects in this area too.

The population among the 65 households surveyed is 281 in total. It means the average family size is about 4. The population among sample households in terms of age categories is shown in Table 5 in Appendix 7.5.

■ Educational Levels

The project affected and influential areas have better access to good schools in Colombo and sub-urban areas. A significant percentage among young population is holding higher education qualifications (though it is small in the table since it is calculated against the total population in each GN division). The information about the educational levels and the percentage of persons educated under each level are shown in Table 6 in Appendix 7.5. The information on educational levels of population in sample households also indicates the significant of education in the area. Table 7.2.12 includes the information on education among sample households.

Table 7.2.12 Educational Levels among Sample Households

Education levels-grades -studied up to	In corridor		Out side corridor	
	Number	%	Number	%
0-5	22	24	28	18
5-10	36	40	42	28
O/L	21	24	50	33
A/L	7	8	32	20
University	4	4	1	1
Total	90	100	153	100

Source: Household survey (HHS) of SIA team

■ Economic Activities and Income of People:

The percentage of families entitled for Samurdhi benefits (Samurdhi is a national program launched by the government to provide support- including welfare and development for poor families in the country) is low compared to other areas of the country. Most of the families residing now are migrates from other areas for employments in Colombo. This means many families have regular income sources. The number of families entitle for Samurdhi benefits are shown in Table 7 in Appendix 7.5. Most of the families draw more than Rs 5000 of income per month. This is due to regular income sources of these families. Table 7.2.13 includes the information on income levels of families in GN divisions.

Table 7.2.13 Income Levels of Families in GN Divisions (families and %)

GN division/income levels-Rs per month	Less than 5000		5000-10,000		10,000-15,000		15,000-20,000		More than 20,000	
	NO	%	NO	%	NO	%	NO	%	NO	%
Hokandara-East	102	10	428	44	218	22	112	11	125	13
Hokandara-North	58	6	358	41	275	31	160	18	42	4
Malabe-east	490	52	132	14	122	13	110	11	91	10
Kotalawela	304	31	310	33	110	11	125	13	115	12
Hewagama	92	11	352	42	248	30	115	14	28	3
Raggahawatta	55	6	349	42	288	34	128	15	28	3

Source: Offices of GN divisions

The employable people in sample families are involved in various income generation activities. Large number of persons is reported from private sector employments. The information of employees in sample families is shown in Table 7.2.14.

Table 7.2.14 Employment of the Persons in Sample Households

Employment	In corridor		Out side corridor (Vicinity)	
	Number	%	Number	%
Government	6	24	11	22
Private	10	40	28	55
Farming	3	12	1	2
Daily labor	2	8	7	13
Self employment	4	16	4	8
Total	25	100	51	100

Source: HHS of SIA team

The income levels of sample families reflect that most of them have regular income generation activities. Most of them draw more than Rs 10,000 per month. The information on monthly incomes is shown in Table 7.2.15.

Table 7.2.15 Monthly Income of the Sample Families

Income levels(Rs/per month)	In corroder		Out of corridor	
	Number	%	Number	%
Less than 5000	1	6	2	5
5000-10,000	10	45	18	42
10,000-15,000	5	23	9	20
15,000-20,000	3	13	6	14
More than 20,000	3	13	8	19
Total	22	100	43	100

Source: HHS of SIA team

■ Income from Home Gardens

Some householders can earn small income from the home gardens. Out of 65 households 62% (40 home gardens) do not have income from home gardens. About 32% (21 home gardens) receive less than Rs 2500 per year. Another 2 householders

(3%) receive about Rs. 2500-5000 per year. The rest, 3% (2 home gardens) receive Rs 10,000 per year from the home gardens.

■ Income from Business Centers:

Seven householders out of 65 interviewed have business activities. The income from such activities and the location of business centers are shown in Table 7.2.16.

Table 7.2.16 Business Centers

Location	In corridor		Out of Corridor		
	Nature of business	Income per month-Rs	Nature of business	Income per month-Rs	Distance from Corridor (km)
1	No	-	Retail shop	35,000	15
2	No	-	Electrical work shop	12,000	0.25
3	No	-	Dress making	10,000	0.25
4	2 centers one on Retail business and other on Coconut timber processing centers	60,000-10,000	Retail shop	25,000	15
5	No	-	No	-	-
6	Blacksmith's work shop	30,000	No	-	-
Total	3		4	-	-

Source: SIA team and GNs (Grama Niladharies) – The Grama Niladhareis are the officers in charge of lowest administrative division in the country called Grama Niladhari Division.

■ Houses in the Affected Area:

Most of the houses affected are either permanent or semi-permanent. The nature of houses and their sizes are shown in Table 7.2.17.

Table 7.2.17 Nature of Houses to be affected

Nature	Number	%
Permanent	17	77
Semi-permanent	5	23
Temporary	None	-
Total	22	100

Source: HHS of SIA Team

The values of houses varied from less than Rs. 5 million to more than Rs. 20 million, with 63% of houses being less than 5 million, according to the calculation of householders themselves. The affected householders valued their houses and such information is included in the Table 7.2.18.

Table 7.2.18 Values of Houses to be affected

Values of house (Rs)	Number of houses	%
Less than 5.0millions	14	63
5-10 millions	2	9
10-15 millions	4	18
15-20 millions	1	4
More than 20 millions	1	4
Total	22	100

Source: HHS of SIA team

■ Land and Property Ownership:

All the sample householders interviewed within the corridor have their home gardens. Out of 22 interviewed inside the corridor 20 householders live in their own houses and only 2 live rented in houses. Except one house built in encroached land all the other houses are built in lands with free hold titles. (The government of Sri Lanka has granted different legal statues for different land. The free hold is the permanent deed that has provisions to sell mortgage to an institution like banks or to any individual. The second category is Land development permits, called LDO permits, that are given for people to do cultivation only and such lands cannot be sold or mortgaged. The last category is encroached land that is government lands encroached by people)

The values of different categories of lands in different locations studied according to the on going local land markets are shown in Table 7.2.19.

Table 7.2.19 Values of Lands (Rs/ per perch)

Location	Home gardens	Other highlands	Paddy lands
1	35,000-80,000	30,000-50,000	1,500-3,000
2	35,000-45,000	35,000-40,000	1,000-2,500
3	50,000-60,000	30,000-60,000	1,000-2,500
4	50,000-100000	30,000-70,000	1,500-3,500
5	50,000-75,000	40,000-60,000	1,500-3,500
6	40,000-90,000	35,000-50,000	2,000-3,500

Source: SIA team/GNs (Grama Niadharies) and community leaders in the project area

■ Communication Facilities:

The project area as whole has access to telecommunication facilities although majority of the houses located in the corridor do not have telephone facilities connected to houses. The percentages of houses have house connected telephone facilities depict this situation. Except locations 2 and 3 all other locations telephone lines run across the corridor. The Table 7.2.20 includes the information on number of houses have telephone facilities in each location studied and the telephone lines run across the road corridor.

Table 7.2.20 Number of Houses with Telephone Facilities

Location	Houses have telephone connections and the %			Telecommunication lines run across
	Number	%	Total sample	
1	2	20	10	Malambe –Athurugiriya road line
2	2	20	10	No
3	4	50	8	No
4	1	8	12	Malambe- Kaduwela road line
5	1	12	8	Vihara Mawatha line
6	1	6	17	Kaduwela-Colombo road line

Source: The observations of SIA team.

There is no post office buildings located in side the corridor. The communities have access to post offices located out side the corridor. But the distance to such post offices is not long and it ranges from 0.5 km to 3 km maximum.

■ Water Supply and Sanitation

Though the project area is close to Colombo urban centers most of the households do not have access to pipe water. Therefore, they depend on wells constructed in home gardens. The water supply facilities for communities in the project area are shown in Table 7.2.21.

Table 7.2.21 Water Supply Facilities

Location	Pipe water		Wells in home gardens		Wells in neighboring home gardens		Sample households
	NO	%	NO	%	No	%	-
1	2	20	8	80	No	-	10
2	2	20	7	70	1	10	10
3	2	25	6	75	No	-	8
4	7	58	5	42	No	-	12
5	6	75	2	25	No	-	8
6	1	9	10	58	6	33	17

Source; HHS of SIA team

The percentages are worked out on the total sample households of the study at each point. Out of 45 wells reported from the sample households only 15 wells are located in side the corridor. Water supply tanks are not located either inside the corridor or in the vicinity. All the householders mentioned that water in the wells is good for domestic use (drinking and other use).

All the households have water sealed latrines. The sanitary facilities among sample households surveyed are included in Table 7.2.22.

Table 7.2.22 Sanitary Facilities among Sample Households

Location	Water sealed latrines		Latrines attached to houses		Sample households
	No	%	No	%	
1	4	40	6	60	10
2	8	80	2	20	10
3	8	100	No	-	8
4	8	67	4	33	12
5	7	88	1	12	8
6	16	94	1	6	17

Source: HHS of SIA team

Note: percentages are worked out on the total sample in each point.

■ Agricultural Activities:

About 1-3 % of population in the project area can be regarded as agriculture communities depending on the data available in GN Offices. This situation is fast changing and in near future the percentage of agriculture communities will become negligible if not zero. There are no families in side the corridors that are fully depending on income from agriculture. Even among the families surveyed in the immediate vicinity only one family was reported as agriculture family but there is agricultural land in each location studied. The current situation of agriculture in each location is described in Table 7.2.23.

Table 7.2.23 Agriculture in Each Location

Location	Agriculture
1	About 10 acres of paddy land is found in this location but it is cultivated occasionally. In home gardens few coconut, banana, and other fruit trees can be seen
2	About 7 acres of paddy land is found but the performance of agriculture is quite similar to location 1.
3	About 10 acres of paddy land is found. It has not been cultivated for about 20-30 years. Now it is marshy type land. Coconut. Banana and so on can be seen in home gardens.
4	About 3 acres of paddy land is found, It is cultivated occasionally. The situation in home gardens is similar to other locations (1,2 and 3)
5	About 3 acres of paddy land is found. The situation is similar to location 4.
6	About 5 acres of paddy land is found. But now this is marshy land due to long-term abundance.

Source: SIA team and the GNs (Grama Niradharies) and community leaders in each study location

■ Road Net Work in the Project Area

Number of good roads is found in side and out side of the road corridor area (refer to Fig. 7.2.5). The information on the roads run across corridor and also falling in the vicinity are as follows:

- Location 1- Athurugiriya- Malambe road (B Type) runs across and Malasingha Goda road (D type) falls in the vicinity
- Location 2- Bakmeegahawatta road (D) runs across and Kahantota road (C) falls in the vicinity
- Location 3- Thun Anda Hena road (D) runs across and Kahantota (C) falls in the vicinity
- Location 4- Malabe –Kaduwela road (B type) runs across
- Location 5- Vihara Mawatha (D) runs across and Colombo-Avissawella road (B) falls in the vicinity
- Location 6- Rama Hera lane (D) and Colombo- Avissawella run across and Rama hera road falls in the vicinity

The Definitions of road categories are as follows:

- Type A- Managed by Road development Authority (RDA), Paved road, Design width ranges from 5.5 to 7.3 m
- Type B- Similar to Type A with different design width of 5.5 to 6.7 m
- Type C- Managed by Provincial Road Development Authority (PRDA), about 99% paved and design width ranges from 4.0 to 5.5 m
- Type D – Managed by PRADA and mostly paved and design width ranges from 3.05 to 4. 0 m

■ Other Infrastructure Facilities:

Except Mahila Samithiya (Mahila samithiya is a local Non Governmental organizations-NGO) in location 4 there are no other significant places such as schools, temples etc in side the corridor. Many common service delivery centers such as schools; temples and other government offices are located in the vicinity of the corridor area (refer to Fig. 7.2.5). The names of such places and the distance of these places are shown in Table 8 in Appendix 7.5. There are no industries located inside the corridor. But some industries are found in the vicinity as shown in Table 9 in Appendix 7.5. There are no proposals for new development of industries or any other projects in the area according to our informants.

7.2.2. Development of Alternatives

In 1999,the JICA Study Team conducted the comprehensive development of alternatives for the OCH in the Feasibility Study (FS). In the study the JICA Study team examined 9 alignments for the OCH taking into consideration the following factors with the aim of selecting the most appropriate alternative in technical, economical and social terms as follows;

1. Construction cost
2. Land acquisition and compensation cost
3. Traffic impacts

The FS concluded that the alignment A5 was most preferable in the 9 alignments. An Environmental Impact Assessment was conducted by the JICA Study Team on the trace. The EIA report was submitted in February 2000.

In the conditional letter of approval on the EIA report issued to the RDA (February2001), the Central Environmental Authority (CEA) has recommended a re-designing to deviate from the Kaduwela – Malambe Road crossing point of OCH at Pittugala junction towards Kaduwela by taking the route to pass through the Maha Ela paddy field to minimize the social impacts based on the findings of the E IA report.

Based on the request from the letter, the JICA Detailed Design Study Team decided deviation route running through marshy area of Maha Ela in Kaduwela section in 2001 in the course of Basic Design.