MINISTRY OF HIGHWAYS, HIGHER EDUCATION AND INVESTMENT PROMOTION

ROAD DEVELOPMENT AUTHORITY

SFG1854 REV

ENVIRONMENTAL ASSESSMENT (EA), ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN FOR NATIONAL ROADS IN SRI LANKA

[CONTRACT NO. WB/RSAP II/CS/33]

Peliyagoda – Puttalam Road (A003)

FINAL REPORT

MARCH 2016

Consulting Engineers and Architects Associated (Pvt.) Ltd.

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Abbreviations

CBO	Community Based Organization
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
DAD	Department of Agrarian Development
DS	Divisional Secretary
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMMP	Environmental Management and Monitoring Plan
EO	Environmental officer
ESC	Environmental Safeguards Compliance
ESD	Environmental Safeguards Division
FD	Forest Department
GN	Grama Niladhari
GoSL	Government of Sri Lanka
GSMB	Geological Survey and Mines Bureau
IEE	Initial Environmental Examination
ID	Irrigation Department
LA	Local Authority
NEA	National Environmental Act
NGO	Non-Governmental Organization
NIRP	National Involuntary Resettlement Policy
RDA	Road Development Authority
RDC	Resource Development Consultants
ROW	Right of Way
SA	Social Assessment
SLLRDC	Sri Lanka Land Reclamation and Development Corporation
WB	World Bank

EXECUTIVE SUMMARY

This is the executive summary for the Environmental Assessment and Environmental Management and Monitoring Plan for Dedugam Oya-Chilaw section of Peliyagoda-Puttalam Road (A03). The report is presented in six Chapters and supporting Annexes.

Chapter 1 – Introduction provides the details of the project including its objectives and project components, reasons for preparing this Environmental Assessment, applicable environmental safeguard policies and laws and methodology used to undertake the Environmental Assessment.

Chapter 2 – Description of the Environment provides the environmental and soci0-economic baseline condition of the Dedugam Oya-Chilaw section of A03 that may be of relevance for the project.

Chapter 3 – Potential Environmental Impacts of the Project detail out the potential impacts based on likely project activities.

Chapter 4 – Mitigation Measures for Identified Environmental Issues provides mitigations measures to be taken into consideration during different stages of project activities.

Chapter 5 – Environmental Management Plan provides consolidation of environmental impacts, mitigation measures, cost associated, and responsible parties to implement and monitor the actions identified in the Plan.

Chapter 6 – Institutional Arrangements provides the arrangements to manage the environmental safeguards of the project including responsibilities of various project partners, monitoring and evaluation requirements and training and capacity building requirements.

Following narration provides the key findings of this Environmental Assessment.

The Road Development Authority through World Bank financing plans to apply Design-Build-Maintain-Operate-Transfer/Output based Performance Road Contract format (DBMOT/OPRC) to the design, rehabilitation/improvement/ maintenance of the national roads, of the Dedugam Oya-Chilaw section of the Puttlam Road (A03) corridor.

The specific objective of the project is to strengthen the Road Development Authority's (RDAs) capacity for asset management and improve the road service delivery on the selected corridor. The project has two activities to meet this objective. They are:

Component 1: Institutional Strengthening and Capacity Building for Asset Management (US$ 25 Million). This component would finance activities to support the RDA in institutionalizing the use of DBMOT/OPRC and implement institutional and system changes necessary to sustain and expand the use of DBMOT/OPRC in the RDA and in the construction industry.

Component 2: Piloting the Implementation of Road Asset Management Principles (US$ 100 Million). This subcomponent will finance the DBMOT contract for the approximately 65 km along the Dedugam Oya to Chilaw section of the A03 corridor. The contract will incorporate all interventions needed during a ten-year period, including road upgrading, rehabilitation, sealing and patching, repaving, drainage structures, widening in selected stretches, sidewalks and all maintenance requirements to achieve a prescribed level of service of the road. The design features will include enhanced road safety, automated traffic management as well as infrastructure demanded by urban population. The corridor also may require minimum widening in identified locations to ensure safety.

The purpose of this report is to assess the expected environmental impacts during the proposed activities of the selected sections of A03 Peliyagoda-Puttlam Road from Dedugam Oya to Chilaw covering 75km.

The main objective of Environmental Assessment (EA) study is to ensure that the proposed development project is environmentally sound and sustainable, while the environmental consequences are recognized and appropriate actions are taken into account in the project designing phase. The EA process is conducted to assist the relevant public officials to make decisions that are based on the understanding of environmental consequences and take action to restore and enhance the environment.

The proposed project involves assets management of a selected section of a National Roads that connects Western Province with North Western Province. The selected section of (A 03 Road) is from Dedugam Oya to Chilaw covering 75km. Majority of the selected section falls within Gampaha District and a small portion in Puttlam District.

The World Bank Safeguards Operational Policies (OP) applicable for the project include OP 4.01 - Environmental Assessment Environmental Assessment, OP 4.04 - Natural Habitats, OP 4.36 - Forests and OP 4.11 - Physical Cultural.

The national environmental policies and laws applicable include: National Environmental Act and Amendment Acts, Coast Conservation Act, Fauna and Flora protection Ordinance and its amendments, Sri Lanka Land Reclamation and Development Corporation Act, Urban Development Authority and/or Municipal/Urban Council/Pradeshiya Sabha Laws, Forest Ordinance and its amendments and Mines and Minerals Act.

The environmental impacts associated with this project are mostly temporary and relate to impacts associated with construction activities. However, if there are improvements such as widening lanes and shoulders, adding extra lanes in steep inclines, etc. depending on the road locality, there may be possible impacts to the environment and people where the existing roads are running through or close to forested areas, wetlands, settlements, business premises, etc. There may also be social impacts in terms of loss of land and other assets/ infrastructure /livelihood located on the land, particularly if the Right of Way is insufficient to meet the design needs; and impact on vulnerable groups. However as the planned development works are to be carried out within the existing ROW and road reservations as far as possible, the activities to be financed by the project generally do not have the potential to trigger significant negative environmental and social impacts. Thus the project is categorized as a Category B project under World Bank environmental classification of projects.

The road trace runs along an area which has several environmentally sensitive areas. These include water bodies such as the Dandugam Oya, Negombo Lagoon, Maha Oya, Gin Oya, and Karambalana Oya (Lunu Oya). The potential impacts from the project on these areas include impacts due to erosion and sediment runoff, discharge of construction waste and wastewater from labour camps which have the potential to cause siltation and pollution of these sensitive eco systems. Stringent precautionary measures have been proposed in order to ensure that construction activities do not affect these sensitive areas adversely. The proposed mitigation measures in order to prevent siltation and pollution of sensitive areas including water bodies is given in chapter 4, and in the Environmental Management Plan.

The other major impact from the project is on agricultural areas including paddy fields. These impacts include erosion and siltation of water ways, drains, paddy fields and blockage of irrigation canals. In addition, culverts and side drains may get clogged unless adequate precautionary measures are adopted. Siltation and pollution of water bodies such as rivers, streams, lakes and lagoons may occur

due to uncontrolled discharges of wastewater and drainage water from construction sites especially during rainy periods. Construction work should be pre planned in order to ensure that construction work is not carried out during the rainy season. Erosion and sediment runoff should be minimized through the adoption of the measures given in chapter 4.

A comprehensive drainage management plan has to be formulated taking into consideration cross drainage of the road, longitudinal drainage of the road surface and road inundation due to overflow of side drains and streams crossed. Drainage related issues were highlighted as the significant problem of this road also during consultations. One of the major impacts of road construction will be from soil erosion and sediment runoff which could result in adverse impacts on water ways and agricultural lands. Appropriate measures should be adopted as given in the report in order to minimize impacts due to soil erosion and sediment runoff. Construction work should be undertaken as far as possible during dry season in order to reduce impacts soil erosion and sediment runoff. In order to minimize impacts on existing road structures such as bridges and culverts, by allowing flow through drainage paths unhindered using side channels. Coffer dams should be placed to heights on par with possible flood levels. Coffer dam heights should not be excessive, and overtopping coffer dams should be allowed and there should be contingency arrangements to breach coffer dams when necessary.

The other potential major impacts are due to noise, vibration and dust emissions during the construction period along the road trace as well as at quarry and crusher sites. Specific measures have been suggested in order to reduce excessive noise from machinery and vehicles in the construction sites as well as in the quarry sites, crusher plants and hot mix and asphalt plants.

Excessive dust emissions is a potential issue that requires to be minimized both from the construction site as well as quarry and crushers. Several mitigation measures have suggested with wetting of dust generating surfaces being one of the simplest measures. As far as the impacts on sensitive areas are concerned although the road trace passes through a number of sensitive areas such as rivers, lagoons and estuaries the impact is not expected to be significant as this is only a road rehabilitation projects and not a new road trace going through these areas. As such no new areas are expected to be opened up.

It is very important to ensure that the material required for the road rehabilitation is obtained from quarries and crusher plants which possess valid permits and licenses from the relevant agencies such as the Central Environmental Authority (CEA) and the Geological Survey and Mines Bureau (GSMB).If new quarry sites or crusher plants are required to be established, it is important to ensure that these quarries and crusher plants obtain the necessary licences from the CEA, GSMB and the relevant Local Authority.

Chemicals, oil or any other hazardous materials required for the project require to be stored securely to ensure there will be human health hazards or contamination of the environment. Similarly workers health and safety factors have to be taken into account as described in chapter 4 and in the Environmental Management Plan.

The Environmental Management Plan (EMP) given at the end of the Environmental Assessment Report provides a summary of the major impacts that may arise during the rehabilitation and upgrading of the selected sections of the A003 road along with the mitigation measures required along with the parties responsible for implementation of the mitigation measures as well as the institutions responsible for supervision and monitoring.

The EMP will form part of the Bid Document and should be taken into consideration along with specifications as per the conceptual design. The contractor who will prepare the detailed design requires to ensure the EA/EMP is updated if needed. The contractor will be primarily responsible for implementation of the EMP, and all sub-contractors should be made aware of the need to comply with

the requirements of the EMP. The measures included in the EMP are an integral part of the construction process and the cost of implementation of the measures should be taken into account during bid preparation and the cost of implementation of these should be included under each item of work. The contractor will be also responsible to prepare Environmental Method Statement in line with EMP.

All of the above mentioned impacts could be effectively mitigated or minimized by the adoption of the mitigation measures indicated in the Environmental Management Plan. The Road Development Authority (RDA) together with Project Management Unit (PMU) and Monitoring Consultant should monitor the implementation of the required mitigation measures on a regular basis and promptly inform the contractor of any violations of conditions in the EMP and take penalty actions identified in the bid documents. The RDA is also responsible to ensure reporting of safeguard performance and compliance.

The RDA and the PMU have adequate capacity to manage environmental safeguards in rehabilitation and maintenance projects. However, it will be still necessary to build capacity of RDA field staff and consultant staff to ensure the project-specific requirements are met by all responsible parties.

CHAPTER 1

1. Introduction

The Road Development Authority through World Bank financing plans to apply Design-Build-Maintain-Operate-Transfer/Output based Performance Road Contract format (DBMOT/OPRC) to the design, rehabilitation/improvement/ maintenance of the national roads, of the Dedugam Oya-Chilaw section of the Puttalam Road (A 03) corridor.

1.1 1.1 Objective and Components of the Project

The specific objective of the project is to strengthen the Road Development Authority's (RDAs) capacity for asset management and improve the road service delivery on the selected corridor.

Component 1: Institutional Strengthening and Capacity Building for Asset Management (US$ 25 Million). This component would finance activities to support the RDA in institutionalizing the use of DBMOT/OPRC and implement institutional and system changes necessary to sustain and expand the use of DBMOT/OPRC in the RDA and in the construction industry. The following sub-components have been identified for project support:

(a) Road Asset Management: This sub-component would provide support to: (i) Operationalize the web-based, multi-user asset management system to improve network data collection and finance additional software and technical support for the customization of the computerized road asset management system; (ii) Establish an asset management unit within the RDA that would be responsible for planning and implementation of DBMOT contracts and it's variants; (iii) Carry out a study to assess staffing, skills, and institutional capacity building needs to institutionalize asset management practices within the RDA; (iv) Enhance capacity of RDA's technical and managerial staff, contractors, consultants, regulatory bodies, auditors and other stakeholders to build awareness and capacity in the implementation of DBMOT contracts;(v) the Monitoring consultant to monitor and evaluate the pilot contract; (vi) Carry out the necessary preparatory work for DBMOT/OPRC formats in the event of a scale up of the operation;(vii) Carry out a Cost efficiency assessment of DBMOT contracts using OPRC contract format that would include all of RDA contracts financed by ADB and the Bank.

(b) Operational Improvements: This sub-component would provide the support to the RDA to transform itself into a more efficient and service-oriented organization. Specifically, it would include support for: (i) developing a Financial Management Information System for the RDA to obtain timely information for appropriate decision making; (ii) establishing a system for monitoring and evaluation of projects;(iii) Establishing a Grievance Redress System to better enable RDA to receive, manage, and respond to public complaints related to national roads and (iv) Incremental Operating cost of the project.

Component 2: Piloting the Implementation of Road Asset Management Principles (US$ 100 Million). This subcomponent will finance the DBMOT contract for the approximately 65 km along the Dedugam Oya to Chilaw section of the A03 corridor. The contract will incorporate all interventions needed during a ten-year period, including road upgrading, rehabilitation, sealing and patching, repaving, drainage structures, widening in selected stretches, sidewalks and all maintenance requirements to achieve a prescribed level of service of the road. The design features will include enhanced road safety, automated traffic management as well as infrastructure demanded by urban population. The corridor also may require minimum widening in identified locations to ensure safety.

The Peliyagoda to Puttalam Road section is basically composed of about 90 km of urban/semi urban and about 36 km of rural national roads, transitioning between Colombo and Northern part of the

Country. The section selected for the project interventions are is entirely within the urban/semi-urban section about 62km. The road is paved by A/C, in relatively fair condition. The World Bank financed Road Sector Assistance Project rehabilitated and upgraded the section from Peliyagoda to Ja-Ela, which was completed in mid-2015 and it is in good condition, The next part of the road section of length about 12.5 km is in substandard 4 lane having lane width of 3.2 m and the rest of the two travelling lanes with a width of 3.5 m each and with a very narrow soft shoulders or sidewalks. The ROW is corresponding to the urban major arterial street/highway and needs a careful consideration regarding the road and pedestrian safety and health requirements. The traffic volume is visibly heavy and of mixed composition, in magnitude of 55,100 vpd at the initial section and reduce to 12,480 vpd towards the Puttlam end. No major vertical and horizontal realignment is envisaged, except for the new bridge and its approaches at Kochchikade, which will be not the part of this project and correction of few black spots.

1.2 1.2 Objectives of the Environmental Assessment

The purpose of this report is to assess the expected environmental impacts during the proposed activities of the selected sections of A03 Peliyagoda-Puttlam Road from Dedugam Oya to Chilaw covering 75km.

The main objective of Environmental Assessment (EA) study is to ensure that the proposed development project is environmentally sound and sustainable, while the environmental consequences are recognized and appropriate actions are taken into account in the project designing phase. The EA process is conducted to assist the relevant public officials to make decisions that are based on the understanding of environmental consequences and take action to restore and enhance the environment.

Based on the Environmental and Social Management Framework (ESMF) for National Roads Rehabilitation, Improvement & Maintenance Projects in Sri Lanka, all roads that will be rehabilitated, improved and/or maintained will need to prepare road specific EAs and Environmental Management Plans (EMPs), to ensure compliance with the World Bank's environmental safeguard policies and the relevant provisions under the National Environmental Act (NEA) and associated regulations.

It is expected that EAs and EMPs will be prepared in close collaboration with the team designing roads specifications and thereby engineering requirements needed to mitigate environmental issues could be incorporated into the designs.

The road-specific EA and EMP should be ready prior to finalization of the bidding documents. Sufficient conditions should be specified in the bidding documents, as well as the contractual agreements clearly defining requirements of compliance to adhere to the EA, implement the EMP and any subsequent changes and penalties for non-compliance. In the case of this project, the detailed designs are expected to be prepared by the contractor as it is the standard practice of DBMOT/OPRC. Therefore, this EA and EMP are prepared in line with the proposed conceptual design and will required to be updated with the preparation of the detailed designs expected to be undertaken during the implementation of the project. It is expected that the EA will provide guidance to the OPRC contractor on the standards to be adhered to, updating of the EA, as well as guidance on managing environmental impacts and designing mitigation measures that will be included in contractor's Environmental Methods Statements. In addition to this, the EA is expected to assist the RDA to ensure that the contractor updated the EA together with the detailed design of the project, monitor the performance of the OPRC contractor in accordance with the Environmental Management and Monitoring Plan (EMMP) and Environmental Standards specified in the contract

In this EA study, environmental characteristics of the study area within 500m either side of the centre line of the roads will be assembled and evaluated. In addition, if potential quarry site/s, burrow pit/s, sand mining site/s and debris disposal sire/s are encountered in close proximity to the respective

roadways, environmental characteristics of such sites will also be gathered during field investigations. These include, gathering and provide information on,

(i). Information about the following existing environmental settings of the project influential area;

- Physical Environment (including topography, soil, geology, climate, air quality, surface and ground water hydrology and quality),
- Biological Environment (fauna and flora and presence of endemic, endangered species),
- Social Environment (socio economic profile of the communities living in the project influence area, infrastructure facilities and land use etc.),

(ii). Identify beneficial and potential adverse impacts on the existing environment during preconstruction, construction and operational phases of the project;

(iii). Propose effective mitigation measures to avoid / minimize the project induced adverse impacts while enhancing the beneficial impacts, and;

(iv). Formulate an effective Environmental Management Plan (EMP) and Environmental Monitoring Plan to be incorporated in the Bid documents, so as to sensitize and guide respective divisions of RDA in environmental and social safeguards compliance during pre-construction and operational stages of the project. Also sensitize and guide respective contractors in environmental and social safeguards compliance during construction stage.

It is important to put additional emphasis in collecting environmental baseline data as soon as the roads have been identified such as river/stream flows, ambient air quality and water quality in random locations along the road, as well as strategic locations where increased levels of disturbances are expected (e.g. town development, etc.). While it is recognized that collection of some of the environmental baseline data related to various sites such as crusher and asphalt plant sites and labour camps may not be possible prior to bidding process, provisions should be made to ensure the contractor with the close supervision of the supervisory consultant measures, records and reports on the baseline data once such sites have been identified and prior to commencing operations.

1.3 1.3 Location of the project

The proposed project involves assets management of a selected section of a National Roads that connects Western Province with North Western Province. The selected section of (A 03 Road) is from Dedugam Oya to Chilaw covering 75km. Majority of the selected section falls within Gampaha District and a small portion in Puttlam District. The following figures provides both the route maps and topographical maps covering the project area.

Gampaha district is bounded by Kurunegala and Puttalam districts to the North, by Kegalle district in the East and by Colombo district in the South. There are 02 Municipal Councils (Gampaha and Negombo) and 06 Urban Councils (Katana, Seeduwa, Ja-Ela, Wattala-Mabola, Peliyagoda, Minuwangoda) within this area.

Puttalam District, situated in the North Western province of Sri Lanka is bounded in the North by Modaragam Aru, Bordering the Mannar district, in the East by Kurunegala and Anurdhapura districts, in the South by ' Ma Oya' bordering the Gampaha district and in the West by the Indian Ocean. There are 01 Municipal Councils (Chilaw) and 4 Pradeshiya sabhas (Chilaw, Nattandiya, Wennappuwa, Arachchikattuwa) within the project area.

There are number of water bodies either crossing the road or close vicinity to the road including: Dedugam Oya, Attanagalu Oya, Maha Oya, Gin Oya, Maha Wewa and Negambo Lagoon. Colombo-

Katunayake expressway runs parallel to the road starting from Peliyagoda and ending in Katunayake. The road section runs through urban/semi-urban section of Peliyagoda- Puttlam Road.

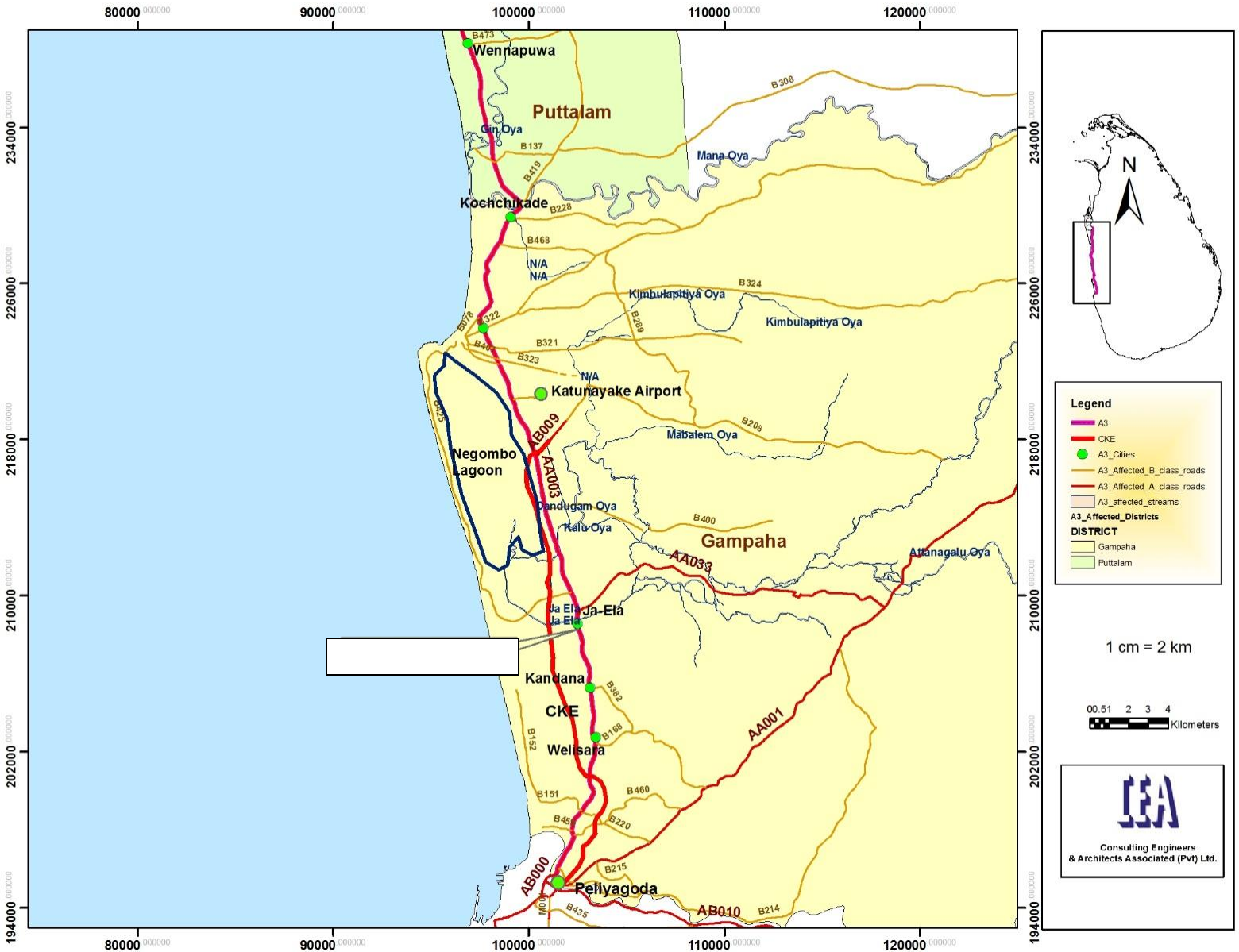

Figure 1-1: Route Map- Peliyagoda - to Puttalam Road (A03)(Part 1 Peliyagoda Kochchikade)

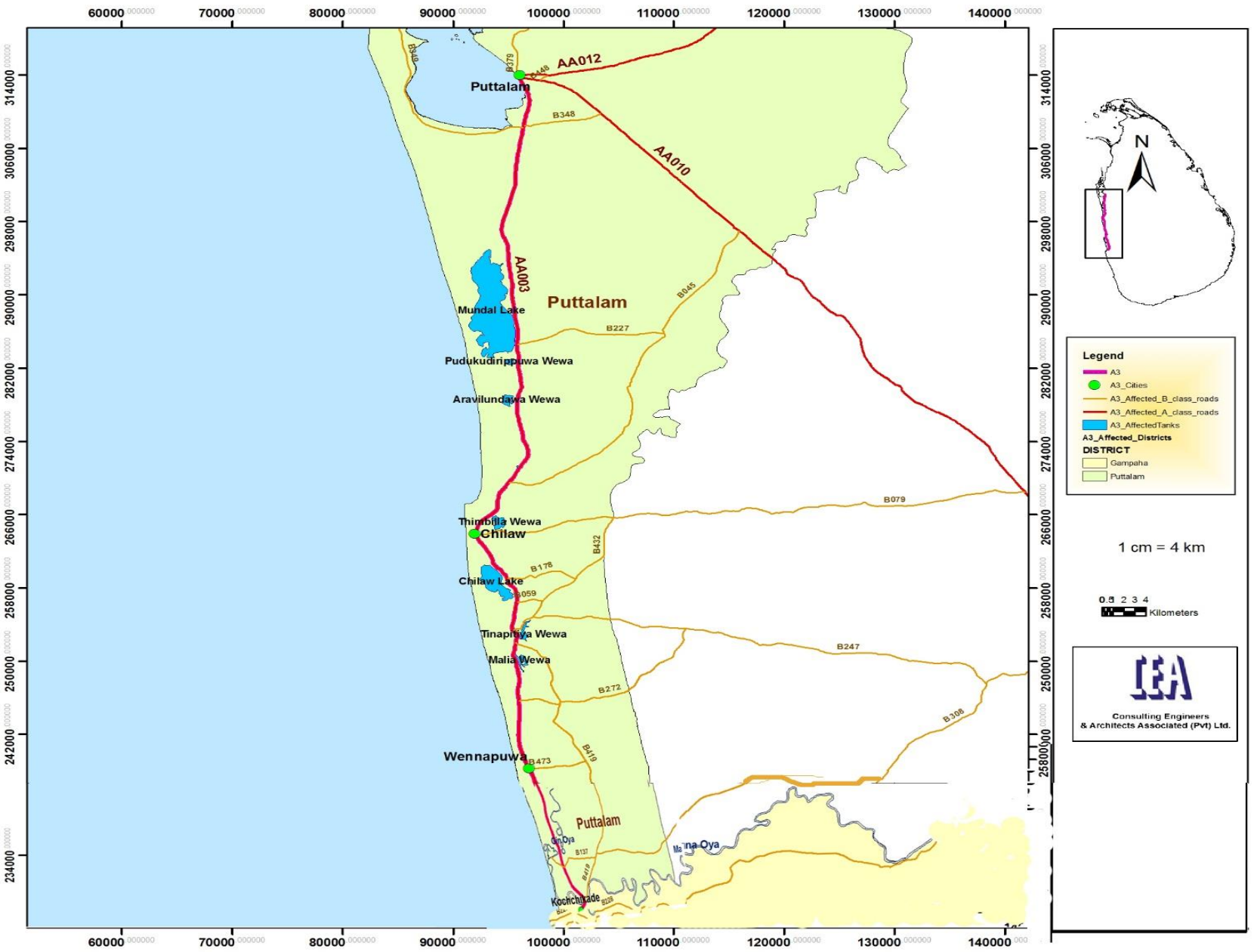

Figure 1-2 - Route Map- Peliyagoda - to Puttalam Road (A03) (Part 2 Kochchikade - Puttalam)

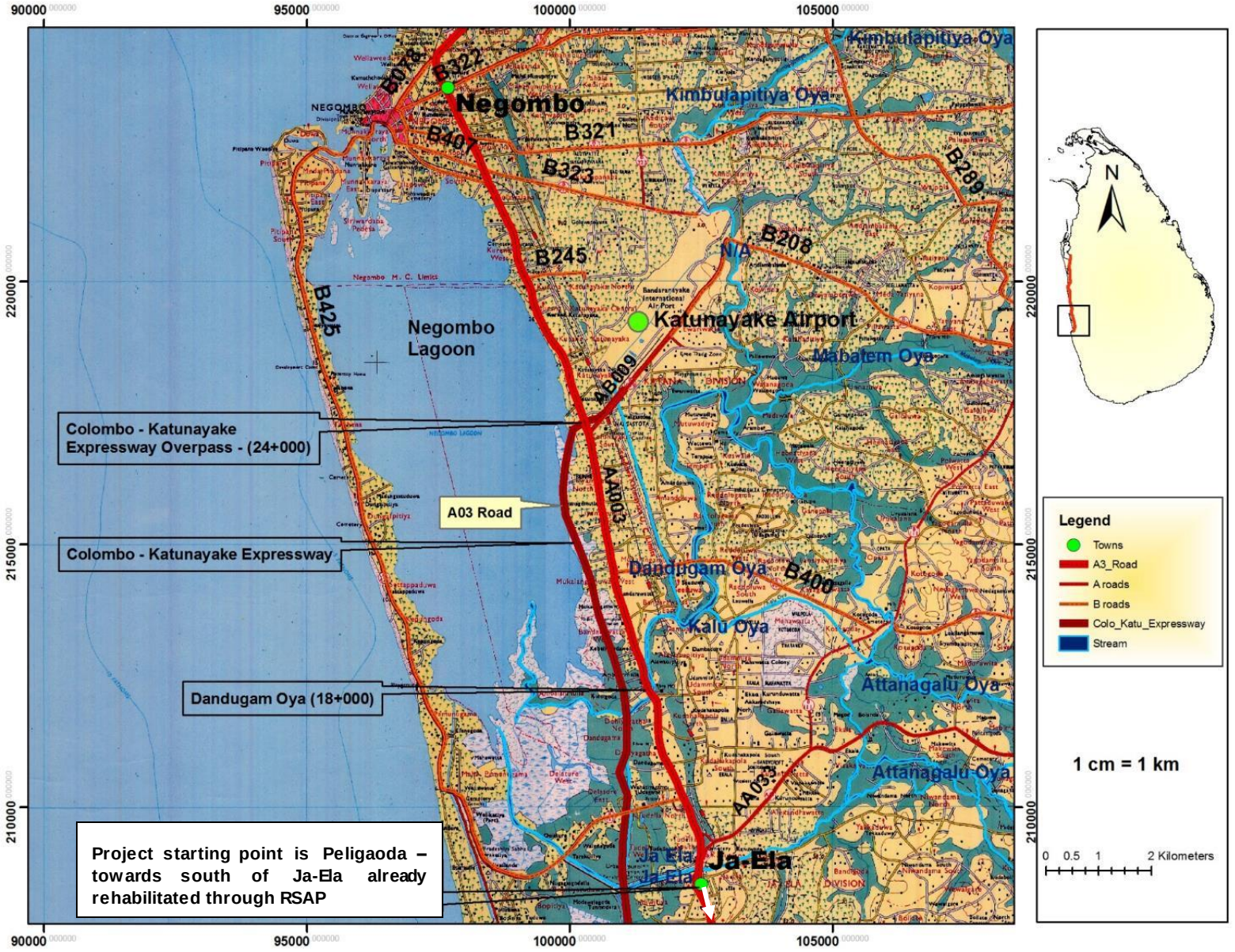

Figure 1-3, Topographical Map (Ja-Ela to Negombo)

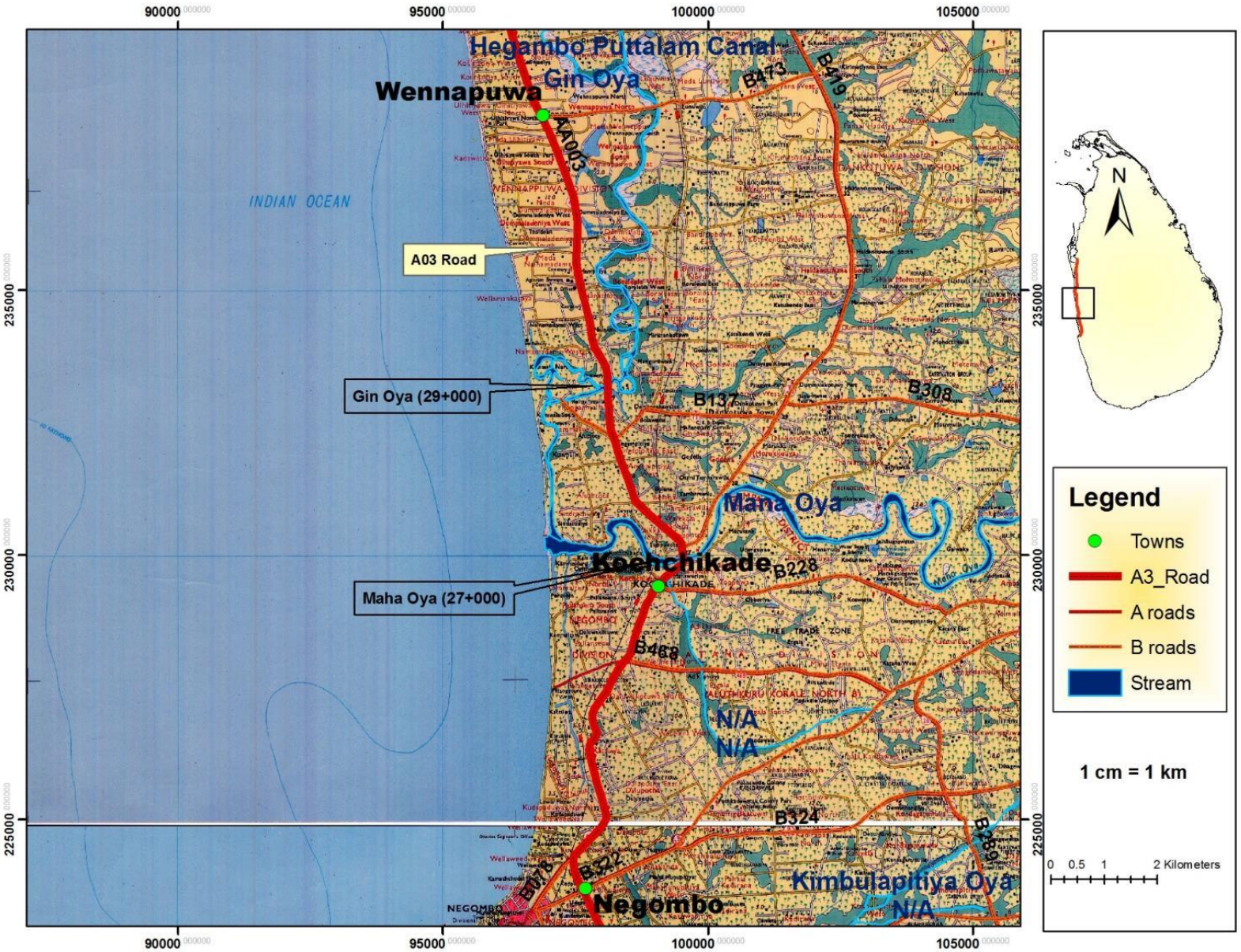

Figure 1-4, Topographical Map (Negombo to Wennappuwa)

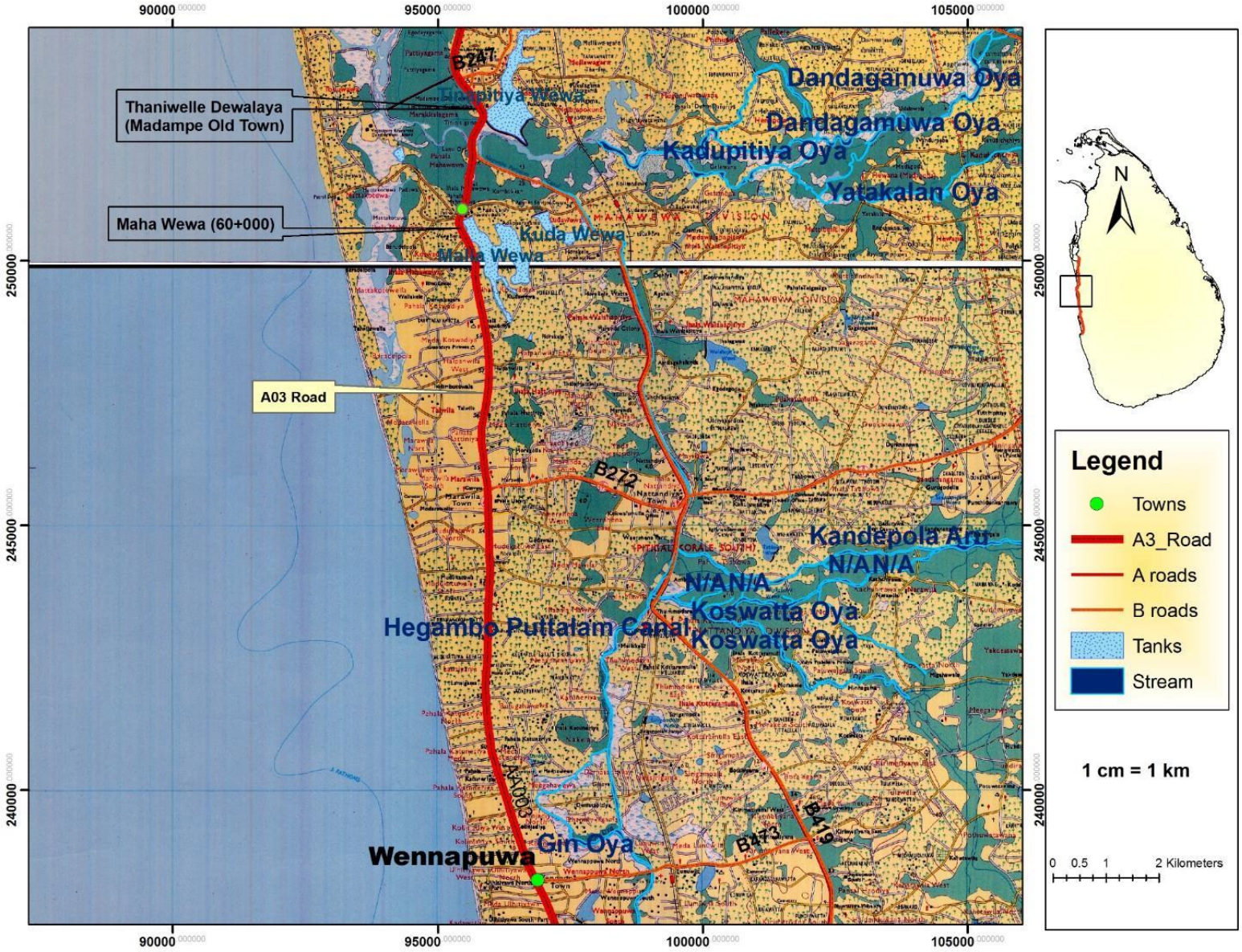

Figure 1-5, Topographical Map (Wennappuwa to Mahawewa)

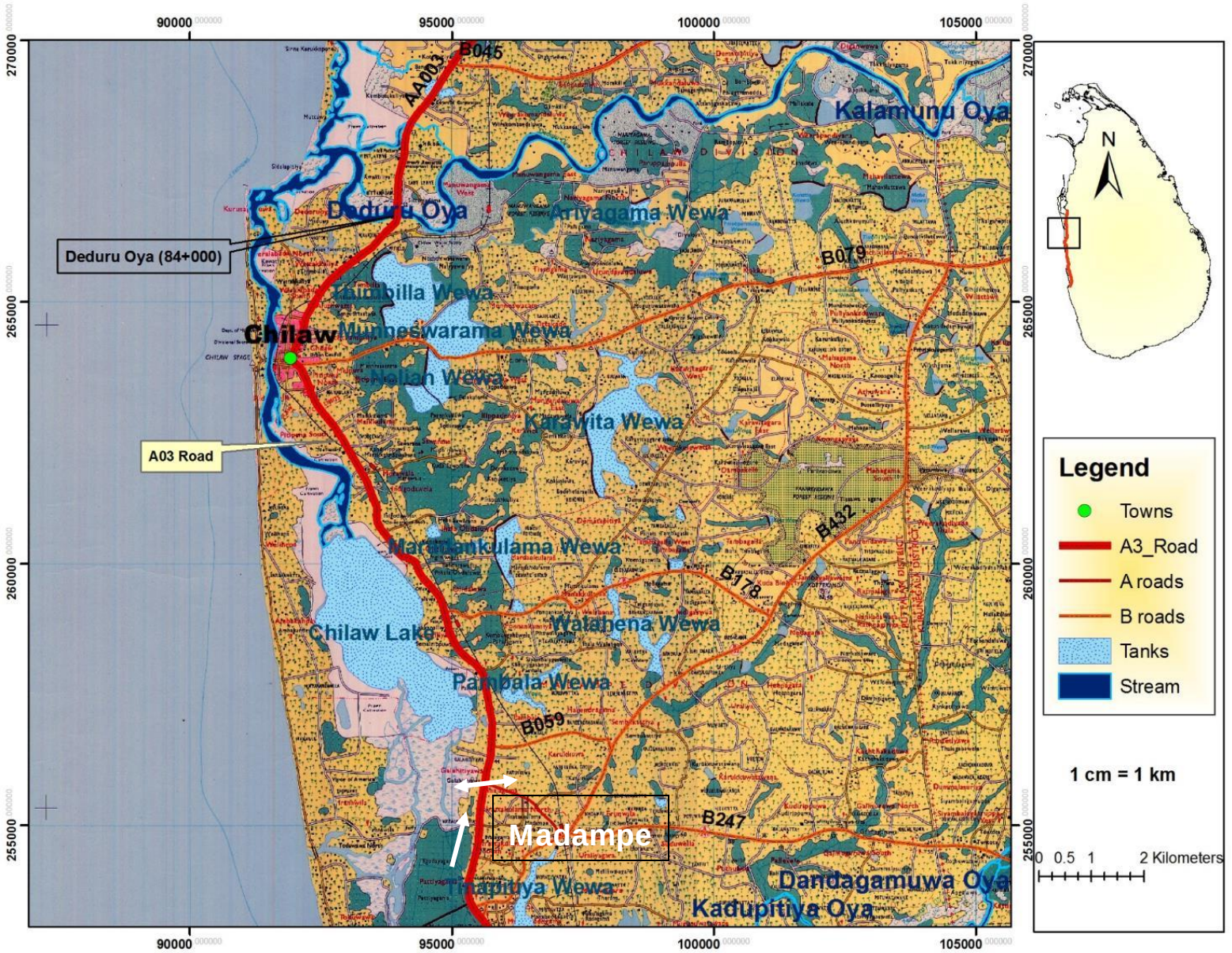

Figure 1-6, Topographical Map (MahaOya to Deduru Oya)

1.4 1.4 Need for the project

The selected section of the A03 road could be considered as one of the busiest road stretch in the country. This is due to high population density, heavy traffic jams and significant development up to the RPW of the road. As a result, the road is extensively occupied by road users with large number of vehicles moving along the road throughout the day. Due to poor maintenance, the some sections of road surface has deteriorated to some extent. In addition, roadside drain system in most places is not functioning well due to inadequacy of the existing drainage system, bottlenecks, blockages in lead aways, etc.

While part of the road up to 20km post along A03 was recently rehabilitated through a World Bank financed project, RDA has identified this as a priority road to be rehabilitated as it provides connectivity to northern part of the country and many proposed future development envisaged in the vicinity of Puttlam town. In addition, this road also has been identified amongst few road sections to demonstrate how DBMOT/OPRC contract works.

1.5 1.5 Types of activities envisaged on road rehabilitation, improvement and upgrading

The following activities are typical for road rehabilitation, improvement and upgrading projects;

- Improvements to the existing road with two or four lane facility,
- Improvements to the existing pavements with AC
- Improvements to the horizontal alignment at selected locations to reduce acute curves in order to provide safe driving conditions,
- Widening, repairing or reconstruction of damaged culverts, construction of new cross drainage structures at locations where road is placed on new embankments and improvements to bridges (if necessary),
- Removal of irregularities on the existing vertical profile,
- Provision of cycle lanes, pedestrian footpaths, bus bays, separate bus lanes and rest bays where necessary,

Such activities are expected to lead to;

- Improving the vehicle operating speeds while ensuring safety of road users and,
- Reduce travel time and vehicle operating costs.

The project will be implemented by the Road Development Authority of Sri Lanka.

1.6 1.6 Applicable Environmental Safeguard Policies of the World Bank and the Government of Sri Lanka

1.6.1 Environmental Safeguard Policies of the World Bank

The World Bank group, in its operational directives has stipulated that all investments made should be environmentally sustainable. The environmental safeguards and concerns of the World Bank group are endorsed by the operational policies of the group. These policies form the guiding principles for assessing the environmental and social acceptability of the project. Operational Policy (OP) 4.01 - Environmental Assessment Environmental Assessment, OP 4.04 - Natural Habitats, OP 4.36 - Forests and OP 4.11 - Physical Cultural Resources are the environmental safeguard policies of the World Bank which are most

relevant to the project. There are no dams in the project area and pest management activities under the project.

OP 4.01 requires that an Environmental Assessment is carried out for this project which is categorized as a category B project under the World Bank environmental classification since this is a project involving rehabilitation and maintenance of an existing road. The EA is expected to identify the potential environmental impacts of the project and suggest ways and means of avoiding or mitigating these impacts, thereby ensuring that the project is environmentally sound and sustainable. Stakeholder consultation is an integral part of the EA process and all project affected people, local non-governmental organizations and local authorities as well as other stakeholder agencies will be required to be consulted.

OP 4.04 requires that all required measures are adopted in order to conserve and protect significant natural resources such as designated protected areas. In the context of Sri Lanka these could include National Parks, Sanctuaries, etc. designated under the Fauna and Flora Protection Ordinance, Environmental Protection Areas under the National Environmental Act or other undesignated natural habitats. In the context of the road section selected, there are no designated natural habitats. However, the road runs closer to natural habitats such as small rivers (or *oya*), small tanks (or *wewa*), and a lagoon, which do not have specific protection status. As part of the EA, an assessment has been done to identify the sites including status of the sites and necessary mitigation measures.

While there are no natural forests along the road corridor or forest management related activities under the project, there may be off-site impacts to the forests due to extraction of construction material. There are as many of gravel and metal extraction sites are located within natural forests within Forest Reserves declared under the Forest Ordinance. The project will not allow extraction of material from natural forests. Therefore, all construction material extraction will need to take place outside such areas and necessary actions to ensure this is included in the EA. However, given the closest Forest Reserve is located significant a long way off and there are number of potential sites for construction material which are not within sensitive areas, it is anticipated that impacts to forests will be most likely non-existent. However, on a precautionary basis, OP 4.36 has been triggered for this project.

OP 4.11 is applicable because there are number of religious sites along the road corridor, but out from the ROW that may require protection when rehabilitation and upgrading activities take place. There are no anticipation of chance finds as the project does not run through a historically significant area.

1.6.2 National Environmental Policies and Laws

National Environmental Act No 47 of 1980 and Amendment Acts of 1988 and 2000- The main legislative Act that will apply for road rehabilitation projects is the National Environmental Act (NEA) and regulations under it. The two main regulatory requirements under the NEA are the Environmental Impact Assessment Procedure (EIA) and the Environmental Protection Licensing (EPL) procedure.

Sri Lankan national Legislation under the National Environmental Act no 47 requires that Environmental Impact Assessments or Initial Environmental Examinations (IEE) are conducted for new road projects and highways which extend over a distance of 10km. Road rehabilitation however does not require environmental assessments under national legislation unless the road expansion results in incursions into environmentally sensitive or protected areas or if the resettlement of more than 100 families is required. Since these are existing roads which are being rehabilitated there is no legal requirement for EIA or IEE under national legislation. However, in order to maintain quarry sites, asphalt plants, etc. it is necessary to obtain EPLs.

Coast Conservation Act (in the case of projects situated within the coastal zone)-The coastal zone is defined in the Coast Conservation Act as the area lying within a limit of three hundred meters landwards of the mean high water line and a limit of two kilometres seawards of the Mean Low Water Line and in the case of rivers, streams and lagoons or any other body of water connected to the sea either permanently or

periodically, the landward boundary shall extend to a limit of two kilometres measured perpendicular to the straight baseline drawn between the natural entrance point thereof and shall include waters such as rivers, streams and lagoons or any other body of water so connected to the sea. Since part of the road trace runs along the coastal zone as defined above the provisions of this Act will be applicable at these locations. RDA will be sharing the final version of this EA with Coast Conservation Department to keep them aware of the proposed project and future monitoring as needed.

Fauna and Flora protection Ordinance No 2 of 1937 and its amendments-The Fauna and Flora (protection) Ordinance no 2 of 1937, as amended by the Fauna and Flora (Amended) Act no 49 of 1993 and Act No 22 of 2009 provides regulations for the protection, conservation and preservation of fauna and flora of Sri Lanka, for the prevention of the commercial exploitation of such fauna and flora, and to provide for matters connected therewith or incidental thereto. This Act is administered by the Department of Wildlife Conservation, and has provisions in it for the protection of fauna and flora in National Reserves and Sanctuaries as well as in private lands in certain instances. In addition, this ordinance provides provisions for the protection of certain species of fauna outside reserves and prohibition and control of the export of some wild animals. This law also has provisions for the protection of some identified protected trees. The provisions in this law will apply to this project if the rehabilitation or road expansion has potential impacts on fauna and flora or if the trace falls within or in close proximity to areas declared under the Fauna and Flora Protection Ordinance.

Sri Lanka Land Reclamation and Development Corporation Act - The Sri Lanka Land Reclamation and Development Corporation (SLLRDC) established under this Act which was amended by law no 27 of 1976, Act no 52 of 1982 and Act no 35 of 2006. The SLLRDC has the power to declare low lying areas as flood protection areas. If the road expansion involves any filling of low lying areas, the approval of the SLLRDC will be required.

Urban Development Authority and/or Municipal/Urban Council/Pradeshiya Sabha Laws-Since the road trace runs along many pradeshiya Sabhas, Municipal Councils and Urban Councils, the provisions in these acts will apply to this project.

The Forest Ordinance no 17 of 1907 and its amendments- The Forest ordinance was first enacted in the form of the Forest Ordinance no 10 of 1885 which made provisions for the declaration of reserved forests. The Forest Ordinance no 16 of 1907 is the cornerstone of the present law relating to forests and plant protection. Since its enactment, the ordinance has been amended many times and was last amended in 2009. The present Forest Ordinance is an ordinance to consolidate and amend the law relating to conservation, protection and sustainable management of forest resources and has provisions for community involvement in forest management and benefit sharing through forest agreements. The provisions in this Act will apply to this project if the road expansion involves forest areas and during the removal of trees for road rehabilitation and expansion. In addition, if extractive activities are taking place on areas declared under the Ordinance, necessary assessment and approval from the Conservator General of Forest will be necessary.

Mines and Minerals Act no 33 of 1992 - The Geological Survey and Mines Bureau which functions under the provisions of the Mines and Minerals Act no 33 of 1992, issues three types of licenses for exploration, mining, trading and transport. The GSMB license is required for all types of mining including sand and quarry mining operations. The license issued by the GSMB grants the license holder the exclusive right to mine, process and trade in all minerals specified in the license. As such, all quarry operations and mining operations connected with road project will require a valid license issued by the GSMB.

1.7 1.7 Potential Environmental Issues during the Implementation of Road Rehabilitation Projects

It is anticipated that environmental and social impacts would be minimal for road rehabilitation and maintenance projects. The environmental impacts associated with road rehabilitation projects are mostly temporary and relate to impacts associated with construction activities. However, if there are improvements such as widening lanes and shoulders, adding extra lanes in steep inclines, etc. depending on the road locality, there may be possible impacts to the environment and people where the existing roads are running through or close to forested areas, wetlands, settlements, business premises, etc. There may also be social impacts in terms of loss of land and other assets/ infrastructure /livelihood located on the land, particularly if the RoW is insufficient to meet the design needs; and impact on vulnerable groups.

However as the planned development works are to be carried out within the existing ROW and road reservations as far as possible, the activities to be financed by the project generally do not have the potential to trigger significant negative environmental and social impacts. Thus the project is categorized as a Category B project under World Bank environmental classification of projects.

Where the project entails acquisition of land, structures and other assets, and/or cause displacement of loss of assets within the public RoW, the Land Acquisition Act No. 9 of 1950 and subsequent LA regulations in 2008 applies. The project must also be in compliance with the policy on ''Involuntary Resettlement''. This has been detailed out in the project's Social Impact Assessment and Resettlement Policy Framework prepared separately to this EA.

The potential major impacts associated with road rehabilitation and maintenance include;

- Air Pollution due to generation of dust
- Blockage of drainage paths and drains due to construction activities.
- Noise from construction equipment and vehicles as well as quarry sites and crusher plants.
- Vibration from construction equipment and quarry sites.
- Impacts on fauna and flora, including loss of trees along the road traces.
- Pollution due to fuels and lubricants and other chemicals
- Siltation and pollution of natural water bodies such as rivers, streams and lakes.
- Soil erosion.
- Impacts due to improper storage of construction materials.
- Improper disposal of debris and spoil material.
- Pollution due to noise and dust from quarry and crusher sites and air pollution from asphalt plant.
- Traffic congestion due to construction activities
- Issues relating to workers Health and Safety

Suitable mitigation measures are required in order to minimize the above mentioned impacts and to abide by the standards stipulated by the Central Environmental Authority and other regulatory agencies.

1.8 1.8 Areas to be Covered and Methodology to be adopted for the Environmental Assessments

1.8.1 Baseline Environmental Data

The EA provides a comprehensive description of the existing environment in the project area including an area of 500m from either side of the centre line of the road trace which maybe potentially affected by the

project activities. The study extends into the assessment of existing physical, biological, socio-economic, archaeological and cultural aspects and expected changes to such aspects in the study area during the construction and after implementation of the project.

The available published literature, documents and maps (e.g. topographic, geological maps, forest, satellite imagery, Google image maps etc.,) related to study area of this project were reviewed.

The information taken by project team on status of land use patterns, topography and soil erosion tendency, slope stability, landslides tendency, etc., within the influence area were reviewed through site observation and on-site delineation in maps.

Site visits & investigation were carried out to identify environmental sensitive locations, conflict points etc. Baseline environmental data for the project area was collected in relation to water quality, ambient air quality and noise levels. Initially a reconnaissance survey was carried out along the total road trace in order to identify the most appropriate locations for sampling of water quality, air quality and noise levels. These locations were identified in order to represent the total road trace. In addition, strategic locations where increased levels of disturbances are expected as well as sensitive sites were included during the site selection process.

Baseline data on socio-cultural environment were also compiled, including present and projected population, present land use and ownership, planned development activities, community structure, present and projected employment by industrial category, distribution of income, good and services, recreation, public health, cultural properties, indigenous people, customs, and aspirations, significant natural, cultural or historic sites, land and water based activities such as agriculture, fisheries within the project influence area.

1.8.1.1 Water Quality

The EA will address the issue of water pollution by identifying the potential sources of water pollution during the road construction process. The EA has proposed precautionary measures to be adopted in order to minimize the potential for water pollution from project activities and has also proposed water quality monitoring locations and frequencies in order to minimize the impacts on water quality due to project activities. Water quality impacts from the project include the possibility of runoff carrying silt and soil into waterways as well as oil spills from machinery and vehicles being washed off into nearby waterways. In order to monitor the potential impacts on water bodies such as rivers, lakes and lagoons, a pre project baseline survey is required of the water bodies within the project area. The baseline water quality of all such water bodies in close proximity to the project site was carried out through a recognized laboratory prior to project implementation. During the construction period of the project these water bodies will be required to be monitored on a regular basis(Monthly or more frequently if required) in order to detect pollution trends. This will make it possible to determine whether a particular water body is being affected by the road construction activities and suitable mitigation measures could be adopted if increasing pollution levels are observed.(for example increase of suspended particulate matter or decrease in dissolved Oxygen levels in the water).

All of the important inland surface water bodies such as rivers, lakes and major streams were included in the ambient water quality monitoring programme in order to set the baseline in relation to water quality. The site selection for sampling was done in a manner that the totality of the road trace will be included in the monitoring process. Ambient water quality of these water bodies was measured through the ITI which is a recognized laboratory.

1.8.1.2 Air Quality

Air Quality impacts from the project will arise mainly during the construction stage of the project. In order to assess the air quality impacts, a baseline air quality measurement was required. This was carried out at identified locations along the road trace including sensitive locations along the route.

The report also specifies the air emission standards to be adhered to by air polluting entities such as crusher plants, quarries and asphalt plants as well as the construction sites. In addition vehicle emission standards to be maintained by the heavy vehicles utilized by the project is specified in the report.

During the project construction and implementation stages suitable mitigation measures will require to be adopted in order to ensure that dust emissions from road construction activities as well as vehicular emissions from the heavy vehicles used for transport of materials. Mitigation measures such as wetting of surfaces likely to emit dust as well as construction of protective barriers to reduce nuisance from dust emissions maybe required at specific locations depending on their sensitivity. Regular measurements of ambient air quality will require to be carried out at selected locations including sensitive locations in order to ensure that dust emissions as well as the emissions from the heavy vehicles used for the transport of construction materials are within the standards stipulated by the CEA. The EA has identified the potential sources of air pollution both during the construction stage as well as the operational stage and suggested ways and means to minimize such impacts. In addition the EA report has specified monitoring requirements for air quality both during the construction and operational stages in order to keep track of air quality trends within the project area.

1.8.1.3 Noise

With respect to noise, appropriate locations were selected along the road trace in order to measure ambient noise levels. The EA report specifies the daytime and night-time noise levels required to be adhered to by the contractor during the project implementation stage. In addition the noise levels to be adhered to by offsite operations such as quarry sites, crusher plants and asphalt plants is also specified in the report.

1.8.1.4 Protected Areas

Environmentally sensitive areas as well as all protected areas under the Forest Ordinance and Fauna and Flora Protection Act such conservation forests, sanctuaries and National Parks situated along the road trace will be identified and marked. In addition other environmentally sensitive areas such as wetlands and Environmental Protection Areas declared under the National Environmental Act were identified. Mitigation measures have been suggested for potential impacts from project activities to these areas.

1.8.1.5 Ecological Environment

Since the proposed development traverses the existing environment of roadside which consists of a variety of ecosystems, both terrestrial and aquatic. Thus the anticipated environmental impacts can be identified as

- Clearing of trees within 500m on either side of the road
- Impact of construction activities on the fauna and flora
- Disturbance to the tanks and streams/river banks, if developments are carried out too close to these habitats
- Disturbance to the crops / paddy fields/home gardens
- In identifying the ecological impacts, ecological surveys will be conducted with special emphasis placed on;
- Impacts on fauna and flora or on existing habitats due to changing land use pattern
- Impacts on existing habitats in and around the project site
- Impact on migratory patterns of fauna in the region

In order to assess the ecological impact of the project, an extensive ecological survey was carried out within the project area and an area comprising 500 m from the road trace. This included an assessment of the existing ecology of the project area inclusive of both fauna and flora, sensitive eco systems, protected areas such as sanctuaries, National Parks or Conservation Forests as well as the presence of Environmental Protection Areas declared by the Central Environmental Authority, under the provisions in the National Environmental Act. The EA has identified whether any of the above mentioned areas are present within or in close proximity to the road trace and whether the project construction activities will affect such areas. The potential adverse impacts to either such environmentally sensitive areas to rare or endemic flora or fauna has been identified, in addition to ways and means by which to minimize such impacts and where necessary alternatives to be adopted in order to prevent or minimize such adverse environmental impacts. The presence of rare or threatened species were noted and recorded. Areas which should be avoided during the construction process due to the presence of such rare or threatened species have been clearly identified and recorded. The baseline survey has identified all existing fauna and flora within the road trace and 500 m beyond the road trace. The EA has specified mitigation measures which are required in order to ensure that the ecological impact of the project will be minimal both during the construction stage and operational stage. In cases where the route suggested is going over an ecologically sensitive area or has the potential to affect sensitive habitats, suggestions have been made in order to adopt alternate routes as far as possible.

1.8.1.6 Hydrology and Drainage

Site reconnaissance was done to assess the condition of the existing environment. The existing hydrological environment of the roadside has been described in terms of average rainfall, rainfall intensity, status of hydraulic structures such as bridges, culverts, flood conditions, adequacy of structure openings for flood passage, road overtopping sections, condition of lead away drains in general and the condition of side drains. It is expected to gather hearsay evidence with respect to social concerns regarding hydrological issues.

One of the key impact assessment will be to assess the baseline hydrological impacts undergone by the road environment. Such impacts are mainly creation of backwater impacts by inadequate structure openings, road inundation due to the low road profile and lack of side drains, inadequacies of lead away drains etc. Other hydrological impacts during construction will also be assessed. Such impacts will be flooding due to coffer dams needed for bridge construction, sedimentation of waterways, work hampering by rainfall etc. Also there could be operational impacts such as water way lockage and drainage congestion because of road culvert and side drain siltation. Thus the complete impact domain will be addressed.

It may be necessary to liaise with Irrigation Department, Department of Agrarian Development, Provincial Irrigation Engineer and Sri Lanka Land Reclamation and Development Corporation (has jurisdiction for Western and Southern Provinces) to assess the impacts on irrigation structures , paddy fields, Provincial and inter provincial rivers.

Mitigation measures are needed to alleviate baseline impacts, construction impacts and operational impacts. Some of the mitigation measures proposed are larger flood and drainage openings, rehabilitation of side drains, raising the road profile in the inundation causing stretches etc. Good work practices during construction has been suggested to mitigate construction related hydrological impacts. An operation and maintenance practices such as desiltation of culverts has been proposed to mitigate operational impacts.

Based on mitigation measures and other conditions hydrologically related Environmental Management requirements have been proposed. Institutional requirements are also mentioned. Irrigation Department, Department of Agrarian Development, Provincial Irrigation Engineer as stated above are the prime institutions which will have jurisdiction regarding hydrological matters.

Apt conclusions have been drawn and recommendations provided based on the study results. Most of the recommendations are in the form of proposed mitigation measures.

1.8.2 Sociological Impacts

The EA has focussed on the potential for negative and positive social impacts caused by the project. Significant developments proposed in the project influence area such as township development, industrial zones that may have impacts on the level of road use as well as to the environment and people and level of impacts. The EA has focussed on the potential for negative environmental and social impacts caused by planned and unplanned in migration of people if applicable to the given road sections, clearing of forest land for agriculture, increased pressure on fuel wood, fodder and water resources, social disruptions and conflicts etc.

1.8.3 Laws, Regulations and Standards applicable to the project

The report has identified all environmental standards to be adhered to by the contractors during the project period. This will include standards on wastewater quality, air emission standards, Noise levels including noise levels to be adhered to during day and night time operations, Hazardous waste Regulations including the disposal of hazardous waste including waste oil, requirements regarding the disposal of waste including construction related waste material. The report has specified the national laws and regulations that require to be adhered to during project implementation.

1.8.4 Licenses and Permits to be obtained

The report has specified all licenses and permits required by the contractors as well other connected operations such as quarry sites and crushers as well as asphalt plants. These include the requirements for site clearances for new sites for crusher plants and asphalt plants, IEE/EIA requirements for new quarry sites, as well as Environmental Protection Licenses for existing and new quarries, crusher plants and asphalt plants.

1.8.5 Identification of Potential Significant Environmental Impacts of the Project and Their Mitigation

The potential major impacts from the proposed projects were identified by inspecting the road trace and potential areas of impact. Particular attention was paid to environmentally sensitive areas as well as protected areas under the fauna and Flora Protection Ordinance and Forest Ordinance as well as the National Environmental Act. Attention was also paid to sensitive areas such as schools, hospitals and places of worship that may be affected adversely due to project activities. Suitable mitigation measures have been proposed to the extent possible for the major impacts from the projects. Impacts from off-site operations such as quarries and crushers as well as asphalt plants have also been identified and suitable mitigation measures proposed in order to minimize the impacts and to meet the standards stipulated by the CEA.

1.8.5.1 Environmental Management and Monitoring Plan

Based on the significant impacts identified during the EA study, cost effective and feasible mitigation measures will be identified in order to reduce such impacts to acceptable levels.

A detailed monitoring plan was developed in order to monitor the implementation of mitigation measures and their effectiveness. The responsible parties for implementation of mitigation measures as well as for monitoring have been identified in the Environmental Management and Monitoring plan.

1.8.5.2 Identification of Further Environmental Studies Required

The requirement for additional environmental studies if any will be identified in the EA report, in the event of a situation where further studies are required which are not possible to be carried out at this stage of the project.

1.8.5.3 Identification of Potential Accidents and Emergency Situations and Measures for Emergency Response

Action to be taken by the contractor for dealing with potential accidents and emergency situations that may arise during the project implementation stage has been identified in the report and suitable response mechanisms to deal with such situations proposed.

1.9 1.9 Detailed Methodology for the Ecological Assessment

The following aspects are covered under the Ecological Assessment.

- Fauna and flora- rare or endangered species within or in areas adjacent to project-related development sites and any adjustments to the present alignment
- Sensitive habitats including wetlands, protected areas or reserves in areas affected by construction, facility siting, land application or disposal
- Aquatic, estuarine or marine communities in affected waters
- Significant natural habitats
- Species of commercial importance in land application sites and receiving waters

1.9.1 Assessment methods

Several methods were utilized to study the flora and fauna of the project route. They included both primary and secondary data collection. For primary data collection, the terrestrial habitats of the proposed routes and the surrounding areas were investigated to understand the distribution of habitat types and flora and fauna they contain. Sensitive habitats such as wetlands, protected areas, reserves and aquatic ecosystems received special attention.

Primary data collection of flora was done following 'Direct Recording Methodology'. A diurnal field survey of flora in the above areas was carried out along a 25m Line Intercept Transects (LIT) covering 10m width on either side of the road. Diameter at breast height (dbh) and tree density, canopy height, vegetation strata, species composition, and ground cover was measured at each plot with relevant the GPS locations.

Vertebrate groups that were studied in the same transects include birds, amphibians, reptiles, mammals and fish (in areas where water bodies/ways were encountered).

For all vertebrate groups but birds, "Visual Encounter Survey (VES) method" was the primary data collecting method that was used to record the fauna. Primary data on amphibians, reptiles and mammals in the project area was recorded during two random diurnal surveys.

The bird survey was carried out using a demarcated circular point within the same transects. Circular point is a visually demarcated 30m radius. During a 20 minute time period in the morning and evening of the same day species and number of birds in each circular point were recorded. Both sightings and bird-calls were used to identify the species. In addition, an opportunistic survey was conducted to record birds inhabiting the area, those who use the trees for nesting and resting in particular.

Fauna and flora that are rare or endangered were recorded with important information such as their abundance in the area etc.

Primary data on vegetation in the water bodies and on their banks along the route were collected using 'Direct Recording Methodology' during random diurnal surveys. Information on fish was obtained from the artisanal fishermen of the area.

Threats due to anthropogenic activities associated with each habitat/ vegetation type were also be noted. The possible adverse impacts to these habitats and flora and fauna due to construction/operation related activities of the proposed project were identified in this study to propose measures to minimize those impacts.

Secondary information on biodiversity of fauna and associated environmental issues was collected by personal communication with villagers and relevant officers. In addition, secondary data collection of fauna from recent related published material such as IEE and EIA reports were obtained.

The presence of protected areas such as conservation forests,

Primary data collection of flora was done following 'Direct Recording Methodology'. General diurnal field surveys of flora in the above areas were carried out along a 25m Line Intercept Transects (LIT) covering 5m width to encompass an area of 125m2 at each site. In addition all tree species subjected to removal along the road were recorded in detail.

Vertebrate groups that were studied in the same area include birds, amphibians, reptiles, mammals and fish. Visual Encounter Survey (VES) method was the primary data collecting method. Primary data on amphibians, reptiles and mammals in the project area were recorded during random diurnal surveys.

Bird surveys were carried out in four demarcated circular points (i.e. visually demarcated 30m radius) of each selected site during single day diurnal surveys. During each time period (i.e. morning and evening of the same day), all four sites were surveyed. At one point, survey was conducted for 20 minutes and species of birds in each plot were recorded during this period of time. Both sightings and bird-calls will be used to identify the species. In addition, an opportunistic survey was conducted to record birds inhabiting the area.

The possible adverse impacts to these habitats and flora and fauna due to construction/ operation related activities of the proposed project were identified in the study and measures proposed in order to minimize those impacts.

Secondary information on biodiversity of fauna and associated environmental issues were collected by personal communication with villagers and relevant officers. In addition, secondary data collection of fauna was done from recent related published material such as IEE and EIA reports.

1.10 1.10 Detailed Methodology for the Air Quality, Water Quality and Noise Impacts

The following activities were carried out in order to evaluate air quality, water quality and noise impacts from the proposed project;

i. Identification of baseline monitoring & measurement locations for air quality, water quality (both surface & ground water) & noise measurement
ii. Listing of potential impacts due to project activities on ambient air quality, surface & ground water sources & noise recipients
iii. Evaluation of significance of these impacts with the support of project team
iv. Propose remedial measures to mitigate adverse impacts
v. Propose EMMP for air, water & noise related issues

Data collection: Following approach was used in collecting data from the field at random locations along the road as well as strategic locations where increased levels of disturbances are expected.

Air - Ambient air quality monitoring locations were identified along the road corridor considering construction activities (cutting & filling operation), population density and downwind location of the proposed asphalt & crusher plant etc. Monitoring will be conducted through recognized environmental laboratory for PM10, PM2.5, SO_2, NO_2, CO & VOC (only for asphalt plants) according to the methods specified in NAAQS & proposed source emission standards of Sri Lanka.

Noise – Background noise level survey was carried out covering traffic noise, industrial noise and residential noise during daytime & night-time in densely populated areas along the road corridor according to the method specified in the noise control regulation of the Sri Lanka.

Water – Surface water from all streams & rivers crossing the road where distance apart of two streams is not less than 500m and having flowing water during long period of the year & nearby lakes were analysed for potential parameters of pH, COD, BOD, TSS, Oil & grease, likely to be change due to project activities.

At least one ground water sample was collected from densely populated rural areas where groundwater is being used for domestic activities and likely to change the quality due to road runoff for the parameters specified in the Sri Lanka Standards for Potable water. Sampling and analysis were conducted through recognized environmental laboratory as per APHA procedure.

After the full documentation of the baseline environmental situation, each of the environmental aspects were examined against the road upgrading component and activities.

Each of the direct and indirect impacts were further evaluated in terms of its magnitude, extent, severity, temporal aspects and sensitivity to determine significance

Environmental issues were assessed to describe the potential impacts that may result from road upgrading and construction. The assessment of impacts was carried out for all the three stages: design, construction and operation. Quantification is difficult in the light of the limited availability of data. Findings of the impact identification, analysis and assessment were fed into:

- Formulation of specific mitigations and enhancement measures;
- Preparation of the Environmental Management & Monitoring Plan (EMMP).

EMMP has been proposed for the significant impacts on air, water and noise related issues as well as hydrological and ecological impacts, including mitigation measures and monitoring during construction & operation period. This also includes the party responsible for implementing the mitigation measures as well as for monitoring.

1.11 1.11 Proposed Methodology for the Hydrological Study

The following activities were carried out for the hydrological study for the proposed project;

1. Preliminary identification of project influence area based on catchments and lead away outlets.
2. Collection of environmental baseline data related to hydrology and drainage.
3. Collection of drainage issues related to the candidate roads in detail.
4. Identification drainage related baseline impacts on screening drainage related issues
5. Formulation of mitigation measures (by design) necessary to alleviate drainage related impacts
6. Identification of drainage related construction impacts
7. Formulation of mitigation measures for construction impacts.
8. Identification of drainage related operational impacts
9. Formulation of mitigation measures for operational impacts.
10. Identification of natural disaster risks such as floods, tsunami

11. Identification of climate change risks
12. Provision of drainage details for the EMMP

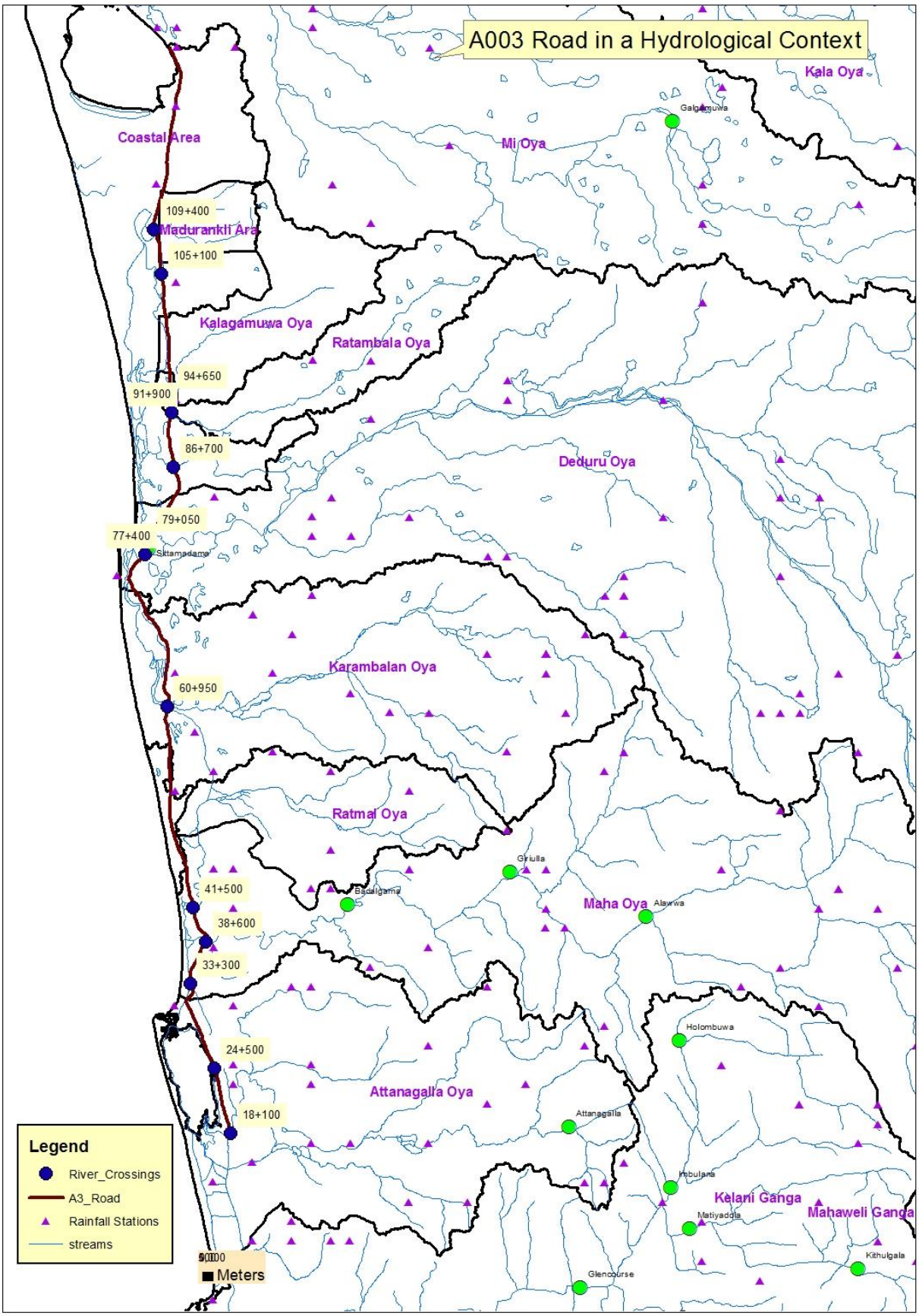

Figure 1-7 Hydrological Context - A03 Road

1.11.1 Preliminary identification of project influence area based on catchments and lead away outlets.

Upstream Catchment Areas

The project influence area in a hydrological context is based on the upstream catchment areas of drainage crossings such as culverts and bridges. The major catchment areas encompassed by the drainage flow of bridge outlets were first identified and mapped using GIS techniques based on the GPS coordinates obtained at site or the bridge location in 1:50,000 topographic maps or both Catchment areas

Lead Away Outlets

Lead away outlets of the culverts and bridges were also be identified on 1:50,000 maps based on the stream system established in these topographic maps.

Based on this information the maps showing the location of culverts, their catchments, stream network and the lead away outlets were prepared.

1.11.2 Collection of environmental baseline data related to hydrology and drainage.

Hydro meteorological baseline data such as rainfall, rainfall runoff characteristics (in the form of catchment yields), stream flows, and monthly average temperature data were collected.

Monthly rainfall data and temperature data related to the roads was obtained from the Department of Meteorology and the catchment yield data was obtained from standard publications.

As stream flows are measured only in the major rivers it is possible to collect such data in a limited way. Stream flow data was obtained from the Irrigation Department. The most important stream flow data will be the annual maximum flood peaks. Following is the relevant gauging station.

- A003 Road – Maha Oya River at Badalgama, Deduru Oya at Sittamadama

1.11.3 Collection of drainage issues related to the candidate roads in detail.

Identification and collection of the site specific drainage issues is the most important task in the hydrological study. Prevailing drainage issues will be identified through joint site reconnaissance with the staff if the Executive Engineers of RDA as they are very familiar with the existing drainage issues. Detailed site inspections were scheduled to cover all the candidate roads. During joint site inspections additional information related to floods, inundation depth etc. was also collected from the roadside stakeholders.

A quick consultation of the RDA Executive Engineers were carried out followed by a cursory site visit to identify the prevailing drainage issues with the intention of planning and carrying out detailed site reconnaissance . Following broad drainage issues were identified with regard to the candidate roads.

Table 1-1, Prevailing Drainage Issues (Preliminary Information)

Approximate Location	Prevailing Drainage Issue
A03 Road up-to Chilaw	
19+450-19+550, 35+450-35+550, 48+000-48+100, 42+950-43+050, 41+850-41+900, 61+950-62+050	Road overflow by floods
Between culverts 115/1 and 116/1 , 22km-23km	New culverts needed

119/3,116/2,116/1,114/1,112/1,108/2,102/1 , 79/2, 79/3	Suspected as under capacity culverts
45km-47km (Wennappuwa Town) , 19kmm-23km	Side drains needed
50/1 ,43/3,	Lead away blocked

1.11.4 Identification drainage related baseline impacts on screening drainage related issues

On screening prevailing drainage issues following baseline hydrological impacts could be identified.

- Road overflow because of low road profile, large upstream catchment area and inadequate number and capacity of culverts and bridges
- Drainage congestion because of no proper drainage continuity between upstream catchment, hydraulic structures and downstream lead away outlets.
- Poor side drain system for longitudinal drainage and nexus with adjoining culverts
- Upstream drainage congestion and resultant backwater from under capacity culverts.
- Road overflow from rivers by the roadside during frequent or less frequent floods.
- Blockage of inlet and lead away drains.

1.11.5 Formulation of mitigation measures (by design) necessary to alleviate drainage related impacts

Once the baseline drainage impacts were identified the first line of mitigation measures which should be implemented are the mitigation measures which could be effected through the design. Such measures are proposed during this EA. Some of the applicable mitigation measures which could be effected through design are;

1. Enlargement of the culvert openings to increase their flow capacity. It is very important to consider the maintenance aspect in these culvert openings. Based on the road condition minimum culvert widths or diameters will be suggested. For box culverts the minimum width for 4 lane sections could be 1.5m and that for two lane section could be 1.0m-1.2m depending on the circumstances. Larger widths for culverts are necessary for town areas as tendency towards culvert blocking through garbage is greater. Box culverts will be more suited for town areas and low lying areas. Minimum diameter for pipe culverts will be 900mm. Caution should be exercised in proposing 1200mm diameter culverts as technical issues of construction may arise because inadequate cover (bedding).
2. Provision of side drains at places where longitudinal drainage is poor. Such side drains will be necessary at places where there are townships.
3. Provision of new culverts at necessary places. Several such places have been preliminarily identified in A03 Road.
4. Raising the road profile in sections subjected to inundation by frequent floods. If the inundation is at a manageable level and the inundation is frequent such sections will have to be raised. Such sections exist in all candidate roads.

The approximate chainage ranges of the road that may have to be raised after further hydrological investigations are given in Table 1-1 above.

5. Proposing road surface concreting for sections subject to infrequent high inundation.
6. Improvement of upstream inlet drains and downstream lead away drains which in low capacity. This activity will also be a very important one and it will be necessary to delve into the areas

outside the Right of Way (ROW). All major inlet and lead away drain issues will be separately identified and reported along with the proposed improvements. Necessary surveys will be proposed to map the drainage network.

1.11.6 Identification of drainage related construction impacts

Drainage related construction impacts are generally common to highway construction and such impacts are listed. If there is any site specific impacts, such impacts will be separately identified. Common construction drainage impacts are;

- Stream blockages by coffer dams for bridge construction
- Stream blockages by culvert construction
- Siltation of paddy and low lying areas from earth used to road embankments and soil from road cuts
- Aggravation of floods during construction by coffer dams, temporary soil mounds, temporary stream diversions etc.

1.11.7 Formulation of mitigation measures for construction impacts.

Suitable mitigation measures including monitoring is provided for construction impacts. Mitigation measures such as controlling the heights of coffer dams, phased construction work, providing temporary side drains, providing silt traps and silt fences are suggested.

1.11.8 Identification of drainage related operational impacts

The most common drainage related operational impact is the periodic siltation of culverts and inlet and lead away drains. There could also be road damage by infrequent heavy floods.

1.11.9 Formulation of mitigation measures for operational impacts.

Operational impacts could also be mitigated by the proposed mitigation measures by design. Other mitigation measures such as periodic maintenance of streams are proposed. Involvement of Local Authorities will also be necessary for this process.

1.11.10 Identification of natural disaster risks such as floods, tsunami

Risks of natural disasters such as floods, Tsunami (for A03 Road in Puttlam Town) were identified using the standard publications and information available in Disaster Management Centre. Information from the website “hazard.lk” were also made use of.

1.11.11 Identification of climate change risks

In order to deal with the climate change considerations relating to the candidate road, several publications were referred to, which are given in the references section. (Reference numbers 1, 2 and 3). Recently updated Rainfall Intensity Duration Frequency Curves were also made use of in this regard.

The main vulnerability indicators relevant to highway infrastructure projects are:

1. Shifting of climate zones
2. Flood risk (Increased vulnerability to floods)
3. Land slides
4. Sea level rise

5. Drought exposure

For each theme vulnerability maps are available for the entire country and the vulnerability of the candidate roads could be inferred. A typical flood vulnerability map is shown in figure 1-11.

1.11.12 Provision of drainage details for the EMMP

Detailed drainage related impacts, related mitigation measures, locations of impacts (road chainage), Implementation organizations (e.g. RDA, Local Authorities. SLLRDC), Irrigation Department will be indicated in the EMMP.

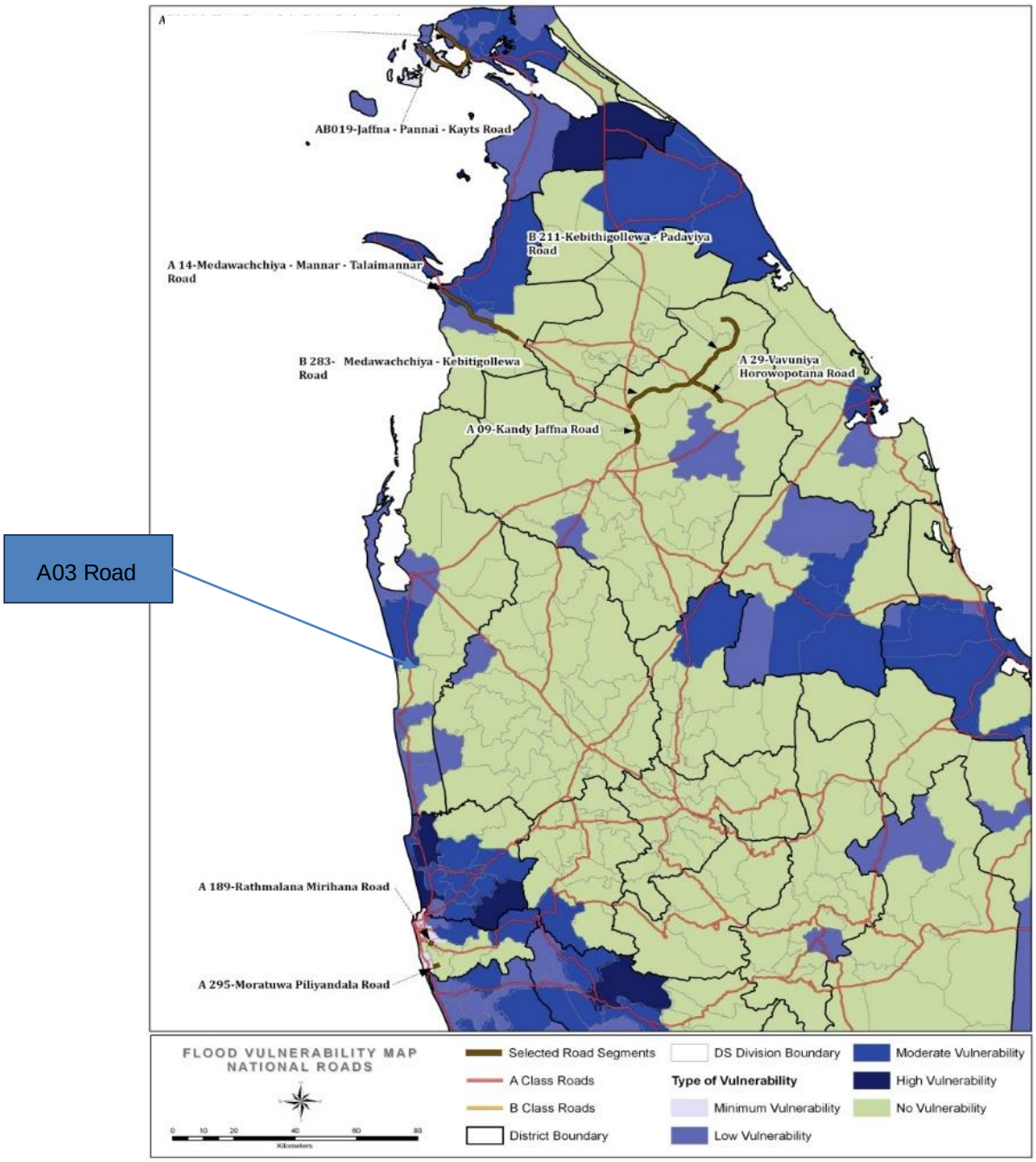

Figure 1-8, A Typical Flood Vulnerability Map

1.12 1.12 Methodology Adopted for the Socio-Cultural and Economic Study

When the inception Report was presented, officials from the World Bank & the Road Development Authority expressed their comments for this Section. RDC is attending to a separate Socio–Economic Survey in detail for the preparation of the RAP for this project. Therefore is in not necessary for an in depth socio economic analysis, to be conducted again.

Therefore the socio-cultural economic study was done to cover this area using the following Methodology.

1.12.1 Literature Survey & desk Study

To identify the social & economic conditions in the project area available information was collected at District Secretariat Office & Divisional Secretariat offices. Total population, ethnicity, Religion by population, total land area & land use patterns, livelihood patterns & main economic activities etc. analyzed by using this information

The details of project affected population / affected land area /affected structures were obtained from Resource Development Consultants. (Results of Survey done by them).

1.12.2 Observation Method for community participation

To identify the perception, views and ideas of the development activities various interviews, such as focus group discussions & key informant interviews among the beneficiaries and affected community, were conducted.

1.12.3 Line Agency meetings

To make aware and get the support for the development programs, stakeholders meetings / line agency meetings in district and divisional level were conducted

CHAPTER 2

2. Description of the Environment

2.1 Climate

2.1.1 Rainfall

The proposed improvement of candidate road (A003) section traverses from Dedugam Oya to the northern part of the country. The road segment starts at Dedugam Oya which is in the Wet Zone area around Ja-ela and traverse through the intermediate zone cities such as Negombo, Marawila and Chilaw. Mean annual variations of these climatic zones are as follows.

Wet Zone - 2000mm-5000mm

Intermediate Zone- 1500mm-2000mm

A003 road traverses all four climatic zones from Ja-Ela to Puttalam and the selected section through the above two.

The following figure 2-1 indicates the Climatic zones of the project area covered by A003 Road.

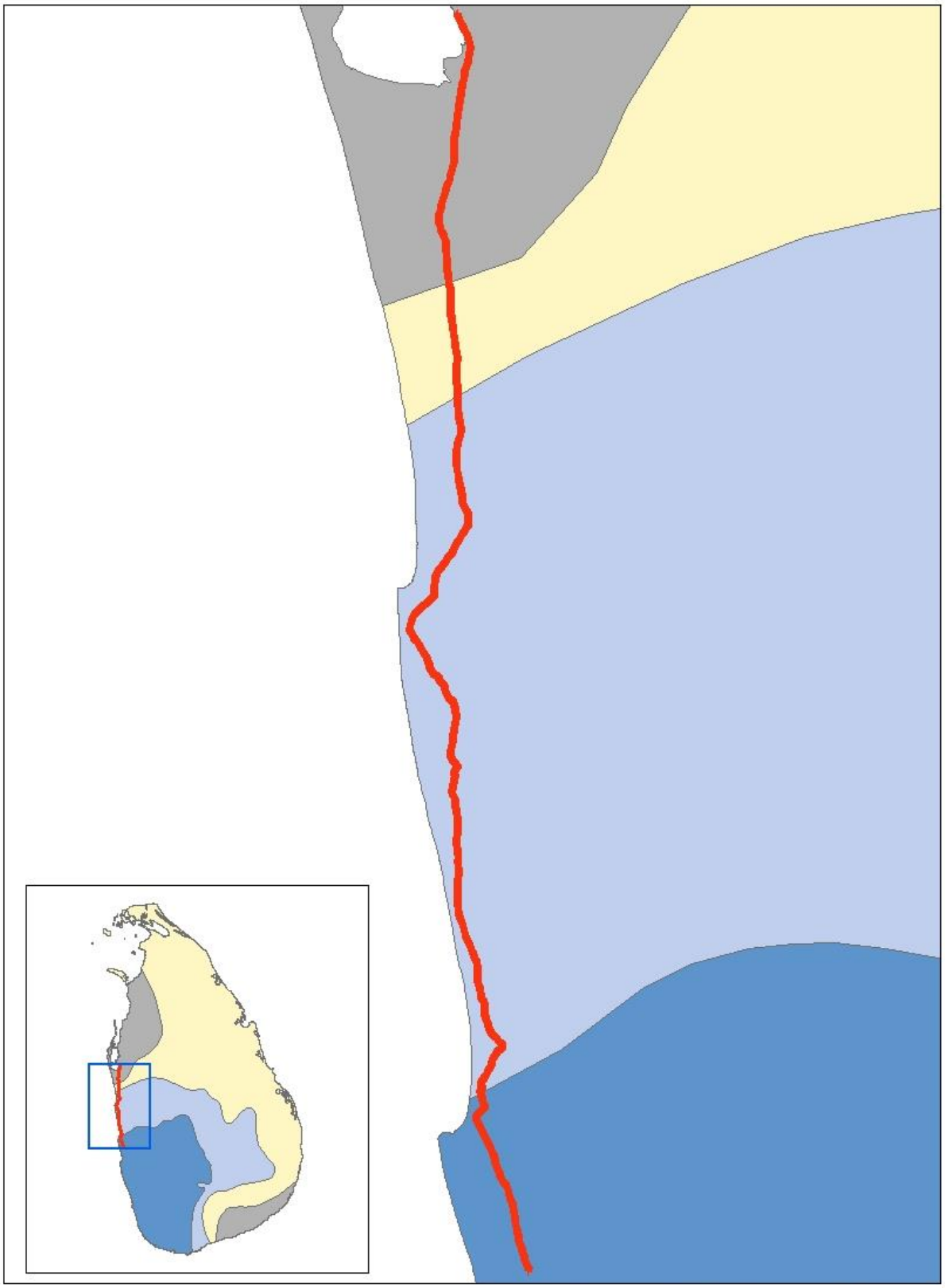

Figure 2-1, Rainfall Variations along the Project Area

The main rainfall seasons along the project trace are the South West monsoon from May to September and North East Monsoon from December to February. The rainfall patterns of the closest metrological stations such as Colombo, Katunayake, Chilaw and Puttalam for the period of 2010 to 2014 are given in the following tables 2-1, 2-2, 2-3. The high rainfall peaks are common in the months of April and May for

the South West Monsoon season and November and December for the North East Monsoon period. Corresponding flood peaks takes place and such flood peaks causes inundation of the candidate road at some locations.

Table 2-1, Monthly rainfall pattern at Colombo station (2010 -2014)

Source: Metrological Department of Sri Lanka

Year	Month											
	January	February	March	April	May	June	July	August	September	October	November	December
2010	21.0	4.5	72.3	482.9	727.8	200.4	117.8	14.7	306.6	158.3	971.5	292.1
2011	61.7	33.7	149.5	354.3	197.8	178.6	98.2	148.6	76.2	242.0	188.3	45.3
2012	158.7	140.1	122.0	532.3	152.0	88.6	41.1	200.3	180.0	507.3	207.4	134.8
2013	90.9	164.3	108.3	148.1	404.5	260.4	198.2	21.8	216.8	140.3	204.7	32.3
2014	85.6	19.5	144.8	254.7	83.5	238.7	35.2	255.4	312.7	449.6	278.8	476.5

Table 2-2, Monthly rainfall pattern at Katunayake station (2010 -2014)

Year	Month											
	January	February	March	April	May	June	July	August	September	October	November	December
2010	52.2	6.3	130.6	310.4	680.1	117.8	51.0	8.1	235.6	201.7	576.9	214.9
2011	26.9	28.2	38.0	272.9	137.8	57.5	66.0	66.4	64.7	404.8	159.9	123.0
2012	12.4	124.0	62.9	328.6	24.3	154.5	44.1	196.7	110.2	567.4	155.8	164.3
2013	122.9	89.2	89.4	76.5	523.5	240.6	157.9	91.2	272.2	164.6	194.3	34.8
2014	26.2	1.5	130.1	193.2	163.0	146.0	110.5	317.7	123.8	369.0	259.0	436.3

Source: Metrological Department of Sri Lanka

Table 2-3, Monthly rainfall pattern at Chilaw station (2010 -2014)

Year	Month											
	January	February	March	April	May	June	July	August	September	October	November	December
2010	3.1	0.0	0.0	21.2	51.5	3.8	0.0	7.9	22.9	19.1	201.7	125.6
2011	5.8	4.6	0.0	202.8	26.6	34.6	25.0	10.0	25.5	230.0	110.0	20.0
2012	9.0	39.5	26.5		0.0		1.9	3.3	31.9	295.6	246.1	400.7
2013		100.5	56.5	16.1	169.5	51.4	9.1	7.9	115.0	216.2	245.2	108.7
2014	71.6	7.3		264.0	147.4	7.0	8.1	261.0	85.1	374.0		

Source: Metrological Department of Sri Lanka Lanka *Missing Data*

Temperature

Average annual temperature varies from 28ºC to 32ºC. The closest metrological stations with reliable metrological data to the project trace are Colombo, Katunayake and Puttalam. Monthly temperature data for these stations from 2010 to 2014 are presented in Tables 2-4, 2-5, and 2-6 below.

Table 2-4, Monthly Temperature recorded at Colombo station

Year	Range	Month											
		January	February	March	April	May	June	July	August	September	October	November	December
2010	Max	31.9	32.4	32.6	32.0	31.2	30.7	30.0	29.7	30.0	30.1	29.8	29.4
	Min	23.6	24.8	25.5	25.5	26.0	26.4	25.6	26.4	25.8	25.6	24.2	23.7
2011	Max	29.9	30.0	31.7	31.0	31.3	30.8	30.2	30.2	30.5	31.0	30.8	30.5
	Min	23.2	24.0	24.7	24.9	26.7	26.4	26.2	26.2	26.1	25.2	24.3	23.6
2012	Max	30.8	31.7	31.5	31.3	31.7	30.8	30.6	30.7	30.4	30.8	31.0	30.7
	Min	22.8	23.4	25.0	24.5	26.7	26.5	26.5	25.5	25.6	24.5	24.0	23.9
2013	Max	31.2	31.5	31.9	32.4	31.1	30.0	30.0	30.1	30.0	30.5	30.9	31.1
	Min	23.3	23.8	25.1	26.4	26.8	25.6	25.6	25.9	25.3	25.5	24.3	23.8
2014	Max	31.4	31.6	32.3	32.2	31.6	31.0	30.9	30.2	30.6	30.4	30.1	29.6
	Min	23.6	23.6	24.8	25.3	26.6	27.1	26.8	25.6	25.3	24.7	24.0	23.8

Source: Metrological Department of Sri Lanka

Table 2-5, Monthly Temperature recorded at Katunayake station

Year	Range	Month											
		January	February	March	April	May	June	July	August	September	October	November	December
2010	Max	31.7	33.2	33.1	32.2	31.6	30.9	30.7	30.4	30.8	30.5	30.2	29.3
	Min	22.5	23.5	24.2	25.0	25.5	25.9	25.2	25.9	25.4	25.0	23.5	23.0
2011	Max	30.1	30.9	32.6	31.5	31.8	31.1	30.7	30.6	31.0	31.5	31.3	30.7
	Min	22.2	22.8	23.7	24.0	26.3	26.3	26.0	25.8	25.3	24.3	23.5	22.9
2012	Max	31.7	32.8	32.1	31.5	31.9	30.8	30.6	30.7	30.5	30.8	30.8	30.8
	Min	21.7	22.8	24.1	23.9	26.2	26.1	26.3	24.9	25.1	23.9	23.5	23.2
2013	Max	31.0	32.3	32.7	32.5	31.0	29.6	29.8	30.4	29.9	30.8	31.2	30.9
	Min	22.3	22.9	24.3	25.4	26.1	25.2	25.3	25.6	24.9	25.0	23.5	22.9
2014	Max	32.4	32.5	33.2	32.2	31.5	31.0	30.8	30.0	30.5	30.4	29.9	29.6
	Min	22.9	22.3	24.0	24.7	25.8	26.8	26.6	25.3	25.2	24.3	23.4	23.4

Source: Metrological Department of Sri Lanka

Table 2-6, Monthly Temperature recorded at Puttalam station

Year	Range	Month											
		January	February	March	April	May	June	July	August	September	October	November	December
2010	Max	31.0	33.1	34.4	33.4	32.6	31.9	31.6	30.7	31.1	30.4	31.0	28.6
	Min	21.2	21.9	23.6	25.2	26.4	26.7	25.9	25.6	25.5	25.4	23.9	22.7
2011	Max	28.9	29.7	32.1	31.9	32.2	31.9	31.2	31.5	31.9	32.0	30.7	30.0
	Min	21.5	21.9	22.7	23.8	26.4	26.8	26.4	26.5	26.7	25.1	23.3	22.3
2012	Max	30.9	32.4	32.5	32.3	32.5	31.7	31.7	31.9	32.1	31.3	30.3	29.6
	Min	20.9	22.0	23.3	24.3	27.1	27.0	26.7	26.5	26.4	24.4	23.4	22.8
2013	Max	29.7	31.0	32.7	33.2	32.5	31.0	31.2	31.6	30.7	31.4	30.9	29.6
	Min	21.5	21.9	23.5	25.3	27.1	26.5	26.2	25.8	25.5	25.1	23.0	21.8
2014	Max	30.1	32.3	34.4	33.0	32.4	32.1	31.6	31.3	30.3	31.1	29.6	28.9
	Min	21.7	20.8	23.1	24.2	26.1	27.6	27.0	26.1	25.6	24.4	23.1	23.2

Source: Metrological Department of Sri Lanka

Table 2-7, Monthly rainfall pattern at Puttalam station (2010 -2014)

Year	Month											
	January	February	March	April	May	June	July	August	September	October	November	December
2010	5.6	1.0	7.7	147.1	52.4	11.9	35.3	52.5	247.4	89.9	353.1	330.0
2011	84.1	104.5	11.9	171.1	1.9	12.6	23.5	5.2	4.7	179.3	167.3	60.2
2012	24.5	28.1	76.0	102.2	1.1	13.6	0.3	18.8	44.2	349.3	164.0	319.1
2013	87.4	93.0	78.5	36.6	27.7	3.0	9.9	14.5	101.6	122.1	287.5	43.3
2014	97.2	9.2	35.3	208.4	84.9	15.4	0.0	66.2	110.1	250.1	347.0	472.8

Source: Metrological Department of Sri Lanka

The tables indicate the monthly average rainfall variations from Colombo and Puttalam rainfall stations close to the road trace, the variations between the lowest and highest average rainfall recorded are quite high

2.1.2 Rainfall Intensity Duration Frequency curve

Rainfall intensity information is more useful than daily rainfall figures as these curves are used to find critical rainfall for different return periods. The rainfall Intensity, Duration Frequency (IDF) curves for Colombo, Chilaw and Puttalam principle meteorological stations are relevant to the candidate A003 Road. These IDF curves are presented below in figures 2-2, 2-3 and 2-4.

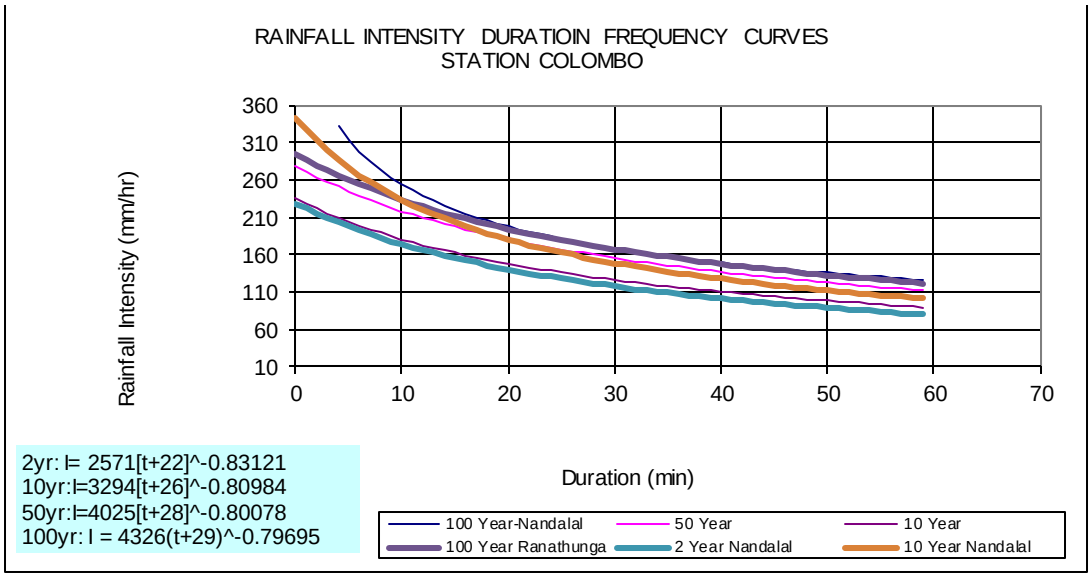

Figure 2-2, Rainfall intensity duration curve at Colombo

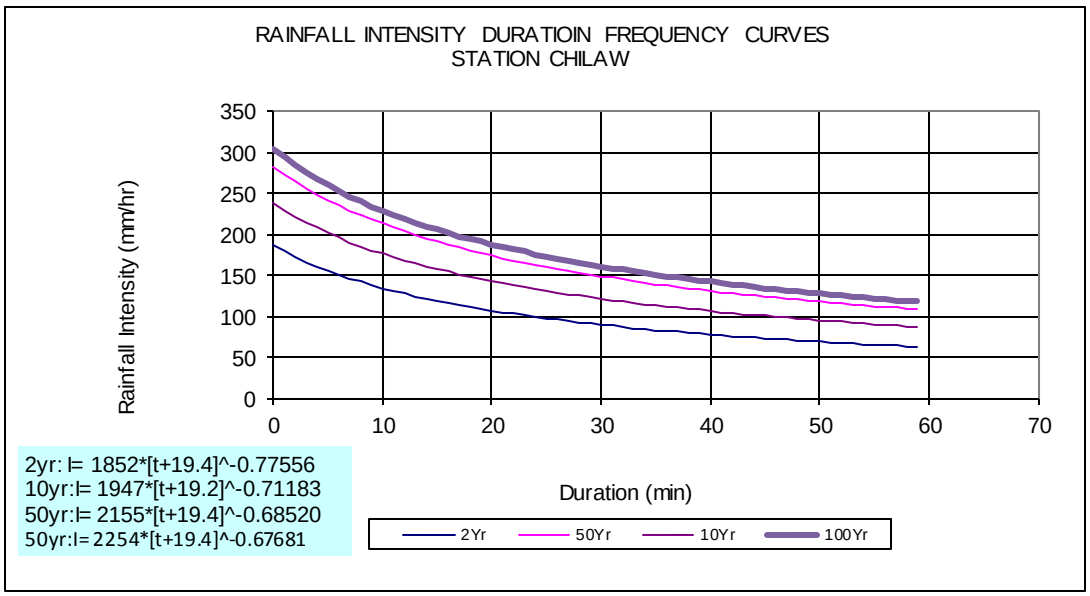

Figure 2-3, Rainfall intensity duration curve at Chilaw

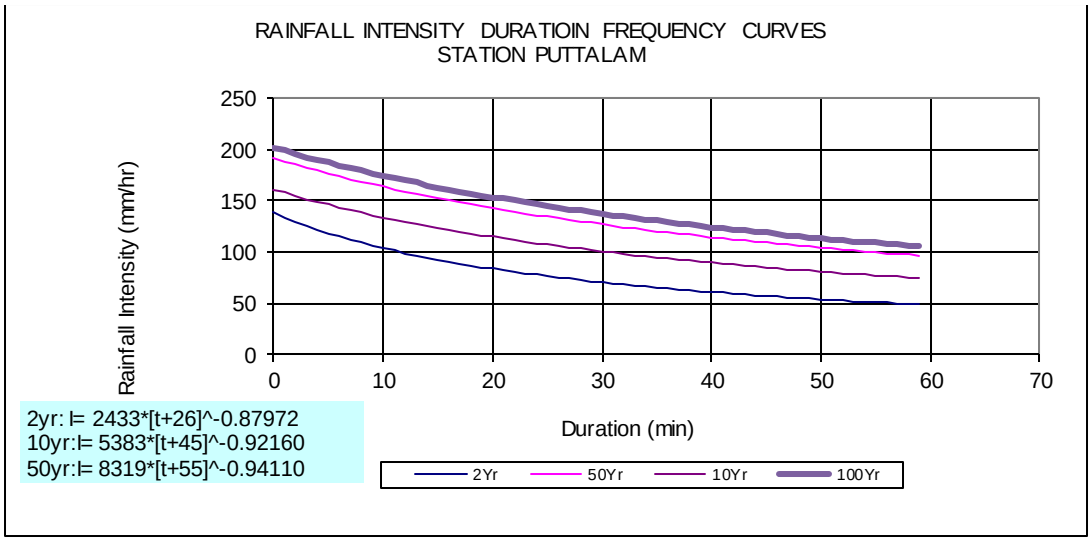

Figure 2-4, Rainfall intensity duration curve at Puttalam

2.1.3 Runoff characteristics around the project area

Runoff characteristics are reflected in the measured flow records of major rivers. The reliable runoff characteristics around the project trace are available for the hydrometric stations Maha Oya at Badalgama and Deduru Oya which are presented below in Tables 2-8 and 2-9.

Table 2-8, Stream flow at Badalgama on a water year basis in MCM

Name of the Station & River basin	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Badalgama/Mahaoya	98.34	64.46	22.18	5.09	10.50	7.71	62.75	8.03	8.63	22.92	7.69	8.83

Source: Hydrological Annual 2011/2012 Irrigation Department, Ministry of irrigation and water resources management

Table 2-9, Stream flow at Chilaw on a water year basis in MCM

Name of the Station & River basin	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Chilaw / Deduruoya	179.04	166.91	167.48	159.45	152.50	169.56	171.82	179.82	164.93	171.19	178.45	165.70

Source: Hydrological Annual 2011/2012 Irrigation Department, Ministry of irrigation and water resources management

2.2 Surface and groundwater hydrology

2.2.1 Groundwater Situation and Aquifers

The A003 road traverses through urban, semi urban and rural areas and close to low lying paddy areas, flat home gardens and crosses major, minor and medium waterways. Groundwater levels are high in paddy areas and in the areas close to river and stream crossings especially in the Wet Zone. Groundwater levels are low in the other climatic zones during most of the months and groundwater levels could be high during the North East monsoon period where heavy rainfall takes place recharging the aquifers. Figure 2-5 below illustrates different types of groundwater aquifers on which the road corridor is placed.

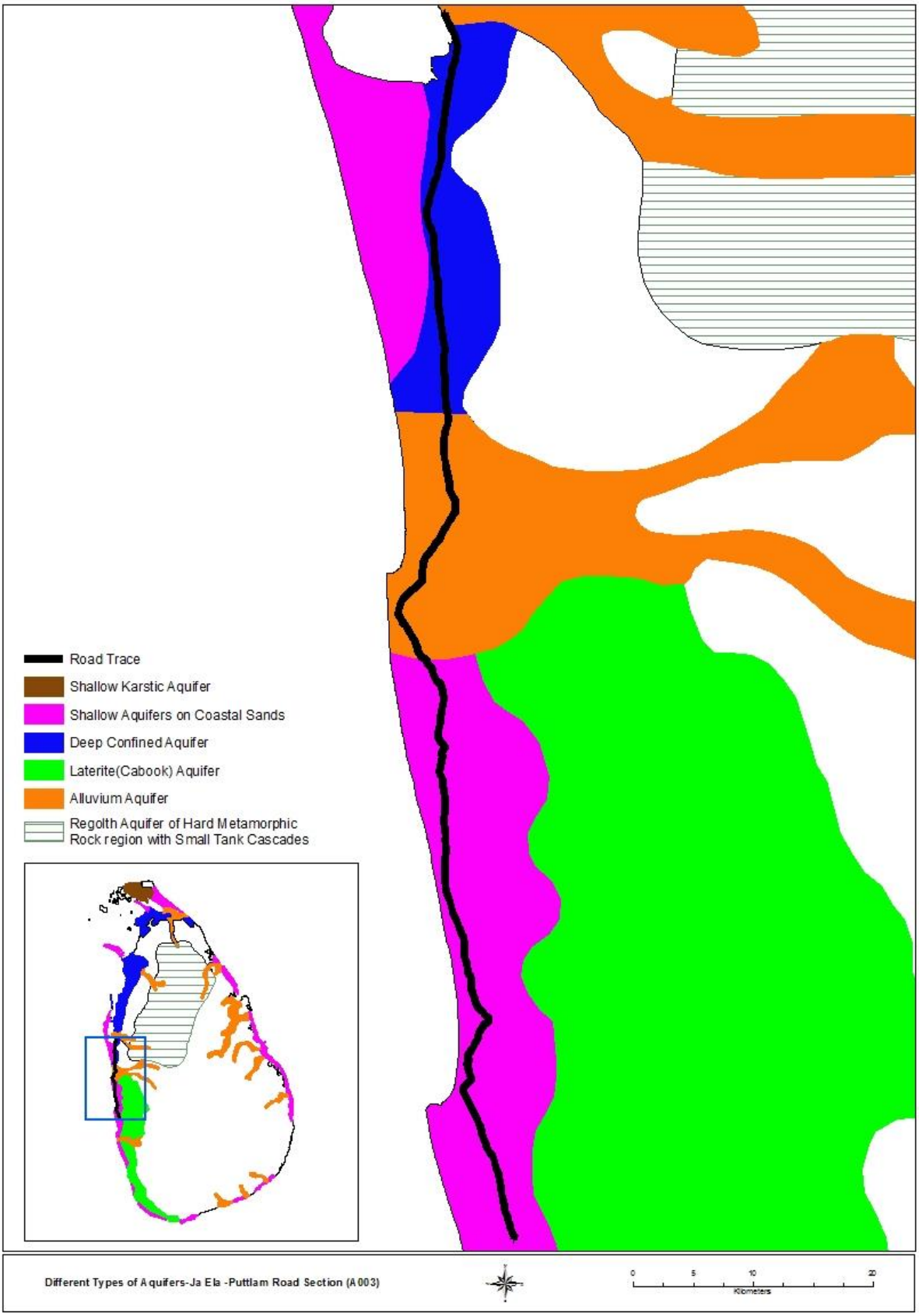

Figure 2-5, Groundwater Aquifers in the Vicinity of A003 Road

2.2.2 Surface Water-Rivers/Streams

The major visible streams intercepted by this road are given in the following table 2-10, In addition to this there are many minor streams and few irrigation canals which pass through the candidate road culverts.

Table 2-10, Major waterways crossed by the A003 road

S.No	Major Waterway Intersected by Ja-Ela – Puttalam Road	Approximate Chainage km+m	Remarks
1.	Dandugam oya	18+500	Within project areas
2.	Maha oya	37+600	A major waterway intersected by A003 Within project areas
3.	Rathmal oya	48+000	Within project areas
4.	Karambalan oya (Lunu Oya)	61+000	Within project areas
5.	Gin oya	41+500	Within project areas
6.	Deduru oya	79+100	The largest waterway intersected by A003. Outside project area
7.	Senagal oya	86+900	Outside project area
8.	Battulu oya	93+800	Outside project area
9.	Madhurankuli aru	109+500	Outside project area

It is noted that, a part of the Negombo-Puttalam canal (Dutch Canal) which is running parallel to the B028 Road falling onto the Lunu oya which cut across the A3 road along with the bridge (Ch 33+400).

It is seen that A003 Road segment from Dedugam Oya to Puttlam passes through several large and medium river basins. Details of river basins, drainage system and hydrometric stations are presented in the Figure 2-6 below.

2.2.3 Drainage Pattern

As the road traverses on the western coastline most of the main waterways drain across the road directed to the West originating from the east. The drainage pattern of the road environs is depicted in the Figure 2-6 below.

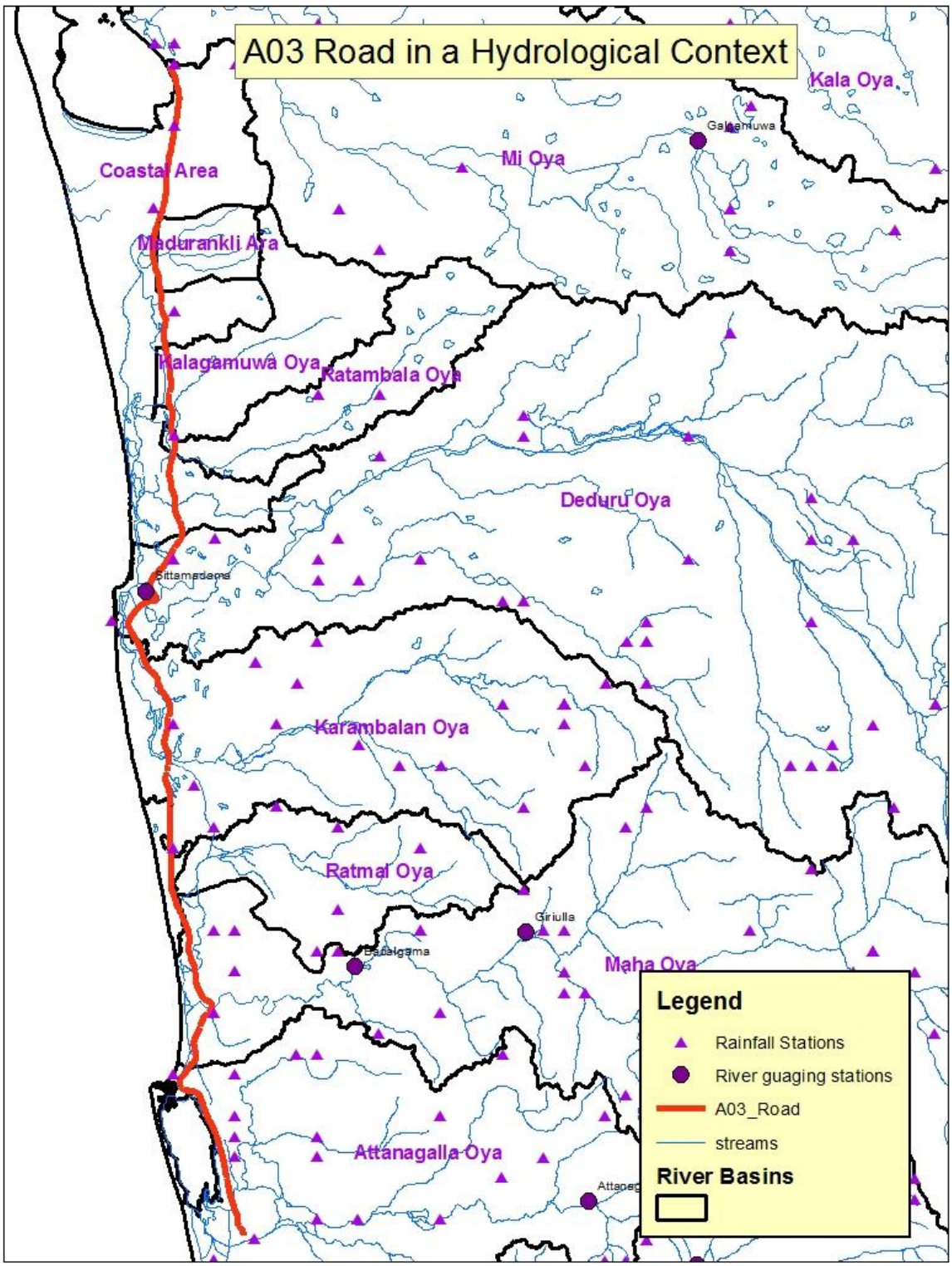

Figure 2-6, Drainage Pattern and Hydrometric Stations

2.2.4 Culverts and Bridges

There are many culverts and few bridges across the road. Within the project Maha Oya has a comparatively larger bridge. There are also few minor and medium scale bridges. Culverts are box culverts and pipe culverts. Locations of these relevant culverts are depicted in Annex 1. Sample of one figure is given below in figure 2-7.

Figure 2-7, Sample of a Culvert Location

2.2.5 Flood areas

Water overflows the road at several locations during frequent and rare floods. Some locations overflow only during rare floods. These locations are given in Annex 2. A sample is given in Figure 2-8 below.

Figure 2-8, A sample Flood Area Map

Approximate Chainage Ranges of Flood Areas within the project section includes: 19+450 -19+550, 35+450-35+550, 48+000-48+100, 42+950-43+050, 41+850-41+900, 61+950-62+050,

2.2.6 Irrigation Tanks

The trace does not encounter any flood protection scheme as such but the A003 road traverse close to number of irrigation tanks and as the trace cuts across many paddy grown areas, it intersects several minor irrigation schemes. Details of the minor irrigation tanks available in the vicinity of the A003 main road are given below in Table 2-11 below.

Table 2-11, Details of Irrigation Tanks in the Vicinity of A003 Road

Name of Irrigation Tank	Approximate Chainage km+mmm	Proximity
Dummaladeniya Wewa	45+000	Away Not applicable for the project
Wennappuwa Wewa	46+000	Away Not applicable for the project
Maha wewa	59+500	Touched by A003 Road; Applicable for the project
Tinapitiya Tank	62+000	Touched by A003 Road; Applicable for the project

It is seen that a few tanks are very close to the road edge and one tank is intersected by the road. However, only water bodies that are closer or linked through streams or canals that cut across the road are likely to have impacts due to project activities.

2.2.7 Lagoons

The candidate part of the road traverses close to Negombo Lagoon (19+000km -29+000km).

To view the approximate distances to lagoon from the candidate road edge, the road trace near the lagoon was plotted on detailed map which is shown below.

Figure 2-9 Proximity of A003 Road to Negombo Lagoon

2.2.8 Retention Areas

Most of the low lying paddy areas throughout the A003 road and some of the flat areas (coconut, home garden or scrubs) close to major waterways (refer table 2-11 above for details) act as retention areas temporarily during floods. These retention areas play an important role in the overall flood alleviation process and they have a positive impact on the road. However some of these retention areas encompass large catchment areas and if the road profile is low such low segments of the road could overflow by frequent floods.

2.3 Soils and Geology

The A 003 road starts from the capital city and ends at Puttalam, a town in the North Western Province. The road traverses across the Gampaha and Puttlam districts. The road traverses through flat terrain within 5km from the west coast of the island. The road crosses three climatic zones; Wet zone, Intermediate zone and dry zone. The road crosses several major rivers and many streams. The economy of the area is mainly dependent on fishery, Agriculture and industries. Coconut farms and paddy can be seen on either the sides of the road.

Since more than 90% of Sri Lanka's surface lies on Precambrian strata, the granulite facies rocks of the Highland Series (gneisses, ilmenite-graphite gneisses, quartzite, marbles, and some charnokites) make up most of the island, surface of the project area also would be the same and totally lies on Wanni complex. Road traverses through inland about 4 km away from the sea at some sections and adjacent to the coast in some other sections, also below 50m above sea level. Existing Jurassic sediments are present in very small areas in Puttalam District, near the western coast and Miocene lime stones underlie the latter part of the project area and extend south in a relatively narrow belt along the west coast. A large number of streams cross the road which are starting from inland so alluvial soil also is there distributed in valleys, river basins and in some coastal areas. Detailed geological maps of the area are shown below in figures 2-13, 2-14, and 2-15.

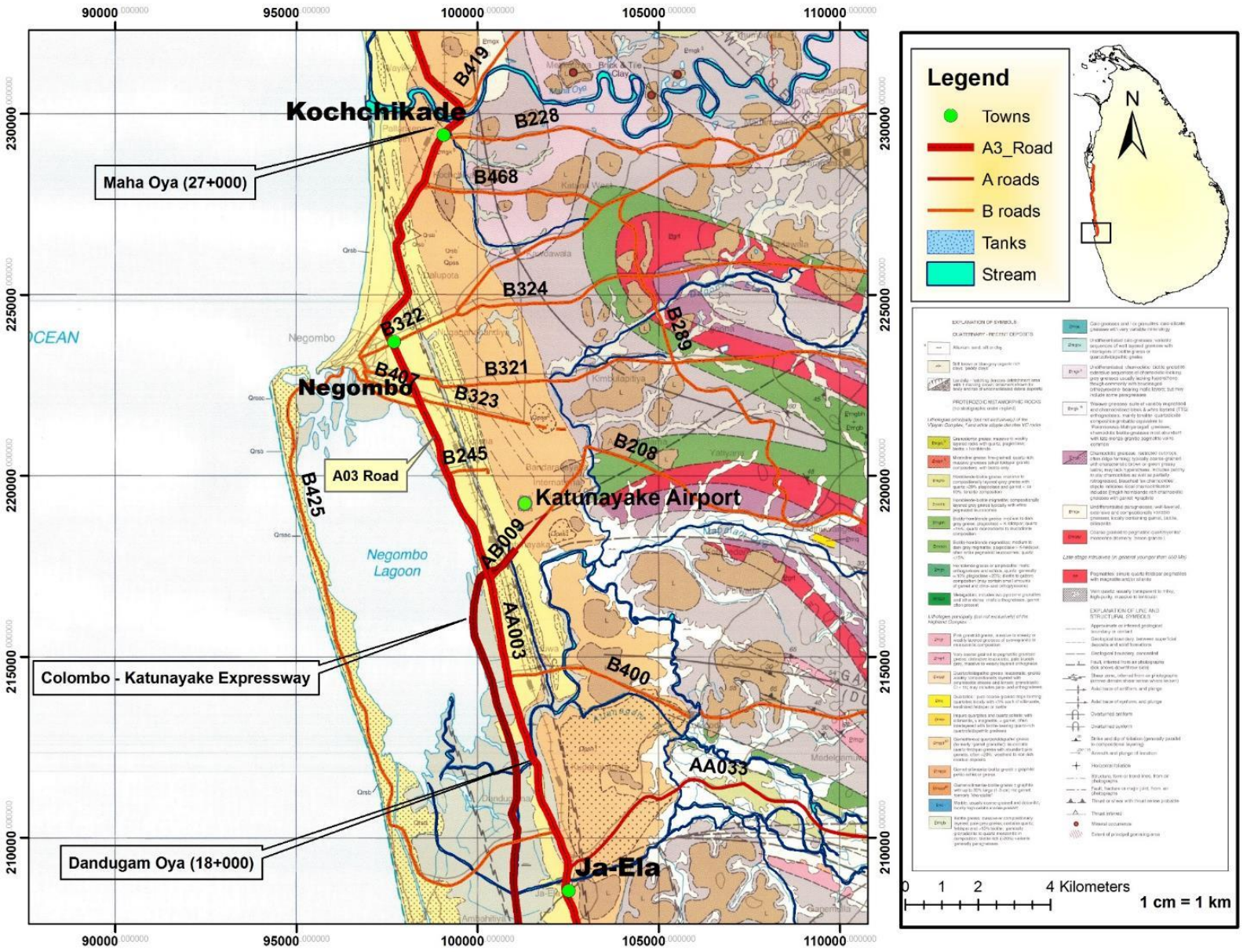

Figure 2-10, Geological Map (Ja-Ela to Kochchikade)

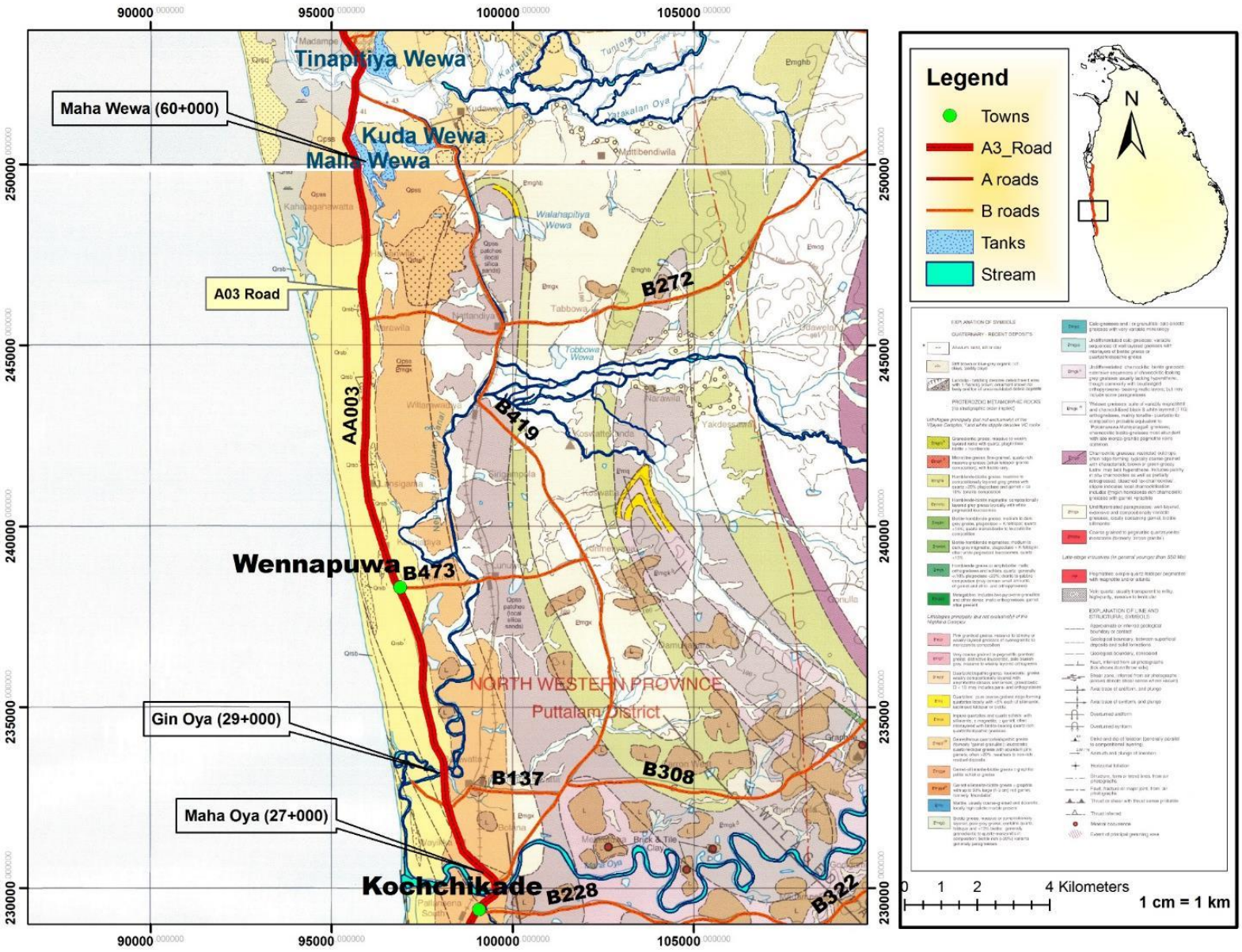

Figure 2-11, Geological Map (Kochchikade to Maha Wewa)

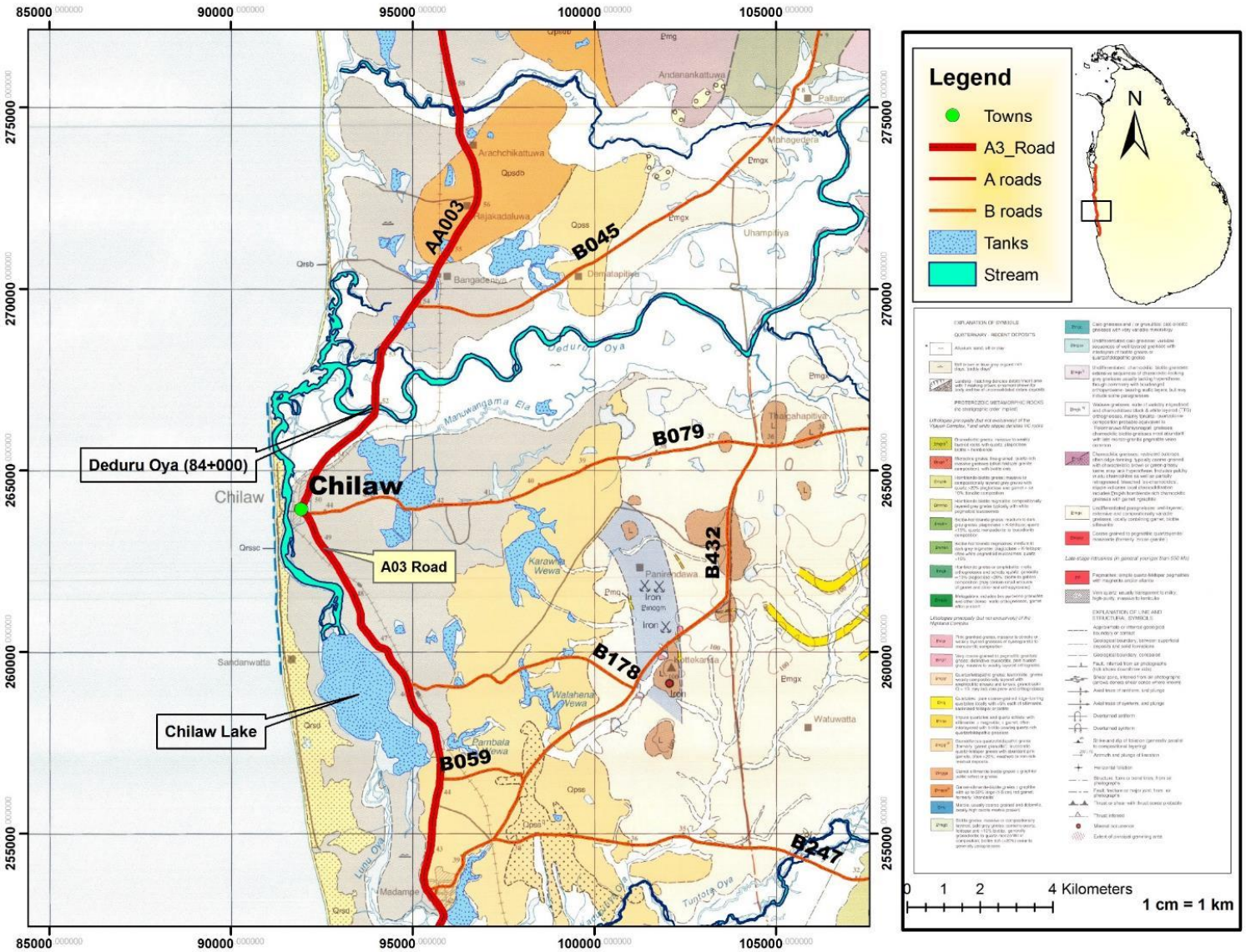

Figure 2-12, Geological Map (Maha Wewa to Anawilundawa)

2.4 Natural disasters

The proposed rehabilitation work along the candidate road (A003), traverse through flat terrain along with some low-lying areas. Seasonal floods and drought are the major disasters which have affected the project area in the past, while the tsunami also affected this area to some extent. Data available from the Disaster Management Centre (DMC) provides details of frequent disaster events for the period 1974 to 2014 as indicated in the table 2-12 below.

Table 2-12 Disaster Recorded for A003 Road (Ja-Ela to Puttalam) - Disaster Data from 01.01.1974 to 31.12.2014

District	DS Division	Disaster	No. of Events	No. of Houses Damaged	No. of People Affected
Gampaha	Ja-Ela	Flood	70	86376	432
	Katana	Flood	71	217087	594
	Negombo	Flood	39	60412	45
Puttalam	Arachchikattuwa	Flood	11	336	73802
	Chilaw	Flood	15	294	60862
	Madampe	Flood	16	131	11651
	Mahawewa	Flood	24	554	23571
	Mundalama	Flood	39	5	88050
	Nattandiya	Flood	65	160	47503
	Puttalam	Flood	18	403	41625
	Wennappuwa	Flood	28	311	8768
Gampaha	Ja-Ela	Drought	2	-	-
	Katana	Drought	1	-	-
	Negombo	Drought	1	-	-
Puttalam	Arachchikattuwa	Drought	10	-	191255
	Chilaw	Drought	5	-	15402
	Madampe	Drought	2	-	15089
	Mahawewa	Drought	1	-	419
	Mundalama	Drought	7	-	68150
	Nattandiya	Drought	2	-	19131
	Puttalam	Drought	8	-	61570
	Wennappuwa	Drought	1	-	363
Gampaha	Ja-Ela	Tsunami	-	-	-
	Katana	Tsunami			
	Negombo	Tsunami	1	259	13350
Puttalam	Arachchikattuwa	Tsunami	-	-	-
	Chilaw	Tsunami	1	-	3000
	Madampe	Tsunami	-	-	-
	Mahawewa	Tsunami	-	-	-
	Mundalama	Tsunami	-	-	-
	Nattandiya	Tsunami	1	-	30
	Puttalam	Tsunami	-	-	-
	Wennappuwa	Tsunami	1	34	648

Source: Disaster Management Centre -Colombo

2.5 Biological Environment

Following section describes the biological environment of the project area. The distribution of flora considered in the study is confined to 5m width from the RDA boundaries on either side of the road. A general distribution of fauna is given. In addition to these two areas, sensitive ecosystems found within 500m from the RDA boundaries along A003 road were studied with their special characteristics. They include streams, tanks and ponds.

2.5.1 Description of the existing flora of the project area

Biogeographically, the proposed road section lies within the low country wet zone and floristically this section falls within Northern Wet Lowlands Floristic Zone. The natural vegetation one would expect in this zone is tropical wet evergreen forest, but the study area does not contain any natural vegetation cover as the total stretch is highly urbanized. As such, the natural vegetation along the roadside of the study area has been replaced by a man-made vegetation. The floristic habitats in the study area can be broadly categorized into home garden vegetation (including both homes, commercial, industrial and other sites such as schools, temples, churches, mosques, institutions etc.) (Fig.2-18.a, 2-19b), roadside vegetation (Fig. 2-20) and stream vegetation Fig. 2-21). The study covered the vegetation (trees and shrubs only) in all three habitat types covering five meter width from the boundaries of the Road Development Authority on either side of the road.

Figure 2-13 a: Home garden vegetation types

Figure 2-14, b: Home garden vegetation types

Figure 2-15, Roadside vegetation

Figure 2-16, Vegetation around Dandugam Oya bridge

2.5.1.1 Home garden vegetation

Including both homes, commercial, industrial and other sites such as schools, temples, churches, mosques, institutions etc.

Majority of habitats in the study area come under home garden category. Most common species observed include *Mangifera indica* (Sinhala name (S): Amba), *Cocos nucifera* (S: Pol), *Filicium decipiens* (S: Pihimbiya), *Terminalia catappa* (S: Kottamba) and *Azadirachta indica (S: Kohomba).* No endemic species were observed under this habitat category (MOE, 2012). Trees and shrubs observed in home gardens are given in Table 2.13.

2.5.1.2 Roadside vegetation

Road side vegetation mostly consisted of exotic trees that had been planted in rows. E.g. *Leucaena leucocephala* (S: ipil)*, Albizia lebbeck* (S: Suriya mara)*, Samanea saman* (S:Pare mara), *Terminalia arjuna*(S: Kumbuk)*, Terminalia catappa* (S:Kottamba), *Phanera variegate*(S: Koboleela)*, Tabebuia rosea* (S: Tabebuia)*, Filicium decipiens* (S: Pihimbiya) etc. No endemic species were recorded (MOE, 2012). Trees and shrubs observed along the roadside are given in Table 2-13.

2.5.1.3 Stream vegetation

There is one stream running across the proposed road section. That is the Dandugam Oya (Stream). The stream in this section is not heavily vegetated. However, some vegetation along the bank and some floating vegetation could be seen. The bank vegetation consisted of species such as Annona glabra (Wel Aththa), *Cerbera odollam* (S: Gon kaduru), Colocasia esculenta (S: Gahala) *Phragmites karka* (S: Nala gas), *Typha angustifolia* (S: Hambu pan) etc. The floating vegetation included species such as *Eichhornia crassipes* (S: Japan jabara) *Ipomea aquatica* (S: Kankun) and *Salvinia molesta* (S: Salvinia). No endemic species were found. None of the species found is nationally endangered (EN), near threatened (NT) or vulnerable (VU) (MOE, 2012). Those observed are common aquatic and associated species. Table 2-14 provides a list of aquatic plants observed in the stream habitat.

2.5.1.4 Status of flora

A total of 78 plant species (trees and shrubs only) were recorded from affected areas (5m from the RDA boundaries on either side of the road) of the home gardens and roadsides while 12 of aquatic and associated plant species were recorded from the stream's affected area (5m from the RDA boundaries on either side of the road). Of the plants recorded, two species, *Diospyros ebenum* (S: Kaluwara) (only 3 trees) and *Buchanania axillaris* (S: Kiripalu) (1 tree) are considered nationally endangered (EN) under IUCN Red List (MOE, 2012). There are three nationally near threatened (NT) plants, namely, *Albizia lebbeck* (S: Mara), *Madhuca longifolia* (S: Mee*) and Pouteria campechiana* (S: Rata lawalu) and one nationally vulnerable (VU) plant, namely, *Phyllanthus emblica* (S: Nelli) among home garden varieties (MOE, 2012).More than 59% were exotic species indicating the disturbed nature of the study area. None of the species recorded is confined to the study area or are unique.

Annex 4 and 5 give the number of trees from each species that will be subjected either to felling or pruning during road improvements, especially to ensure safety of the road users. There are all road-side planting done within the RoW.

2.5.2 Description of existing fauna of the project area

In the absence of rich vegetation, the faunal diversity is poor, representing common species that usually inhabit disturbed habitats. One of the important species reported by people in the area is the saltwater crocodile (S: Gata kimbula) (*Crocodilus porosus*) inhabiting the Dandugam Oya. This species is considered as near threatened (NT) under IUCN Red list (MOE, 2012). None of the other reptiles, mammals,

amphibians or fish reported from the area is endemic, threatened or vulnerable. None of the species is confined to the area. List of reptiles, mammals, amphibians recorded/ reported by people living in the area are given in Table 2-15. List of fish recorded from Dandugam Oya is also given in Table 2-15. Table 2-16 gives a list of birds observed in the field study. They are mostly garden varieties and those inhabit aquatic habitats. None of the bird species recorded from the area is endemic, endangered (EN) near threatened (NT) or vulnerable (VU) (MOE, 2012). None of the species is confined to the area.

Table 2-13, Plant species found within 5m from the RDA boundaries on either side of the road in project area

No	Family	Scientific Name	Common name Sinhala	Type	Status	National Red List Status	Project area	
							H	R
1	Anacardiaceae	*Anacardium occidentale*	Kaju	T	I	*	√	
2	Anacardiaceae	*Buchanania axillaris*	Kiripalu	T	N	EN	√	
3	Anacardiaceae	*Lannea coromandelica*	Hik	T	N	LC	√	
4	Anacardiaceae	*Mangifera indica*	Amba	T	I	*	√	√
5	Anacardiaceae	*Spondias dulcis*	Amberella	T	I	*	√	√
6	Annonaceae	*Annona muricata*	Katuaththa	T	I	*	√	
7	Annonaceae	*Annona reticulate*	Aththa	T	I	*	√	
8	Annonaceae	*Polyalthia longifolia*	Willow/ Owila	T	N	LC	√	√
9	Apocynaceae	*Alstonia scholaris*	Ruk Attana	T	N	LC	√	√
10	Apocynaceae	*Plumeria obtuse*	Araliya	T	I	*	√	√
11	Arecaceae	*Areca catechu*	Puwak	T	I	*	√	
12	Arecaceae	*Borassus flabellifer*	Thal	T	I	*	√	√
13	Arecaceae	*Caryota urens*	Kitul	T	N	LC	√	
14	Arecaceae	*Cocos nucifera*	Pol	T	I	*		
15	Arecaceae	*Syagrus sp.*	Palm	T	I	*	√	√
16	Bignoniaceae	*Tabebuia rosea*	Tabebuia	T	I	*		√
17	Callophllaceae	*Callophyllum inophyllum*	Domba	T	N	LC	√	
18	Clusiaceae	*Garcinia mangostana*	Mangosteen	T	I	*	√	
19	Clusiaceae	*Mesua nagassarium*	Naa	T	N	LC	√	√
20	Combretaceae	*Terminalia arjuna*	Kumbuk	T	N	LC		√
21	Combretaceae	*Terminalia bellirica*	Bulu	T	N	LC	√	
22	Combretaceae	*Terminalia catappa*	Kottamba	T	I	*	√	√

No	Family	Scientific Name	Common name Sinhala	Type	Status	National Red List Status	Project area	
							H	R
23	Ebanaceae	*Diospyros blancoi*	Velvet apple	T	I	*	√	
24	Ebenaceae	*Diospyros ebenum*	Kaluwara	T	N	EN	√	
25	Elaeocarpaceae	*Elaeocarpus serratus*	Weralu	T	N	LC	√	
26	Euphorbiaceae	*Macaranga peltata*	Kanda	T	N	LC	√	
27	Euphorbiaceae	*Phyllanthus acidus*	Ambul nelli	T	I	*	√	
28	Euphorbiaceae	*Phyllanthus emblica*	Nelli	T	N	VU		
29	*Flacourtiaceae*	*Flacourtia indica*	Ugurassa	T	N	LC	√	√
30	*Flacourtiaceae*	*Flacourtia inermis*	Lovi	T	I	*	√	√
31	Lauraceae	*Cinnamomu verum*	Kurundu	T	N	LC	√	
32	Lauraceae	*Persea Americana*	Ali Pera	T	I	*	√	
33	Lecythidaceae	*Careya arborea*	Kahata	T	N	LC	√	
34	Leguminosae	*Acacia leucophloea*	Katu andara	T	I	*		
35	Leguminosae	*Acacia melanoxylon*	Acacia	T	I	*	√	√
36	Leguminosae	*Adenanthera pavonina*	Madatiya	T	I	LC		
37	Leguminosae	*Albizia lebbeck*	Mara	T	I	NT		√
38	Leguminosae	*Cassia auriculata*	Ranawara	T	N	LC	√	
39	Leguminosae	*Cassia fistula*	Ehela	T	I	*	√	√
40	Leguminosae	*Delonix regia*	Mai mara	T	I	*	√	√
41	Leguminosae	*Leucaena leucocephala*	Ipil Ipil	T	I	*	√	√
42	Leguminosae	*Phanera variegate*	Koboleela	T	I	*	√	√
43	Leguminosae	*Piliostigma recemosum*	Maila	T	N	*		√
44	Leguminosae	*Pongamia pinnata*	Magul Karanda	T	N	*	√	√
45	Leguminosae	*Samanea saman*	Pare Mara	T	I	*	√	√

No	Family	Scientific Name	Common name Sinhala	Type	Status	National Red List Status	Project area	
							H	R
46	Leguminosae	*Saraca asoca*	Asoka	T	N	*	√	
47	Leguminosae	*Sesbania grandiflora*	Katurumurunga	T	I	*	√	
48	Leguminosae	*Tamarindus indica*	Siyambala	T	I	*	√	
49	*Malvaceae*	*Sterculia foetida*	Thelambu	T	N	LC	√	
50	Malvaceae	*Thespesia populnea*	Sooriya	T	I	*	√	
51	Meliaceae	*Azadirachta indica*	Kohomba	T	I	*	√	√
52	Meliaceae	*Melia azedarach*	Lunumidella	T	N	*	√	
53	Meliaceae	*Swietenia macrophylla*	Mahogany	T	I	*	√	
54	Moraceae	*Artocarpus heterophyllus*	Kos	T	I	*	√	
55	Moraceae	*Artocarpus incises*	Del	T	I	*	√	
56	Moraceae	*Ficus benghalensis*	Nuga	T	N	LC	√	√
57	Moraceae	*Ficus benjamina*	Heen Nuga	T	I	*	√	√
58	Moraceae	*Ficus racemosa*	Attikka	T	N	LC	√	
59	Moraceae	*Ficus religiosa*	Bo	T	I	*	√	
60	Moringagaceae	*Moringa oleifera*	Murunga	T	I	*	√	
61	Myrtaceae	*Psidium guajava*	Pera	T	I	*	√	
62	Myrtaceae	*Psidium guineense*	Ambul pera	T	I	*	√	
63	Myrtaceae	*Syzygium cumini*	Damba / Madan	T	N	*	√	
64	Myrtaceae	*Syzygium samarangense*	Pini jambu	T	I		√	
65	Pinaceae	*Pinus sp.*	Pinus	T	I	*	√	
66	*Poaceae*	*Bambusa vulgaris*	Kaha Una	S	N	*	√	
67	Rutaceae	*Aegle marmelos*	Beli	T	I	*	√	
68	Rutaceae	*Citrus sinensis*	Dodam	T	I	*	√	

No	Family	Scientific Name	Common name Sinhala	Type	Status	National Red List Status	Project area	
							H	R
69	Rutaceae	*Limonia acidissima*	Divul	T	N	*	√	
70	Sapindaceae	*Filicium decipiens*	Pihimbiya	T	N	LC	√	√
71	Sapindaceae	*Nephelium lappaceum*	Rambutan	T	I	*	√	
72	Sapindaceae	*Schleichera oleosa*	Kone	T	N	LC	√	√
73	Sapotaceae	*Madhuca longifolia*	Mee	T	N	NT	√	
74	Sapotaceae	*Manilkara zapota*	Sapodilla	T	I	*	√	
75	Sapotaceae	*Pouteria campechiana*	Rata Lawulu	T	I	NT	√	
76	Tiliaceae	*Berrya cordifolia*	Halmilla	T	N	LC	√	√
77	Tiliaceae	*Muntingia calabura*	Jam	T	I	*	√	√
78	Verbenaceae	*Tectona grandis*	Thekka	T	I	*	√	√

Source: Observations of the present study (Species identification was done from Bandaranayake et al, 1974, Ashton et.al.1997: endemic species identification - Heart, 2007; National Red List information from MOE 2012)

Abbreviations: E-Endemic, N -Indigenous, I- Exotic, T – Tree, S – Shrub, EN – Endangered, VU – Vulnerable, NT – Near Threatened, LC-Least concern *- Status not given, H-Home garden, R- Roadside

Table 2-14, Flora observed within and around Dandugam Oya bridge area

Family	Scientific name	Common name- Sinhala	Plant type	Whether Threatened / rare / common
Annonaceae	*Annona grabra*	Wel Aththa	Tree	Common
Araceae	*Pistia stratiotes*	Pistiya	Floating plant	Common
Clusiaceae	*Callophyllum inophyllum*	Domba	Tree	Common

Cyperaceae	*Cyperus corymbosa*	Gal-eha	Shrub	Common
Euphorbiaceae	*Ricinus communis*	Beheth endaru	Shrub	Common
Graminae	*Phragmites karka*	Nala gas	Herb	Common
Lemnaceae	*Lemna sp.*	Pasi	Floating plant	Common
Malvaceae	*Hibiscus tiliaceus*	Wal beli	Tree	Common
Pentederiaceae	*Eichornia crassipes*	Japan jabara	Floating plant	Common
Salviniaceae	*Salvinia molesta*	Salvinia	Floating plant	Common
Typhaceae	*Typha angustifolia*	Hambu pan	Herb	Common
Verbeneceae	*Stachytarpheta indica*	Balu naguta	Herb	Common
Source: Observations of the present study (Species identification was done from Bandaranayake et al, 1974, Ashton et.al.1997: endemic species identification - Heart, 2007; National Red List information from MOE 2012)				

Table 2-15, Mammal, amphibian, reptile and fish fauna observed in and around project area

Family	Species	Common name (English/Sinhala)	Status	National Red List Status
Herpestidae	*Herpestes edwardsii*	Grey mongoose / Alu mugatiya	N	LC
Herpestidae	*Herpestes smithii*	Ruddy mongoose /Hothambuwa	N	LC
Pteropodidae	*Pteropus giganteus*	Common flying fox/ Ma vavula	N	LC
Viverridae	*Paradoxurus hermaphroditus*	Palm cat/Kalawedda	N	LC
Sciuridae	*Funambulus palmarum*	Palm squirrel/Lena	N	LC
Ranidae	*Hylarana gracilis*	Skipper frog/Lanka diya madiya	N	LC
Bufonidae	*Duttaphrynus melanostictus*	Common house toad	N	LC

Family	Species	Common name (English/Sinhala)	Status	National Red List Status
Varanidae	*Varanus salvator*	Water monitor/Kabaragoya	N	LC
Varanidae	*Varanus bengalensis*	Land monitor /Thalagoya	N	LC
Agamida	*Calotes versicolor*	Common garden lizard/Katussa	N	LC
Agamida	*Calotes calotes*	Common green forest lizard/Katussa	N	LC
Scincidae	*Eutropis carinata*	Sulaba hikanala	N	LC
	Hemidactylus frenatus	Sulaba ge huna	N	LC
Colubridae	*Ahetulla nasutus*	Green vine snake /Ahetulla	N	LC
Colubridae	*Atretium schistosum*	Olive keelback/Diya wanaya	N	LC
Colubridae	*Dendrelapis tristris*	Common bronzeback /Thuru haal danda	N	LC
Colubridae	*Ptyas mucosa*	Common rat snake /garandiya	N	LC
Colubridae	*Xenochrophis piscator*	Checkered keelback /Diya bariya	N	LC
Crocodylidae	*Crocodilus porosus*	Saltwater crocodile/Gata kimbula	N	NT
Poeciliidae	*Poecilia reticulate*	Guppy/Wel gappy	I	*
Poeciliidae	*Gambusia affinis*	Mosquito fish/ Guppy	I	*
Anguillidae	*Anguilla sp.*	Eel/Anda	N	*
Cichlidae	*Oreochromis sp.*	Tilapia/Tilapia	I	*
Cichlidae	Etroplus suratensis	Pearl spot/Koraliya	N	*
Channidae	*Chanos chanos*	Milk fish/Wekkaya	N	*
Mugilidae	*Mugil sp.*	Mugil/Godaya	N	*

Source: Observations of the present study and information obtained from the villagers (Species identification from - *De Bruin et al, 1995* De silva, 1990, 2009a,2009b;Dutta and Manamendra-arachchi, 1996, Kotagama, S., 2004; Gunatilleke, 2006; National Red List information from MOE 2012)

Abbreviations: E-Endemic, N -Indigenous, I- Exotic, LC-Least concern *- Status not given

Table 2-16, Bird species observed in and around project area

Family	*Species*	Common name (English/Sinhala)	Status	
Ardeidae	*Egretta garzetta*	Little Egret/ Punchi Ali-koka	Very common, breeding resident	F
Ardeidae	*Ardeola grayii*	Pond Heron/ KanaKoka	Very common, breeding resident	F
Ardeidae	*Ardeola purpurea*	Purple Heron/ KarawelKoka	Common, breeding resident	F
Centropodidae	*Centropus sinensis*	Common Coucal /Ati kukula	Very common, breeding resident	F
Cerylidae	*Ceryle rudis*	Pied kingfisher/ Gomara pilihuduwa	Common, breeding resident	F
Cisticolidae	*Prinia socialis brevicauda*	Ashy Prinia/Alu Prinia	Common, breeding resident	F
Codvidae	*Pericrocotus cinnamomeus*	Small minivet/Punchi miniviththa	Common, breeding resident	F, Fl
Columbidae	*Columba livia*	Rock pigeon/Podu paraviya	Very common, breeding resident	P
Columbridae	*Streptopelia chinensis*	Spotted Dove/ Alu Kobeiya	Very common, breeding resident	F,N,P
Corvidae	*Oriolus xonthornus ceylonensis*	Black-hooded oriole	Very common, breeding resident	F,P
Corvidae	*Corvus splendens*	House Crow/ Kolamba Kaputa	Very common, breeding resident	P,N
Cuculidae	*Eudynamys scolopacea*	Asian Koel/Kowla	Very common, breeding resident	P
Megalaimidae	*Megalaima Zeylanica*	Brown-headed Barbet/ Polos kottoruwa	Very common, breeding resident	F,P
Muscicapidae	*Copsychus saularis*	Oriental Magpy Robin /Polkichcha	Very common, breeding resident	F,P
Nectariniidae	*Nectarinia lotenia lotenia*	Long-billed sunbird/Lotan sutikka	Very common, breeding resident	F,P
Nectariniidae	*Dicaeum erythrorhynchos ceylonense*	Small Flower Pecker / Lathudu pililichcha	Very common, breeding resident	F,P
Nectariniidae	*Nectarinia zeylonica*	Purple-rumped Sunbird/ Nithamba	Very common, breeding resident	F,P

	zeylonica	dam Sootikka		
Passeridae	*Lonchura punctulata*	Scaly-breasted munia/ Laya kayuru wee kurulla	Very common, breeding resident	F,P
Picidae	*Dinopium benghalense psrodes*	Red backed woodpecker /rathu pita rath kerala	Very common, breeding resident	F
Pycnonotidae	*Pycnonotus cafer cafer*	Red-vented Bulbul/Kondaya	Very common, breeding resident	F,P
Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen/ Layasudu Korawakka	Very common, breeding resident	F
Sturnidae	*Acridotheres tristis melanosturnus*	Common Myna /Myna	Very common, breeding resident	F,P
Sylviidae	*Orthotomus sutorius sutorius*	Common tailor bird/ Nodili battichcha	Very common, breeding resident	F,P
Sylviidae	*Turdoides affinis taprobanus*	Common (Yellow-billed) Babbler/ Demalichcha	Very common, breeding resident	F,P

Source: Observations of the present study and information obtained from the villagers. Identification done from Kotagama and Wijesinghe,2003

Abbreviations: F-feeding, P-perching ,Fl-flying

2.5.3 Other important ecosystems which are located within 500m boundary along the A003 road

Negombo estuary - A003 road runs within 500m from the RDA boundary at Katunayaka (7°10'17.00"N, 79°51'52.00"E) Being a shallow coastal estuary, Negombo estuary is rich in terms of biodiversity. It supports artisanal fishery where a variety of fish and several species of shrimps and crabs are caught. About 125 fish species have been reported from Negombo estuary (Amarasinghe et al. 2002). At least 80 of them are of marine origin, including the penaeid shrimps. Four major angiosperm genera and seven species out of which four are true sea-grasses have been recorded from this water body (De Silva and Amarasinghe, 2007). In total, 29 mangrove species have been recorded from the Negombo estuary of which 18 species are true mangroves (Jayasiri and Haputhanthri 2015) while, 89 species of benthic invertebrates belonging to 58 families consisting of 36 species of polychaetes, 13 species of crustaceans, 24 species of gastropods and 16 species of bivalves have been reported (Dahanayaka et al. 2008).

Streams found along A003 road - Maha oya - at Kochchikade (Thoppuwa) (7°16'15.01"N, 79°51'51.70"E), Gin Oya- at Nainamadama (7°17'59.00"N, 79°51'3.00"E), Karambalana oya (Also call Lunu oya) at Mahawewa (7°28'19.76"N, 79°49'42.22"E), are the streams through the project section which the A003 road runs. Bridges have been built at all sites and on the roadsides in the vicinity of these bridges, exotic trees that had been planted in rows. E.g. *Leucaena leucocephala* (S: ipil ipil), *Albizia lebbeck* (S: Suriya mara), *Samanea saman*(S: Pare mara), *Terminalia arjuna*(S: Kumbuk), *Terminalia catappa* (S: Kottamba), *Phanera variegate*(S: Koboleela), *Acacia melanoxylon* (S: Acacia), *Filicium decipiens* (S: Pihimbiya) etc. No endemic species were recorded (MOE, 2012). Of the riverine vegetation, *Terminalia arjuna*(S: Kumbuk) and *Terminalia catappa* (S: Kottamba) dominate. Other common riverine varieties include *Annona grabra (*Wel Aththa), *Hibiscus tiliaceus (S: Hibiscus tiliaceus).* A noteworthy riverine vegetation can be seen at Gin Oya which is *Nypa fruiticans* (S: Gin pol). It is very rare to see such a thick belt of this saltwater species at one stretch. These streams are inhabited by aquatic avifauna such as Cormorants, Egrets, Herons and Bitterns and stream associated fish species most of which are migratory species from the sea.

Tanks (S: wewa), Ponds (S: Pocono) found along A003 road - The Tanks (S: wewa), Ponds (S: Pocono) located within 500m boundary along the A003 road include; Passing Puttalam town, towards Negombo, small tank is located about 10m away from the RDA boundary on the land side of the road (GPS location 7°00'72.2"N, 79°83'82.9"E), water front is seen on the sea side at GPS location 7°92'87.5"N, 79°82'67.5"E, small pond is located on the seaside at GPS location 7°69'09.8"N, 79°83'00.6"E, small tank located on the land side at GPS location 7°64'48.1"N, 79°83'23.6"E, Tank near Suduwella Devale at GPS location 7°47'73.1"N, 79°83'01.3"E and Mahawewa tank at GPS location 7°45'62.8"N, 79°82'72.2"E. These are typical seasonal tanks and ponds which get dried up during dry season and getting filled during wet season. Bordering these tanks and ponds are some *Terminalia arjuna* (S: Kumbuk) trees. Common aquatic plants are *Nymphaea pubescens* (S: Olu), *Nelumbo nucifera* (S: Nelum)), *Nymphoides hydrophylla* (S: Kumudu), *Phragmites karka* (S: Nala gas),*Typha angustifolia* (S:Hambu pan), *Eichornia crassipes* (S: Japan jabara), *Salvinia molesta* (S: Salvinia), *Lemna sp.* (S:Pasi) etc. These tanks and ponds are inhabited by a variety of wading bird species (e.g. Herons, Egrets, Water hens etc.) and edible species of fish such as *Tilapia, Etroplus* and *Puntius* are common in these water bodies.

- The labour camps should not be established too close to ecologically sensitive areas such as water bodies or mangrove areas.
- Labour camps should be provided with proper sanitation measures such as water supply, wastewater, sewage and solid waste disposal etc.

2.6 Description of the Physical Environment- Ambient Air Quality, Noise Levels, Receiving Water Quality of Water Bodies

2.6.1 Surface water

Surface water includes rivers, streams, and canals and stagnant water bodies (lakes, ponds, tanks, lagoons and other impounded water bodies). The project road traverses near to the western coastal zone of the country and almost flat terrains with several surface water bodies, where perennial water and rain water runoff are collected. Sometimes the storm runoff is accompanied by large quantities of debris from upstream side. The nearby surface water bodies, lagoons and streams cutting across the Dedugam Oya to Putttam section of the A 03 road are described in following.

2.6.1.1 Dandugam oya

Dandugam oya crossed A03 road at Dadugama bridge (7.110003N, 79.882665E) Ch. 18+300.

Dadugam Oya is branch of Attanagalu Oya, a stream running water moving to lower level in a channel on land. Attanagalu oya basin is situated between the two major river basins Kelani and Maha Oya and has an extent of 779km^2. This River originates from the second peneplain of Sri Lanka and falls into topographical region of South West. Majority of Attanagalu Oya is located in the Western Province.

The four streams Diyaeli Oya, Attanagalu Oya, Uruwal Oya and Kimbulapitiya Oya form the Attanagalu Oya discharges into Negombo lagoon as Dandugam Oya

According to the water quality monitoring carried out in the period of April 2011 to December 2012, locations near to the bridges at Kirindiwita, Kotugoda, Opatha, Muthuwadiya, Palliya Junction & Seeduwa, revealed the quality of the water of Dadugam oya is not satisfactory with respect to all parameters which has been used for the evaluation of the water quality index, where exceeding turbidity and microbiological contaminants regularly.

The water quality of upstream of the Seeduwa Bridge indicate the evidence of the industrial pollution with compare to the domestic and non-point sources. The gradual decrease of DO and high level of COD was recorded in many time. Values obtained for heavy metals are lower than the detection limits of the method used for the detection of heavy metals and nutrient such as nitrate and phosphate are significantly below the ambient water quality standard proposed by the CEA.

The WQI is gradually decreases up to 45 toward the downstream direction of the Dadugam Oya. The WQI evaluated excluding turbidity and faecal contaminant clearly shows that the domestic sources are more prominent in the upstream site of the Dadugam Oya. The total contribution for the deterioration of the water quality is industrial pollution. *(Ref. CEA Publication Water quality monitoring of MA Oya*

2.6.1.2 Negombo lagoon

A03 road is running closer to Negombo lagoon at Katunayaka (7.171635N, 79.864893E), Ch. 25+500.

Negombo lagoon is a very productive shallow coastal body of water, receiving fresh water from the Attanagalu Oya drainage basin via Dandugam Oya and Ja-Ela and connected with the sea by a single narrow opening. The volume of discharge varies seasonally with rainfall and regulates variations in salinity and nutrient flow to the sea. It is interconnected with the Muthurajawela marsh. The estuary is multi-functional but is threatened by accelerated and haphazard infrastructure development.

2.6.1.3 Maha oya

Ma oya is crossing A03 road at Thoppuwa, Kochchikade (7.271016N, 79.864293E). Ch. 37+900.

Maha Oya which originates in the hilly regions around Aranayakje, Bible rock and Kadugannwa has catchment area 1538 km^2 and a stream length of 130 km .Average rainfall in most parts of this catchment area usually exceeds 3800 mm per annum while average annual runoff is about 1485 million cubic meters.

Ma Oya has very little hydro power potential. The most important use of water in the Ma Oya is for the supply of drinking water, presently there are 14 water supply intake is located in the basin serving an urban population of about 200,000.

Among the eight water quality monitoring locations near to the bridges at Mawanella, Hiriwadunna, Karadana, Alawwa, Griulla, Kotadeniyawa, Badalgama and Kocchikade, the Kochchikade Bridge had the worst water quality compared to the all others. This site is situated across the Colombo-Chilaw main road and flows through a relatively flattened terrain therefore, rate of aeration is low. Upstream to the bridge, the river will receive fair amount of wastewater from high and medium scale industrial activities and runoff from agricultural activities. Since this stretch of river flow through a highly urbanized area, the anthropogenic activities such as bathing, washing, sand mining and discharge of domestic wastewater and solid waste are also very high while downstream of the bridge is closer to the river mouth, hence, salinity intrusion also occurs regularly and highest during the February-March period. The industrial activities, other anthropogenic activities and salinity intrusion are the main contributors to the inferior water quality and lowest WQI value exceeding turbidity regularly and DO, COD, FC etc, occasionally.

(Ref. CEA Publication Water quality monitoring of MA Oya)

2.6.1.4 Gin Oya

The Gin oya is cutting across A03 road at Nainamadama (7.299745N, 79.850709E). Ch. 41+700.

Gin Oya is a stream, located in North Western Province, Sri Lanka, a body of running water moving to a lower level in a channel on land reach the sea near Waikkal.

2.6.1.5 Karambalana oya (Also call Lunu oya)

Lunu oya is crossing the A03 road at Mahawewa (7.472138N, 79.828388E). Ch. 61+300.

Lunu Oya (Karambalana oya) cross the A03 road at Mahawewa and discharges water to the southern channel of Chilaw lagoon with an annual mean discharge of 8m^3/s, a part which is discharged to the sea when the southern outlet is opened at Thoduwawa.

Table 2-17 Summary of Surface water quality results

Surface Water Body	GPS Coordinate of the Location	Analytical Results (in mg/l except pH)				
		pH	COD	BOD	TSS	Oil & Grease
1. Dandugam oya	7°06'35.6"N, 79°59'57.8"E	6.30	45	<2	20	<2
2. Negombo lagoon	7°10'17"N, 79°51'52"E	6.75	45	<2	30	<2
3. Maha oya	7°16'15"N, 79°51'51.7"E	6.80	20	<2	22	<2
4. Gin Oya	7°17'59"N, 79°51'03"E	6.80	60	<2	10	<2
5. Karambalana oya (Also call Lunu oya)	7°28'20"N, 79°47'46.85"E	6.35	45	<2	10	<2
6. US EPA Guideline	7. Aquatic Life	8. 6.5 – 9.0				
	9. Human Health	10. 5 - 9				

Even though the National ambient water quality guideline is not available at present for regulation of surface water quality, baseline monitoring will help for water quality comparison up to certain extent

since, there is a potential for change of water quality due to road runoff during construction & operation period. The water quality parameters monitored clearly implied the pollution contribution (if any) from the road runoff.

2.6.2 Comment on analytical results on wastewater discharge to surface water

According to the World Bank Group (WBG) Environment Health and Safety (EHS) guidelines, wastewater discharge to surface water should not result in contaminant concentrations in excess of local ambient water quality criteria or, in the absence of local criteria, other sources of ambient water quality. Hence stream water quality compared with the USEPA ambient water quality criteria for aquatic life and human health. The pH value of these stream water is comply with the guidelines. However other parameters specified are mainly for pesticide and heavy metals, those are not expected as a result of this project activities.

According to the above analysis, no significant pollution levels are indicated with respect to the monitored parameters of these water resources. In general quality of flowing water body is highly vulnerable to upstream changes due to natural and/or anthropogenic causes. However, above analysis revealed that, the quality of water is recoverable even if polluted or no significant pollution potential for these streams. Hence, pollution contribution from the road project can be monitored by analysing upstream & downstream samples to be compared with the baseline data once unrecoverable changes appeared with respect to these parameters which are likely to impact as a result of road runoff also.

2.6.2.1 Ground water

Major part of the road corridor will cover the shallow coastal sand groundwater aquifer. These aquifers are re-charged mainly during the rainy weather and water in these aquifers then get collected in the form of a fresh water 'lens' floating above the denser saline water. The volume of fresh water in these aquifers usually expands during the rainy season and contracts during the dry season with fluctuating brackish and saline boundaries. Any over extraction from these fresh water lenses results in the coning or entering of the underlying brackish water in to the fresh water.

Chilaw to Puttalam section of the road corridor mainly covered with the alluvial aquifer. These alluvial deposits occur over several diversified alluvial landforms such as coastal and inland flood plains, dissected and depositional river valleys and stream beds with shallow alluvial deposits, and inland valleys of varying shape, form and size with fine and coarse depositional in-fill materials. The rivers such as Deduru Oya and Mi oya, have broad and deep alluvial beds of variable texture and gravel content in their lower reaches (Ref. Ground Water Resources of Sri Lanka by CR Panabokke)

Hence, groundwater resources along the road corridor generally represent high TDS and electrical conductivity due to frequent salinity intrusion during dry weather period. In addition northern parts groundwater contain significantly high hardness due to presence of underneath lime rock nearby and high pan evaporation rate in this tropical region.

No significant anthropogenic activities other than the township development along the road corridor that cause to adverse change of groundwater quality. Diversion of storm water drainages also not expected within the township. Since, it is planning obtain raw material required for the project from the existing sources no tendency for contamination in new sites during construction period other than the aggravation in same location. During operation period road runoff and township contaminants discharge together as at present. Hence, no significant changes expected for groundwater quality due to the project activities.

However, groundwater samples are collected for the baseline information from existing wells located in populated areas where the groundwater are being utilized. The several ground wells selected were

given in the analytical result table 2-18 below with the GPS coordinate of the location. (Refer Annexure 7 for the full analytical report)

The groundwater samples collected on 18/03/2015 & 23/04/2015 were analysed for the parameters specified in the Sri Lanka Standards (SLS 614:2013 Specification for Potable water) as these are the parameters which are likely to change as a result of project activities.

Table 2-18 Results of Water quality Monitoring

Parameter \ Location with GPS Coordinate	Kurana 7°11'56"N, 79°51'15.60"E	Katuneriya 7°22'0.02"N, 79°49'57.80"E	Madampe 7°28'37.33"N, 79°49'48.92"E	Chilaw 7°34'56.52"N, 79°47'46.85"E	Kiriyankalli 7°45'50.01"N, 79°49'43.76"E	Rathmalyaya 7°59'53.73"N, 79°50'15.46"E	Sri Lanka Standards (SLS 614:2013)	WHO Guideline
1. Electrical conductivity at 25^{0}C (µs/cm)	450	265	1073	1416	394	2820	**750**	
2. Total Alkalinity (mg/l as $CaC0_3$)	119	19.8	55	95	178	427	**200**	*##*
3. Total dissolved solids (mg/l)	290	155	572	950	250	1900	**500**	*##*
4. Total Hardness (mg/l as $CaC0_3$)	138	40	69	255	168	273	**250**	*##*
5. Colour (Hazen Units)	10	<5	<5	<5	<5	<5	**15**	*##*
6. Free Ammonia (mg/l as NH_3)	<0.02	<0.02	<0.02	0.08	0.1	<0.02	**0.06**	*##*
7. Turbidity (NTU)	<1	<1	1.0	<1	<1	<1	**2**	***0.1***
8. Nitrate (mg/l as NO_3^-)	4.1	12.1	3.2	13.4	11.5	163	**50**	***50***
9. Chloride (mg/l as Cl^-)	45	49	271	486	16	201	**250**	*##*
10. pH	6.02	8.32	6.64	7.64	7.19	7.71	**6.5-8.5**	*##*
11. Phenolic compounds (mg/l as phenolic OH)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.001**	
12. Grease & Oil (mg/l)	<2	<2	<2	<2	<2	<2	**0.2**	
13. COD (Chemical Oxygen Demand) (mg/l)	33	<5	<5	11	27	12	**10**	
14. Total Coliform /100 ml	5	140	NIL	>1800	350	350	**3**$^{\#}$	
15. Faecal Coliform /100 ml	NIL	2	NIL	12	7	50	**NIL***	

#. Shall not be detectable in any two consecutive sample **. Shall not be detectable in any sample*

No health base guideline specified

2.6.4 Comment on analytical results on drinking water quality

According to the WBG EHS guideline, the drinking water sources, whether public or private, should at all times be protected so that they meet or exceed applicable national acceptability standards or in their absence the current edition of WHO Guidelines for Drinking-Water Quality. However no health based guideline specified for most of the parameters analyzed. There are very rare chances of direct pollution of groundwater due to project activities. Poor sanitation in the camping site, haphazard deposition of solid waste on land and Pollution of nearby stagnant water bodies due to discharge of wastewater or surface runoff are several possibilities for ground water pollution. However those could be mitigated by implementing the mitigation measures proposed in the EMP.

According to the above analysis these ground wells do not comply with the Sri Lanka Standards for potable water with respect to the parameters analysed. However ground wells located up to Madampe can be used for domestic purposes with a simple treatment or it could be naturally recoverable with the change of weather pattern. But wells located in dry zone, beyond Madampe has shown significant salinity except well located in Kiriyankalli where several perennial streams flowing with fewer chances to lagoon water intrusion.

2.6.4.1 Air Quality

The major atmospheric emission source in the Ja-Ela - Puttalam road influence area is accumulated vehicular emissions in Katunayaka, Negombo, Kochchkade, Wennappuwa, Chilaw and Puttalam due to frequent heavy traffic. However traffic volume is visibly heavy and of mixed composition, in magnitude of 55,100 vpd at the start section and reduce to 12,480 vpd towards the end. Other emission sources which can influence the road corridor are industrial emissions from tile factories located in Wennappuwa & Bangadeniya area, standby generators in the townships and few boilers operated in small scale industries etc. However these are not in continuous operation.

Raw material required for the project will be obtained from existing quarries, metal crushes, asphalt plants and ready mix plants possessing an Environmental Protection License (EPL) at present according to the prevailing environmental regulations. Hence ambient air quality will be monitored regularly in raw material supply sources.

However, following two locations are identified for ambient air quality monitoring. Mundal RDA depot could be used as raw material yard during construction period while Madampe is a highly populated area with some religious activities and road widening is required for hard shoulder construction.

The ambient air quality was monitored for the parameters specified in the National Environmental (Ambient Air Quality) Regulations as per the Gazette No 91562/22 of 15/08/2008. The air quality monitoring was carried out on 09/03/2015 is given in the table 2-19 below. (Refer Annexure 7 for the full analytical report)

Table 2-19 Results of Air quality monitoring

Parameter	Monitoring Location		Sri Lanka Standards	WHO Guideline (As per EHS Guideline of IFC, WBG)
	Mundal (Sri Bodhi Rajaramaya, near to RDA raw material yard) 7°48'16.2"N, 79°49'32.2"E	Madampe (Thaniwella Devalaya) 7°28'37.33"N, 79°49'48.92"E		
PM10 in µg/m^3 (24h average)	21	25	100	50
PM2.5 in µg/m^3 (24h average)	10	12	50	25
NO_2 in µg/m^3 (08h average)	14	17	150	200 (1-hr average)
SO_2 in µg/m^3 (08h average)	9	12	120	20 (24-hr average)
CO in ppm	1	1	9	

(08h average)				

According to the World Bank Group EHS guideline, emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines (see last column of the Table 2.19), or other internationally recognized sources;

All monitored parameters are well below the Sri Lankan standards and WHO guideline, including particulate matter that has higher potential for exceeding the limit during road construction.

2.6.1.5 Noise Quality

The existing sources of noise in the Ja-Ela - Puttalam road corridor influence area are;

- Traffic movement Noise
- Localised workshops, garages, carpentry works etc
- Noise arising from Residential areas

The project is planning to obtain raw material from existing suppliers those who are, in operation with environmental protection licence (EPL) and no new raw material supply sources will be established. Hence, baseline noise monitoring was conducted only along the road corridor. According to the nature of the project noise generation cannot be avoided during construction. However the ten most sensitive locations were selected for baseline ambient noise quality monitoring during daytime and night-time as specified in the National Environmental (Noise Control) Regulations of Gazette No 924/12 dated 23/05/1996. Results are given in the table 2-20 below. (Refer Annexure 7 for the full analytical report).

Table 2-20 Results of Noise quality Monitoring

Date of Measurement	Measurement Location & GPS Coordinate		Noise Level dB(A)	
			Day	Night
10/03/2015	1. Puttalum (Near Buddhist Centre)	$8^0$01'08''N, $79^0$50'03''E	66	57
10/03/2015	2. Erukkalampiddy (Near mosque, Nugawilluwa)	$7^0$57'45''N, $79^0$49'50''E	61	57
09/03/2015	3. Mundal RDA Depot (Material Yard)	$7^0$47'50''N, $79^0$49'31''E	64	62
09/03/2015	4. Bangadeniya (Near Church)	$7^0$37'43''N, $79^0$49'21''E	66	62
09/03/2015	5. Jayabima ,Chillaw (Near Sama Viharaya Temple)	$7^0$35'41''N, $79^0$48'18''E	67	65
10/03/2015	6. Chillaw (Near District General Hospital)	$7^0$34'21''N, $79^0$47'50''E	70	69
10/03/2015	7. Madampe (Bend near Thaniwelle Devalaya)	$7^0$28'38''N, $79^0$49'48''E	68	66
09/03/2015	8. Wennappuwa (Near St.Joseph's Church)	$7^0$20'25''N, $79^0$50'31''E	68	67
09/03/2015	9. Negombo (Near Maris Stella College)	$7^0$12'46''N, $79^0$50'52''E	70	68
09/03/2015	10. Seeduwa (Near Wijaya	$7^0$07'33''N,	69	68

Date of Measurement	Measurement Location & GPS Coordinate		Noise Level dB(A)	
			Day	Night
	Kumarathunga Hospital)	$79^{0}52'39''E$		

The ambient noise monitoring revealed higher noise levels at large townships and moderate levels in other areas. However during construction period Schedule III of the above regulation could apply where the noise level (LAeq, T) shall be below 75 dB (A) at daytime while 50 dB (A) at night-time. Hence, according to the existing noise levels monitored, significant noise impact will not be expected from daytime activities of the project during construction period while noise quality improvement is expected during operation period.

According to the WBG EHS guideline, the noise impacts should not exceed the levels presented in the Table below, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Noise Level Guidelines		
Receptor	One Hour LAeq (dBA)	
	Daytime 07:00 - 22:00	Night-time 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

2.7 Socioeconomic Environment

2.7.1 Methodologies Used in the Socioeconomic Investigation.

The investigation and collection of information, is mainly based on secondary data sources which were available at relevant District and Divisional Secretariats, Road Development Authority and Local Authorities etc. In addition observations were used to identify existing human settlements, commercial establishments and government and privately owned properties along the road within the proposed project area. For this purpose line agency meetings, focus group meetings and key informant interviews were conducted by the consultant team. Qualitative data included to this report was obtained from the socioeconomic survey, done by RDC.

2.7.2 Geographical Background of Project Area

The proposed project area is situated within the Gampaha District in the Western Province and Puttlam District in the North Western Province of Sri Lanka

Gampaha District- Administration Boundaries

The project area in Gampaha District of the road runs through three Divisional Secretary's Divisions (DSDs) and starting from Ja-Ela,(Dandugam Oya) through Ja-ela and Katunayaka -Seeduwa UC areas, and ends up at Kochchikade (Thoppuwa Bridge - District Boundary of Puttlam) area of Negambo D.S Division.

Puttlam District- Administration Boundaries

The project area in Puttlam District covers with this project from Thoppuwa Junction (Thoppuwa Bridge) to Madampe. However, there are two Municipal Councils (Chilaw and Puttlam) and 08 Divisional Secretary's Divisions. (Puttalam, Mundal, Arachchikattuwa, Mahawewa, Madampe, Chilaw, Naththandiya, Wennappuwa, and) covered within the district boundary

2.7.3 Overall Socio –Economic Profile of the Project Area

This section shows briefly the social, economic, cultural and geographical background in the proposed project area separately for Gampaha and Puttlam Districts. It is expected to identify the socio-economic backgrounds of the residents and business population settled on either sides of A03 Road from Ja-Ela to Puttlam A few selected parameters were applied, relating to the social background such people, and the results were analyzed in order to assess their economic status.

2.7.5 Basic Information of DS Divisions in the Project Area in Gampaha District and Puttlam District.

The following table shows the basic physical and demographic information of the DS divisions situated within the proposed project area in Gampaha District & Puttlam District.

Table 2-21 Total No. of DS & GN Divisions and land area

District	DS Division	No of GNDs	Total land area (Ha)
Gampaha	Jaela	57	6400
	Katana	79	10760
	Negambo	39	3080
Puttlam	Wennappuwa	52	4000
	Naththandiya	47	7350
	Madampe	49	9110
	Chilaw	49	9100
	Mahawewa	47	7360
	Arachchikattuwa	33	15780
	Mundal	31	23440
	Puttlam	22	17330

Part of the road falls within Gampaha District (Ja-Ela, Katana, Negombo) and this section is situated in a highly populated and commercialized area. When comparing the two districts, Gampaha district is more urbanized than Puttlam district.

2.7.5 Natural Disasters

During heavy rains, a part of lands and buildings in three divisions in Gampaha District and 07 DSDs from Wennappuwa up to Mundal is affected by surface run-off water. Residents living along the Negombo road within the proposed project area are the most vulnerable to floods. The main reason for flooding in this area is the lack of a proper drainage system to discharge the large quantity of water during heavy rains and large quantities of rain water flooding the roads and homesteads. According to key Informant Interviewer's statements (DSs / AD (pl) in Puttlam District, this situation has arisen as a result of some development projects out of this area. (E.g. Deduru Oya irrigation project and Wijayakatupotha Wewa project.) This is the main disaster that the residents are faced with at present, and the proposed project has been formulated in such a way in order to address this issue.

2.7.6 Demographic Features

The following table shows the current population in the project area based on the Divisional Secretariat Divisions.

Table 2-22, Population density at D.S. Divisional Level - 2010

District	D.S. Division	Total	Total land area (Ha)	Population density
Gampaha	Ja-Ela	194806	6400	3044
	Katana	234,910	10760	2183
	Negambo	152,196	3080	4941
Puttlam	Wennappuwa	79603	4,000	1990
	Naththandiya	62106	7,350	840
	Mahawewa	54615	7,360	742
	Madampe	50619	9,110	558
	Chilaw	69353	9,100	762
	Arachchikattuwa	62475	15,780	260
	Mundal	65494	23,440	279
	Puttlam	82041	17,330	560

Source – Department of Census and Statistics 2013

Above table indicates that population density is comparatively high in project areas. Katana DS has more rural features than the other DS divisions of the Gampaha district in the project area. Either sides of the Puttlam Road, of Wennappuwa, Naththandiya, and Chilaw are more commercialized than the other DS Divisions. Also the population density in Puttlam District is lower than Gampaha District.

2.7.7 Ethnic Background of the Population

The following table shows the ethnic composition of the population in the project areas.

Table 2-23, Ethnic Composition of the Population

DS division	Sinhalese	Tamil	Muslim	Other	Total
Ja-ela	166321	9342	9321	7822	194806
Katana	191498	15413	11753	16246	234910
Negambo	114021	12111	21027	5037	152196
Wennappuwa	77995	1357	90	171	79603
Mahawewa	53540	1023	29	23	54615
Madampe	45975	1028	3272	44	50919
Chilaw	57393	5561	6352	47	69353
Arachchikattuwa	40636	2892	189	14	43728
Mundal	28308	13042	24144	-	65494
Puttlam	41129	16382	22832	1699	82041

Source- Socio-economic resource profiles, 2011/2013

The great majority of the population represents the Sinhalese ethnic group and Muslims and Tamil were the second and third majority respectively in the project area. Meanwhile considerable percentages from the population represent other ethnic groups such as *Malays* and *Burgers.*

2.7.8 Religious Composition of the Population

Table 2-24, Religious Composition of the Population

District	DS Division	Buddhist	Catholic/ Christian	Islam	Hindu	others	Total
Gampaha	Ja-ela	58289	120138	9347	3132	3900	194806
	Katana	45.158	93855	11900	9950	4047	234910
	Negambo	60312	61606	21050	5301	3927	152196
Puttlam	Wennappuwa	9452	68729	76	466	880	79603
	Mahawewa	24188	29404	25	421	577	54615
	Madampe	37550	451	3269	8967	82	50919
	Chilaw	24368	32627	6372	4587	1399	69353
	Arachchikattuwa	26529	15217	172	1639	171	43728
	Mundal	11101	19072	24144	10547	-	65494
	Puttlam	20305	27101	22847	8812	2976	82041

Source- Socio-economic resource profiles, Ja-ela, Katana, & Negambo DSDs, 2011/2013

Above table shows that, the Buddhism & Christin / Catholic religion are popular in the area and considerable percentage of Islam have been reported from all DS Divisions. Islam is most popular in Mundal, but a considerable number of Hindus are found in Mundal and Madampe DS Divisions.

2.8 Land Use Patterns

2.8.1 Land Use Pattern in the Project Divisions

The following table shows the existing pattern of land use in all DS Divisions.

Table 2-25 Land use pattern

Type of Land used	Ja-ela	Katana	Negambo	Wennapuwa	Naththandiya	Mahawawa	Madampe	Chilaw	Arachchikattuwa	Mundal	Puttlam
Lands used for buildings and home gardens	82	65	45	85	88	65	80	78	88	64	48
Water bodies and other	18	35	55	15	12	35	20	22	12	36	52
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

The above table shows existing land use pattern and figures indicate that around 75% lands have been used for residential and commercial purposes and other human activities. Only around 25% of lands represent water bodies. This clearly illustrates the population pressure in the area from Ja-Ela to Wennappuwa and Puttlam Divisional secretariat.

2.8.2 Per capita land used by Divisional Level

Table 2-26, Per Capita land used by Divisional level

District	D.S. Division	Area (Ha)	Population	Per capita land consumption (Ha)
Gampaha	Ja-Ela	6400	194806	0.03
	Katana	10760	234910	0.05

District	D.S. Division	Area (Ha)	Population	Per capita land consumption (Ha)
	Negambo	3080	152196	0.02
Puttlam	Wennapuwa	4,000	17625	0.2
	Naththandiya	7,350	16395	0.4
	Mahawawa	7,360	13671	0.5
	Madampe	9,110	12511	0.7
	Chilaw	9,100	16498	0.6
	Arachchikattuwa	15,780	11476	1.4
	Mundal	23,440	14373	1.6
	Puttalam	17,330	16235	1.1

Source - District Statistical Branch, Gampaha & Puttlam 2013

2.8.3 Agricultural Activities

Table 2-27, Asweddumized extent of paddy by Divisional level - 2010

District	D.S. Division	Asweddumized extent (Ha)			
		By Irrigation		Rain fed	Total
		Major	Minor		
Gampaha	Ja-Ela	234.4	159.3	160.8	554.6
	Katana	0.0	22.7	123.4	146.1
	Negambo	0.0	0.0	0.0	0.0
Puttlam	Naththandiya	271.02	485.67	231.72	988.41
	Mahawawa	60.05	518.73	85.79	664.57
	Madampe	175.67	343.78	137.94	657.39
	Chilaw	350.03	334.96	381.01	1066.00
	Arachchikattuwa	686.40	562.88	485.02	1734.30
	Mundal	349.15	261.60	374.14	984.89
	Puttalam	203.44	407.52	63.32	673.28

(1 Ha = 2.471 Ac) Source - District Statistical Branch, Gampaha

2.8.4 Plantations

Table 2-28, Highland crop Statistics by Divisional Level – 2011 (Extent in Ha)

District	D.S. Division	Coconut	Cinnamon	Coffee	Pepper	Cashew	Arecant	Mango	Jack	Plantain	Pineapple
Gampaha	Ja-Ela	2732.4	20.0	11.5	25.5	9.5	8.0	96.0	48.0	185.0	128.0
	Katana	8003	6.9	8.5	28.3	13.7	21.0	58.9	48.6	84.2	24.5

	Negambo	2732.4	20.0	11.5	25.5	9.5	8.0	96.0	48.0	185.0	128.0
Puttlam	Wennappuwa	2753.7		1.0	2.40	10.50	0.20	55.80	43.90	47.70	5.6
	Naththandiya	5543.9		3.6	2.80	20.00	7.70	31.0	35.60	59.60	32.3
	Mahawawa	3854.4		5.44	1.40	26.0	3.40	45.30	59.0	56.40	13.0
	Madampe	5929.6		1.38	1.20	48.0	4.30	55.80	50.0	54.50	7.00
	Chilaw	4607.4		1.0	0.2	42.20	0.20	51.60	14.0	61.20	
	Arachchikattuwa	7324.3				67.50	2.40	60.50	13.60	62.00	
	Mundal	12073				77.30		33.0	6.00	41.20	0.80
	Puttalam	5083.0				120.0	1.20	47.0	24.00	45.00	

Source -District statistical Branch, Gampaha

The above table shows coconut cultivation is found in all 11 Divisional secretary's division, as these are coastal areas. Cashew cultivation is also popular and is found in all 08 DSDs in Puttlam District.

2.8.5 Social Conditions

Three parameters such as land ownership (Per capita ratio) level of Income and existing occupation pattern were used on the available data to study their social status.

Level of Education

Level of education is one of the basic social parameters used to identify the overall

Social status of the people living in an area. Therefore, the level of education of all the residents in the study area was investigated.

Table 2-29, Level of Education (Head of the HH) Gampaha District

District	DS Division	Never schooling	No schooling	Gr.1-5	Gr. 6-11	Gr.12-13	Higher education	Total
Gampaha	Jaela	7.326	5.367	31.161	31.219	20.396	1.320	96.789
	Katana	860	7864	19.984	28.000	15.005	1.151	72.864
	Negambo	512	1216	12977	21155	9873	689	51482

Source- Socio-economic resource profiles, 2011/2013

Above table shows that literacy levels among both male and female populations are high in DSDs of Gampaha District. Majority has received at least a primary education and secondary level education in some cases. The percentage of people who have never attended school was very low and the number of graduates is considerably high in all 03 DS divisions.

Table 2-30, Literacy - Puttalam District

District	DS Division	Bellow age 5	Never schooling	students	Grade 1-5	Grade 6-11	Pass O/L	Pass A/L	Higher Edu	Dip/ others
Puttlam	Wennappuwa	4604	1666	15337	12455	25039	14069		2156	4276
	Mahawawa	4121	802	9439	10234	15726	8781	4303	693	516
	Madampe	4317	`1129	9693	6560	16412	6789	4039	853	527
	Chilaw	1311	231	-	9124	18224	7912		9356	-
	Arachchikattu.	3325	1070	8699	6463	14583	4824	4824	255	653
	Mundal	665	2454	13581	14962	20905	5363		231	1333
	Puttalam	1340	1028	16555	9320	11002	9622	-	1035	980

Source-Puttlam District 2013

Above table shows that literacy levels among both male and female population in 08 DSDs of Puttlam District. Majority has received at least a primary education and the population of schooling children is very high. It also shows that a considerable number of people have received secondary and higher education. The percentage who has never attended school was very low.

Occupation Pattern

It was very important to study the occupation pattern in the area to identify their principle economic activities and social backgrounds. Therefore the existing occupational pattern in all DS divisions is analyzed in the table below.

Table 2-31, Occupation Patterns in Puttlam District

District	D.S.Division	Govern. Jobs	Private Jobs	Agriculture	Non Agriculture	Fishing	Foreign Jobs	Labor	Other	Total
Puttlam	Wennappuwa	1684	7271	713	3456	-	10878	5331	5106	34439
	Mahawewa	1353	5955	919	7939	4173	4352	3197	1238	29126
	Madampe	2841	4136	576	2769	07	2505	4912	1689	19435
	Chilaw	1805	3416	2363	5467	2313	3840	3116	2453	24773
	Arachchikattuwa	1468	2827	2710	2330	-	1885	2967	1414	28453
	Mundal	808	3583	3304	4635	2763	2329	7299	1425	22842
	Puttlam	1320	6832	1305	5016	3679	1215	8902	3035	31304

Source- Socio-economic resource profiles, 2011/2013

Above table indicates that the great majority of the inhabitants of Puttlam district are engaged in labor jobs. Private sector jobs are the second highest employment category (except Wennappuwa) and this situation indicates that the migration pattern to the area is related to employment opportunities. Government or The other important category of employment is foreign employment .Specially Wennappuwa is very famous for foreign employment. Fishermen are in a minority. However the situation in 02 DS divisions (Wennappuwa & Naththandiya) in Puttlam District is slightly different from other 06 DS divisions.

2.8.6 Economic Conditions

Income Generation Sources

Two parameters were used in identifying the existing principle income generation activities in all DS divisions, namely, sources of income and monthly income pattern at household level. The following indicates the existing situation pertaining to sources of income in the area.

Income Distribution Pattern

The following table shows the income distribution pattern among the dwellers in the area.

Table 2-32, Monthly income (Rs) /Number of HHH

District	Divisional Secretary Division	Below 5000	5001-15,000	15001-30,000	30,001-45,000	45,001-60,000	Over 60,000	Total HHH
Gampaha	Jaela	4,521	17,394	29,364	22,891	18,359	4,620	96.789
	Katana	5,221	19,365	26,328	25,328	9,658	4,364	72,864
	Negambo							

Source- Socio-economic resource profiles, 2011/2013

Table 2-33 Monthly income (Rs)

District	Divisional Secretary Division	1000-3999	4000-7999	8000-11999	12000-15999	16000-19999	20000-23999	24000 - 27999	28000-31999	32000 & above
Puttlam	Wennappuwa	658	1074	1276	2218	2285	3151	3907	2565	1851
	Naththandiya									
	Mahawawa	926	1878	1994	2200	1885	1584	1655	1259	1376
	Madampe	859	1029	1912	2330	1140	2016	1255	1246	1917
	Chilaw	417		8449		8081			1883	1012
	Arachchikatt.	2042	2498	1919	1946	1761	843	576	516	451
	Mundal	5009	3387	2248	1990	1356	1028	545	545	336
	Puttalam	1212		6328		12001			1312	3072

Source- Socio-economic resource profiles, 2011/ 2013

Above table indicates that majority of residents living in the project area are earning a monthly income of more than Rs. 15,000. Considerable number of families are under category of Rs. 12,000- Rs. 15,000 and the rest of them are earning monthly incomes below Rs.12000.00. Dwellers representing the pro-poor group within the proposed project area are in a minority.

2.9 Social Impacts

Existing social impacts of the proposed project area as (Pre-project situation) and the potential impacts which may be generated during the construction period and after are considered.

2.9.1 Existing Social Impacts

Blocking of the pavement of the road sections traversing between Vaikkala and Wennappuwa, by the politicians and other influential groups by dumping earth to prevent water flowing into their premises. This has caused immense inconvenience to the pedestrians including school children.

Stagnation of water at many places along the road. It is caused due to lack of capacity of the drains to retain the water on rainy days. Poor maintenance of drainage system is an issue. Due to indiscriminate disposal of garbage into the drains by the public and some of the road side vendors the situation has become worse. In the above circumstances it is imperative to make a concerted effort by all relevant agencies and the public to find a solution to this grave issue.

However, negative social impacts due to the proposed road improvement project would be very insignificant.

According to the SIA results done by the RDC the total extent of the land to be acquired would be only 28.18 perches coming within the entire length of the ROW. Most of the land lots that will be affected are located within 1.6Km distance within the city limit of Puttalam. The total number of structures to be affected is 41, out of which 28 are located within the city limits and 132 of them are located within the ROW of the entire length of the road. Out of the total number of 41 structures, 31 will be partly affected and 4 structures will be fully affected.

2.9.2 Potential Social Impacts

1. Impacts on the 2 Lane and 4 Lane Scenarios

The development of the road length of 108.6km from Ja-Ela to Puttalam will be of two scenarios. Only 14.1km will be considered for 4 lane development and 94.5km (the balance sections) will be developed as two lanes. The road section from Ja-Ela will be improved as a substandard 4 lane to a distance of 12.5km and the width of each lane to be 3.2m.From this point to the 125th km post the road will be developed to a 2 lane road having 3.5m width of each lane. The last section of the road from the 125th km post to a distance of 1.6km will be widened to a 4 lane stretch up to Puttalam town. (Source: SIA done by RDC)

The potential negative impacts of the major section of the 2 lane development of 94.5km will generate moderate impacts as the ROW for the envisaged development is mostly available without major land acquisition. The total number of affected households is approximately 45 and the total APs are identified to be 140 carried out by the Resettlement survey. The total land area to be taken over will be approximately 35.8 perches (Resettlement Survey, RDC). Accordingly, 2 lanes section which covers 94.5km out of 108.6km of the total road will affect less number of households and not a single house is fully affected within this section of the road.

The last section of the 4 lane distance from the 125th km post up to the end of the road generate significant impacts to 15 shops and stores running businesses. These 15 shops and business units will need relocation as 1.6km section will need to be developed as a 4 lane road. These business units are semi-permanent and of temporary nature. However, the occupants have been doing business and providing services the urban sector of Puttalam town over a very long period. Most of them were selling fish. They prefer to stay in close proximity to the city centre. It is learnt that some of them do not have titles to their lands but, this could be ascertained only after preparation of the preliminary plans under the LAA. There is no acquisition involved in the case of state lands, but the APs s who occupy state lands need to be provided with alternative accommodation or be paid with reasonable compensation before vacating their lands.

2. Impact on Mobile Vendors

There are approximately 60 - 65 road side vendors engaged in selling variety of items for the commuting population along the entire length of the road in both 2 lane and 4 lane sections. They are not directly affected as they carry out their activities outside the proposed ROW, but this proposed development will obstruct their day today business activities. Some relief need to be considered for them as their livelihood may face some obstruction as a result of this development.

Negative Potential Impacts

1. Some APs will lose lands, structures and some of them will lose part of the structures of their houses.

2. There may be temporary or permanent relocation for a few APs as a result of implementation of this project

3. During the project implementation period there will be obstructions to commuters resulting an increase in the travel time

4. The barricades and obstacles placed by the road constructors might result in accidents, unless precautionary measures are taken by the implementing agencies to ensure the security of the commuters and pedestrians

5. Inconvenience to the public because of road closures and deviations are anticipated to occur in this project as well, as has happened in the previous road development projects.

6. Air pollution, sound pollution and emission of smoke by vehicle will be hazardous to the road users.

7. Digging of the road side by construction workers may damage underground water supply lines, sewerage, electricity or any other system.

8. Felling of trees may cause damage to the environment and to the bird life. Some people start their business or day today activities after feeding the birds etc.

9. Stock piling of material and storing of equipment by the contractors and parking of vehicle on the pavement will cause inconvenience to the road users.

10. Digging of drains on the either side of the roads and the construction work on the pavement may damage the livelihood activities of the business community and the informal sector vendors.

11. Delays in completing the construction work will cause inconvenience to commuters, pedestrians and road side vendors.

12. If the road construction work is not done according to excepted standards the entire nation has to bear the cost.

13. The influx of construction workers to the project development areas may generate social issues and health risks such as HIV/ AIDS.

Positive Potential Impacts

2. All stakeholders using the road will experience positive beneficial impacts because an upgraded highway will save travel time and enjoy comfortable travel. Pedestrians also will get the opportunity of walking on upgraded pavements and walkways.

3. The land owners will get the benefit of enhanced land values.

4. Employment opportunities for the skilled, semi-skilled and unskilled labourers will be generated during the construction period of the road and their earnings will be added to the family income.

5. It is also observed that with the influx of the workers into the construction sites of the road, incomes of those who engage in small business activities such as tea kiosk, supply of lunch packets and snacks and other consumer items will be increased.

6. Upgrading of the road will contribute to enhance retail business activities in a more planned manner and consequently tourist attraction will also be enhanced.

2.10 Consultations

2.10.1 Consultations with Government Agencies

The officials of government agencies are important since they are the people who represent various types of service institutions. The District Secretary /Divisional Secretary (DS) who is responsible for all administrative matters of the District / Divisional Secretariat Divisions. Meetings conducted with DSs have helped to clarify several issues related to social and environmental impacts in Puttlam District. Very important discussion had with the Engineers attached to the Road Development Authority in Puttlam District.

The consultant team has noted special requirements or problematic issues related to road improvements that need special attention. In this exercise, special attention has given to existing road condition and road traffic areas, culverts and drainages.

2.10.2 Community Consultations

Awareness Programme. The consultation programme for Jaela – Puttalam Road commenced with the stakeholder consultative meeting held at Puttalam Divisional Secretariat on 30-01-2015. The stakeholders involved in this development project were from RDA, Health Department, and Divisional Secretariat, Women Organizations and APs within 1.6 Km distance from Puttalam town were present at the meeting. At this meeting the consultants explained the process to be followed in developing the proposed road and the entitlements of the affected people (Aps). APs and other stakeholders raised their issues and expressed their views on the project. They requested that if their current business places are affected, to provide them with alternative places to continue their business activities. The Divisional Secretary responded by requesting them to consult the Grama Niladharis and report back on the availability of suitable lands. The Medical Officer of Health (MOH) and some of the other stakeholders raised issues pertaining to their lands, houses and parapet walls that are likely to be affected by the proposed road project. The stakeholder meeting was followed by a visit by consultants to the properties of APs who raised their land issues and found that the impacts are extremely negligible and decided to await the outcome of the field survey.

Focus Group Discussions. In addition, the Consultants held Four (4) Focus Group Meetings with different communities. Road side vendors in Madampe, Women's' Society at Puttalam, three wheel drivers at Palliya Junction Liyanegemulla and the community engaged in light engineering work at Vaikkala were the communities consulted through the focus group discussions. The minutes of these meetings and the lists of participants are given at the end of this Annex **9.** In summarizing the general outcome of these discussions it is important to record that all stakeholders including APs agreed support this development project and no one raised any voice against this development though few of them sought clarifications on their entitlements. They all understood that during the construction period there

may be temporary disturbances to their activities, but such disturbances can be avoided by mutual arrangement between APs and the executing agencies.

At focus group discussions, it was transpired that the roadside vendors in Madampe area are inoccupation of lands along the road over the past 20 years. Most of them are women and they are residents of the neighbouring villages. They sell fruits, king coconut (Thambili), vegetables and snacks, mostly to commuters who travel on this road. The temporary huts they have constructed with wood and zinc sheets have been built according to a plan given by Pradeshiya Sabha, Madampe. They agreed that for the development of the road some of their wooden structures need to be shifted and there is enough land space to shift their huts backward without being relocated elsewhere. They requested assistance to shift their hut backward. They only wanted formation of land behind the existing huts, by the executing agency. The consultants explained to them that even though they may have to face temporary interruptions during construction period, their business will be more profitable with the migration of labourers and other people to the area.

Focus Group Discussion with the three wheel drivers was very encouraging. They complained that when road development activities were carried out previously, they were never consulted. They also opined that they always in association with common people their familiar with the feelings and perceptions of the commuter population. They made two important points at the discussion. One is the inundation of the road section at Liyanagemulla, (approximately2 km) even with a slightest rain fall. The reason is that the drains are not maintained properly and do not have the capacity to carry away the water during the rainy days. They also pointed out that the bus stops are not demarcated properly and with the haphazard vehicle parking, the traffic blocks are created. They said that they would support this road development project as it will benefit them as well as the local population including the pedestrians

A Focus Group Discussion was held with the community who engaged in iron work (light engineering work) at a place where many iron workshops are concentrated, just in front of Vaikkala Rail Gate. The only request they made was to expedite the construction as any delay in construction will cause to disturbances to their work and such disturbances will affect their livelihood activities as already experienced when the previous upgrading of this road was carried out. They are a well-established community engaged in manufacturing knives and similar items and the marketability of these products depend on the commuters who use this road. Therefore, if any disruption occurs, not only their livelihood will be severely affected, but the daily paid labourers employed in these workshops will lose their regular income.

They accepted the fact that as a result of this road development project, a better drainage system will be in place and environmentally the area will be upgraded. They also agreed with the fact that pedestrians will enjoy the convenient and comfortable walkways along the constructed pavements. Several participants opined that there will be negative impacts such as increasing the road accidents and loss of livelihoods as a result of proposed road development. The Consultants reiterated that the affected parties will be adequately compensated and the project will take all possible measures to mitigate negative impacts and to improve the living standards of APs even better than pre project level.

Discussions with Key Informants. Discussions were also held with Ven. Magama Dhammasiri Thera, the Chief Incumbent of Suvisuddaramaya, Liyanagemulla, Seeduwa, Ven.Udammita Dhammachara Maha Thera, Rev.Father Fabrice Loschi and Mr.Winston Dias of the Association of St. Joseph- 525- Colombo Road – Kurana- Negambo, Mr.R.E.P. Fernando-Notary Public- Sapatha- Katuneriya- Nathandiya, Mr.C.M.Mahusook Marikkar- Chief Trustee- Muslim Jumma Mosque- Madampe, Mr. Sendil Kumar Kurukkal-Priest of the Hindu Kovil-Madampe and Mr.W.G.L. Gunasiri- Police Officer attached to Seeduwa Police Station.

Valuable ideas and views were expressed at these discussions. The chief incumbents of the two temple requested that if parapet walls of the temples are to be affected they be reconstructed by the executing agency as the Temples do not have funds for this purpose. They however opined that proposed project would be extremely important. Rev.Father Loshi and Mr. Winston Dias pointed out that the road at this place is inundated during rainy days as the drains are not properly maintained and the water holding capacity of the drains is not sufficient. Local Authority is also inactive in attending to their duties, they pointed out. Mr. Fernando a Notary Public highlighted some important points about the current status of road maintenance. He said that many sections of the road are flooded during rainy days and the situation has become more aggravated as influential persons and certain politicians of the area are in the practice of dumping lorry loads of the earth to prevent water flowing into their premises. This has resulted in blockage of the pavement and the pedestrians have become victims who have to tread on the muddy water. There are placards and display boards kept on the pavement of the road during the day time and this has become a severe menace to the pedestrians. Responsible agencies have failed to take action to prevent this menace. Chief Trustee of the Mosque at Madampe pointed out that there are traffic blocks on Fridays. He said that about 1000 devotees attend the Mosque on Fridays and when they leave the Mosque after prayer there is huge traffic congestion. It was observed that the drain right in front of the Mosque is blocked. Therefore it is necessary to examine the drainage system by the road designers of this project. A Police Officer said that this road is busy during 6 am to 9 pm. He further opined that after opening of the Katunayake Express Way the traffic volume has slightly reduced.

2.11 Places with Archaeological Value in the Project Area

Within 500m radius of the proposed road, only one Archaeological Site is encountered.

Table 2-34, Archaeological Sites

No	D.S. Division	Village	Monuments	Chainage	Distance from Centre line	GPS Location	Location	Gazette details
1	Madampe	Marakkalagama and Mahabaddegama	Thaniyawella Devalaya (Bodhiya and Devalaya)	60+700	15m	7.77629°N 79.83025° E	Madampe old town	1264 2002/11/22

2.12 Sensitive Locations in project area

Within the proposed project area sensitive places are encountered. These centers will not be directly impacted such as damages or need for relocation. However, there can be some disturbances such as access restriction and noise during construction phase of the project. The details of these religious places are given in Table 2-40.

Table 2-35, Socially Sensitive places

DS Division	Place		Chainage	Distance
Ja-Ela	Church	St Mary's Church	15+800	90m
	Statue	Two Statues of Jesus		
Katana	Hospital	Wijaya Kumaranathunga Memorial Hospital	20+200	43m

DS Division	Place		Chainage	Distance
	Temple	Gangarama Viharaya	17+400	30m
		Gangaramaya	18+400	20m
		Suvisuddarama Viharaya	21+800	85m
	Church	St Sebestian Catholic Church	24+700	40m
		Methodist Church	26+000	40m
		Gethsemana Prayer Center Church	26+200	13m
		St Philip's Church	26+600	35m
Negambo	School	Maris Stella College	30+500	15m
		Loyola College Negombo	35+500	150m
	Hospital	Negombo District General Hospital	30+400	35m
	Temple	Sri Sarармodhaya Bodh Gaya Viharaya	36+600	10m
		Mahamewuna Asapuwa	36+350	10m
	Church	AG Church	30+100	70m
		St Anthony's Church	32+300	100m
		St Francis de Seles Church	33+150	100m
	Mosque	Yusufiya Mosque	31+900	15m
	Statue	Statue of lord Buddha		
		Statue of lord Jesus	39+450	10m
Wennappuwa	School	Waikkala Government School	39+700	10m
		Jennings International School	43+600	75m
		Joseph Vas College	46+300	60m
	Hospital	Life Care Hospital	46+100	50m
	Church	St Joseph Church	46+300	60m
	Cemetery	Nainamadama Cemetery	43+600	10m
Naththandiya	Church	Lansigama Church	50+900	50m
Mahawewa	School	Halpanawila Temple	57+200	50m
	Temple	Mahawewa Temple	59+100	220m
	Other	Mahawewa lake	59+500	20m
Marawila	Temple	Senanayaka Aramaya	63+500	160m
	Other	Thaniwella Dewalaya	60+700	15m

CHAPTER 3

3. Potential Environmental Impacts of the Project

3.1 Identification and assessment of impacts

The proposed project will have both positive and negative impacts on the surrounding environment. This chapter assesses the nature, type and magnitude of the potential negative impacts on the various relevant physical, biological and cultural environmental components along the project corridor. For the assessment of impacts, the baseline information has been supplemented by the field visits and the primary surveys of the various environmental components carried out during the study.

A scoping exercise on the proposed project indicates the potential major impacts of the project and their potential significance as given below;

Table 3-1 Potential Major Impacts

No	Impacts On	Significance and duration of Impact (Construction stage)	Significance of impact-Operation stage	Assumed impacts
1	Water Ways, drains and adjacent lands	A-(temporary)	B-(long term)	Erosion and siltation could result in adverse impacts on water ways, such as rivers lakes and lagoons. Water retardation could be caused by coffer dams.
2	Road Works	A-(temporary)	D	Damage and hindrance to road works may occur due to minor and major floods, at flood prone locations.
3	Irrigation Canals and irrigation schemes. .	A-(temporary)	D	Blockage of irrigation canals may occur. Irrigation water issues through culverts and other irrigation structures maybe hindered.
4.	Paddy Areas	A-(temporary)	D	During construction stage, siltation of paddy areas may occur, thereby causing a hindrance to cultivation.
5.	Existing road infrastructure	A-(temporary)	B-(long term)	Water flow through drainage paths maybe hindered.
6.	Culverts and side drains	A-(temporary)	B-(long term)	Clogging of culverts and side drains with sediment and debris.
7.	Lead Away Drains	B-(temporary)	B-(long term)	Weed growth in lead away drains may cause flow retardation.
8.	Valuable Plant species	B-(short term)	D	Removal of a limited amount of valuable plants may be necessary for road expansion purposes.

No	Impacts On	Significance and duration of Impact (Construction stage)	Significance of impact-Operation stage	Assumed impacts
9.	Sensitive Habitats	A-(short term)	B-(long term)	Road widening and rehabilitation may have adverse impacts on sensitive mangrove habitats in Puttalam Town and Puttalam Estuary
10	Sensitive Habitats	A-(short term)	D	Sensitive habitats such as water bodies/mangrove areas may be affected due to solid waste and wastewater discharges from labour camps and from construction spoil and debris.
11	Siltation/Pollution of water bodies	A-(temporary)	B-(long term)	Siltation and pollution of water bodies such as rivers, streams and lakes and lagoons may occur due to uncontrolled discharge of wastewater and drainage water from construction sites during rainy periods in particular. Wastewater from vehicle/plant maintenance and service stations and construction sites may contain excess oil and other pollutants leading to the pollution of water bodies.
12	Noise /Vibration	A-(short term)	B-(long term)	Excessive noise maybe generated from construction equipment, machinery and vehicles creating a nuisance to nearby residents and pedestrians.
13	Quarry Sites	A-(short term)	D	Operations at unregulated/unlicensed quarry sites may cause pollution, nuisance and danger to nearby residents through uncontrolled use of explosives, dust generation and damage to houses
14	Air Pollution	A-(short term)	B-(long term)	Excessive dust generation from work sites may cause a nuisance to nearby residents and pedestrians. Emissions from Batching/Hot Mix Plants/Crushers may cause air pollution and nuisance. Vehicles transporting construction materials may generate excessive dust during transportation.
15	Soil Pollution	A-	B-	Soil pollution may occur due to uncontrolled discharge of wastewater from construction sites and wastewater containing oil from vehicle maintenance and service stations.

No	Impacts On	Significance and duration of Impact (Construction stage)	Significance of impact-Operation stage	Assumed impacts
16	Solid and Liquid Waste	A-(short term)	D	Construction spoil, debris, sludge, wastewater from construction sites and vehicle maintenance and service stations may cause pollution of soil and water bodies.
17	Odour	D	D	No problems due to odor is anticipated both during construction and Operational stages.
18	Workers Health	B-(short term)	D	Workers may suffer due to high noise levels from construction equipment and due to excessive dust emissions from construction sites, Batching Plants, Hot Mix Plants and Crusher plants.
19	Landscape	A-(temporary)	B+(long term)	Construction activities will cause adverse impacts on the landscape due to the presence of construction equipment and dust generation during construction. The landscape will be improved after the construction period is over, as planned construction will be carried out.
20	Cultural heritage	B-(short term)	D	Negative impacts on nearby cultural sites may occur during the construction period especially due to high noise levels and dust emissions. There may be possibilities of access restrictions

A- Significant Negative Impact Expected
A+ Significant positive impact expected
B- Some negative impact expected
B+ Some positive impact expected
C Unknown impact
D Negligible Impact or no impact is expected

3.2 Pre-Construction Impacts

3.2.1 Climate Change Risk Impacts

In order to deal with the climate change considerations regarding to the candidate road, several publications relating to climate change and its impacts in the local context were referred to as indicated in the reference page (reference nos 1, 2 and 3).

According to the National Climate Change, Adaptation Strategy for Sri Lanka 2011 to 2016 Sri Lanka is a negligible contributor to global warming. However, as a nation, we are highly vulnerable to the impacts of climate change, which include:

a) Increases in the frequency and intensity of disasters such as droughts, floods and landslides;

b) Variability and unpredictability of rainfall patterns;

c) Increase in temperature; and

d) Sea level rise, among others.

Climate change vulnerabilities cut across many sectors in the economy and one of such affected sector is the transportation sector, and threatens to compromise the significant achievements the country has recorded in the last 20 years. Investments are currently being deployed (for example road rehabilitation works) as part of our on-going development drive is also at risk. The following have been recommended in respect of the road rehabilitation.

- Considerations, such as updated rainfall intensity
- Revised manuals curves, bridge and road construction manuals, etc.
- Climate resilience criteria should be included in guidelines for all national infrastructure development

Climate Change Vulnerability Data Book of the Ministry of Environment Sri Lanka January 2011 outlines the impacts on climate change on various sectors in the form of maps and data table. The main vulnerability indicators which are relevant to road rehabilitation are;

(1) Shifting of climate zones

(2) Flood risk

(3) Land slides

(4) Sea level rise

(5) Drought exposure

As far as the climate change issues are concerned, on drainage issues the climate change affects in two ways;

(1) Increased rainfall intensity

(2) Increased vulnerability to floods as a result of increased rainfall intensity

On the issue of increased rainfall intensity there are no standard publications showing the IDF curves which reflect the climate change of Sri Lanka except for the qualitative descriptions of increase of rainfall intensity.

However the publication entitled “Sector Vulnerability Profile – Urban Development Human Settlement and Economic Infrastructure – Supplementary Document to Climate Change Adaptation Sri Lanka” provides a series of maps called transport sector vulnerability maps showing some of the indicators listed above.

Using the climate change maps indicated above climate change vulnerability maps for the candidate road were prepared and are presented below.

3.2.2 Flood Vulnerability

Most of the culverts and bridge openings have been designed for 50 and 100 year floods which are infrequent and of which the peak will last for a very short time. Most of the frequent events (i.e. annual floods) are very much below 100 or 50 year level which could withstand the increase of rainfall intensity due to climate change.

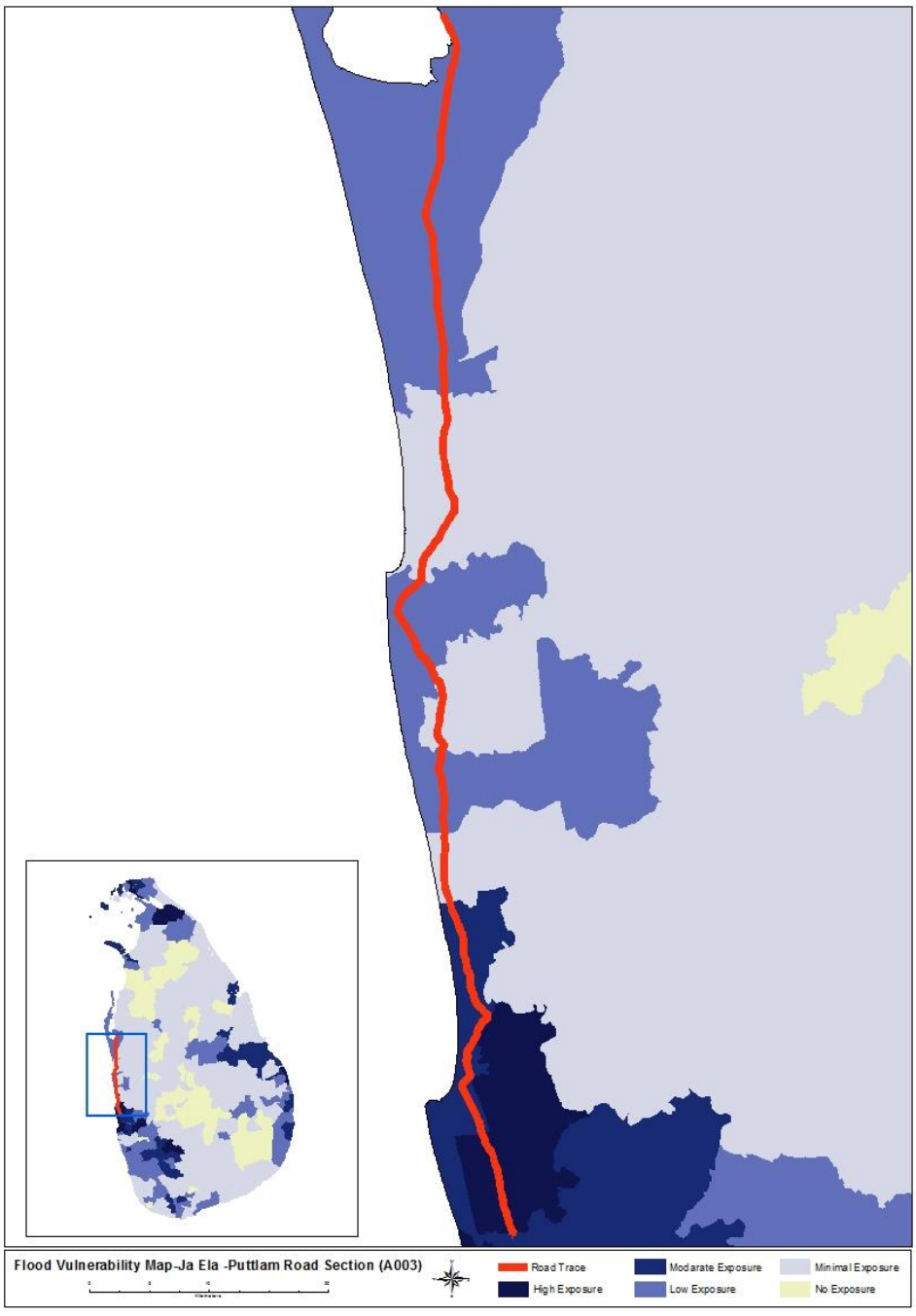

Figure 3-1, Flood Vulnerability of the Project area (A003 Road)

According to the flood vulnerability map given in figure 3-1, it is observed that A003 Road has High, Moderate, Low and Minimal exposures to flood vulnerability.

3.2.3 Climate Zone Shift

In order to identify the climate change vulnerability/exposure of the candidate provincial road, the candidate roads were superimposed with the climate zone variation (shift) maps and presented in Figure 3 2 below

According to the figure 3-2, the A003 road is vulnerable to climate zone shifts as it passes through several climatic zones.

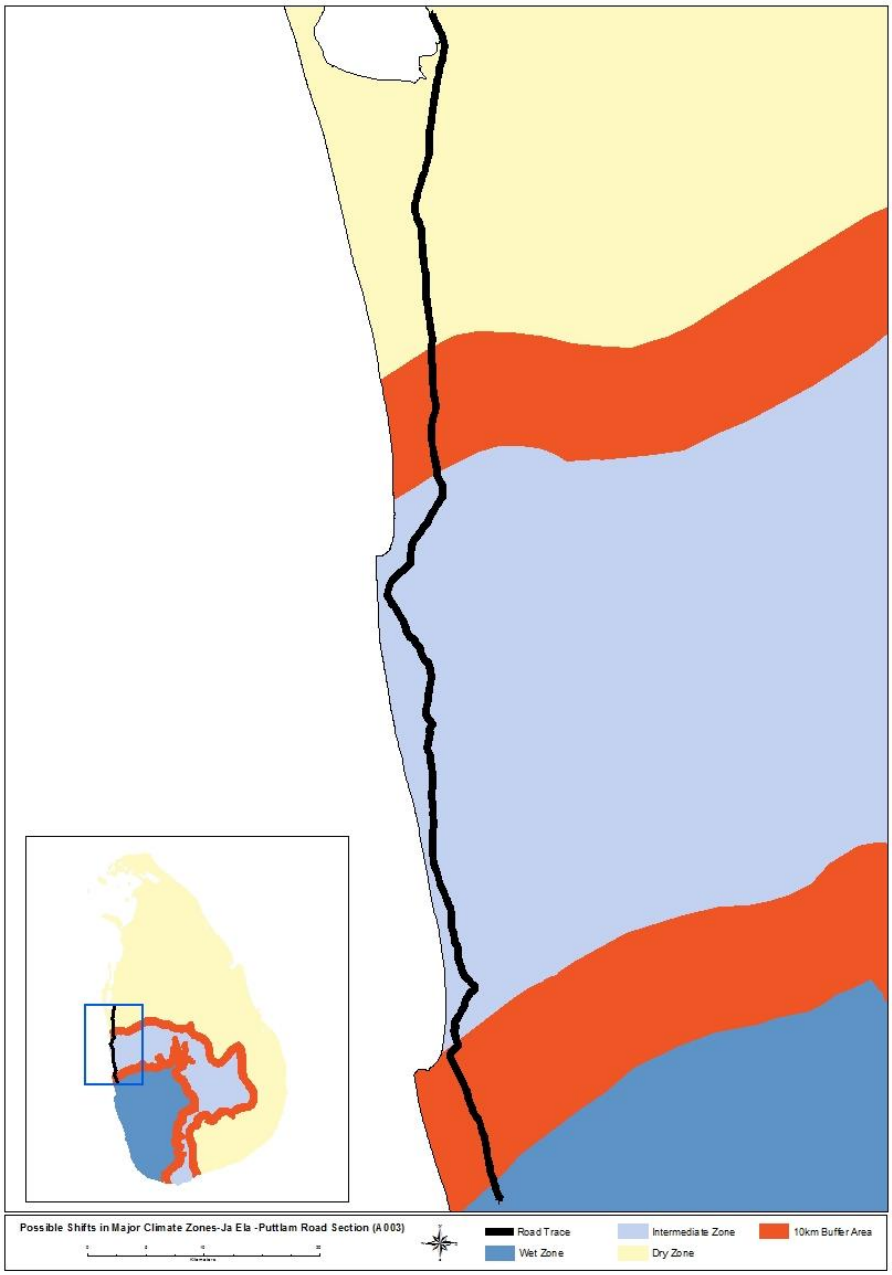

Figure 3-2, Climate Zone variation map of the Project area (A003 Road)

3.2.4 Sea Level Rise

The whole stretch of the candidate road (A003) from Ja-Ela to Puttalam, traverse close to the coastal area. Few sections of this candidate road approximately from Ja-Ela to Negombo and the section closer to Kalpitiya to Puttalam are vulnerable to moderate level of exposure due to the sea level rise (Refer figure 3-3 for more details). It should be noted that the sea level rise zones in the map are not based on precise terrain levels and because of local levels of the road some areas will not become vulnerable.

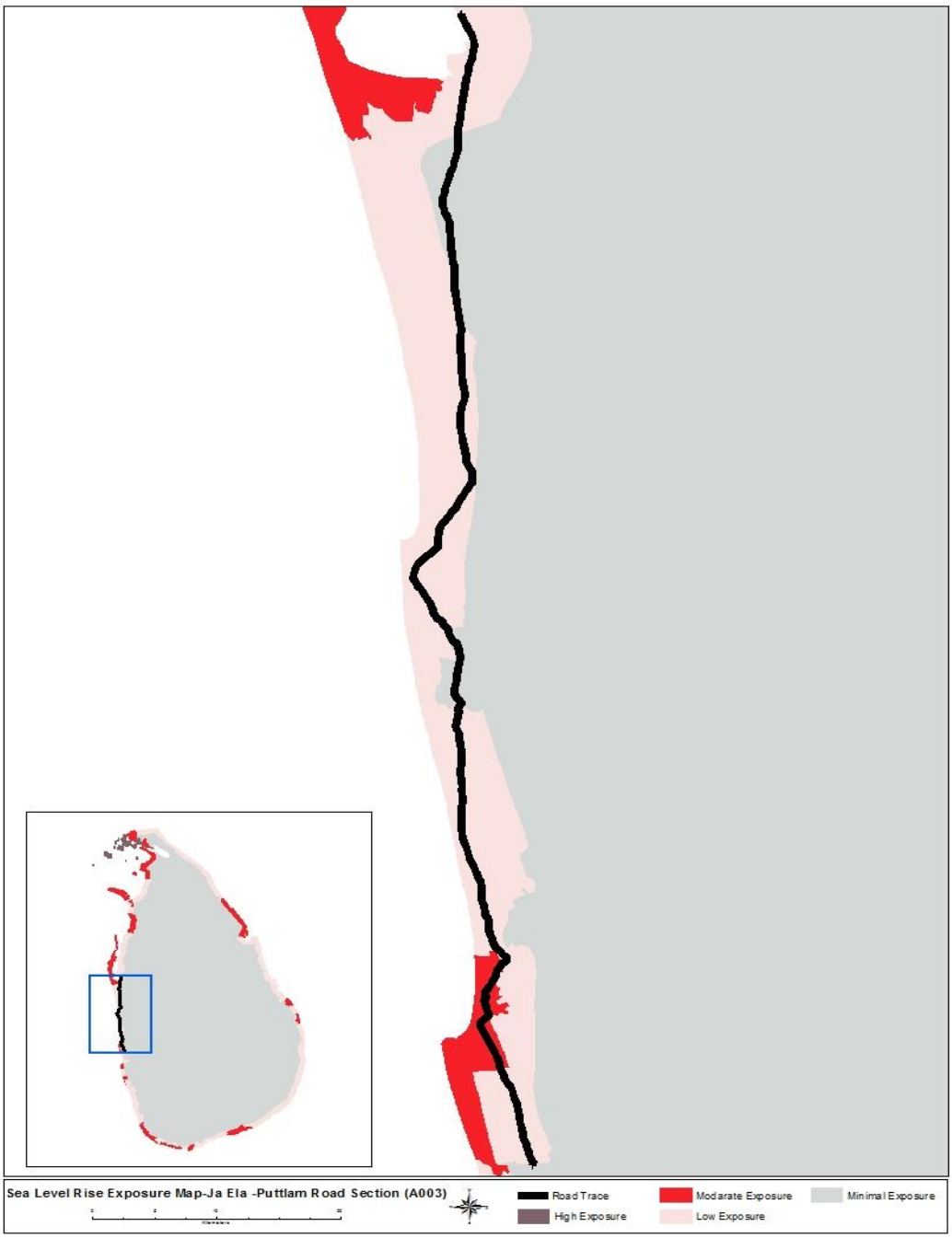

Figure 3-3, Sea Level Rise Vulnerability Map of the Project area (A003 Road)

3.3.5 Landslide Vulnerability

From the map in figure 3-4below it is observed that the candidate road has no exposure to the landslides throughout the project trace as A003 Road does not cut across mountainous areas.

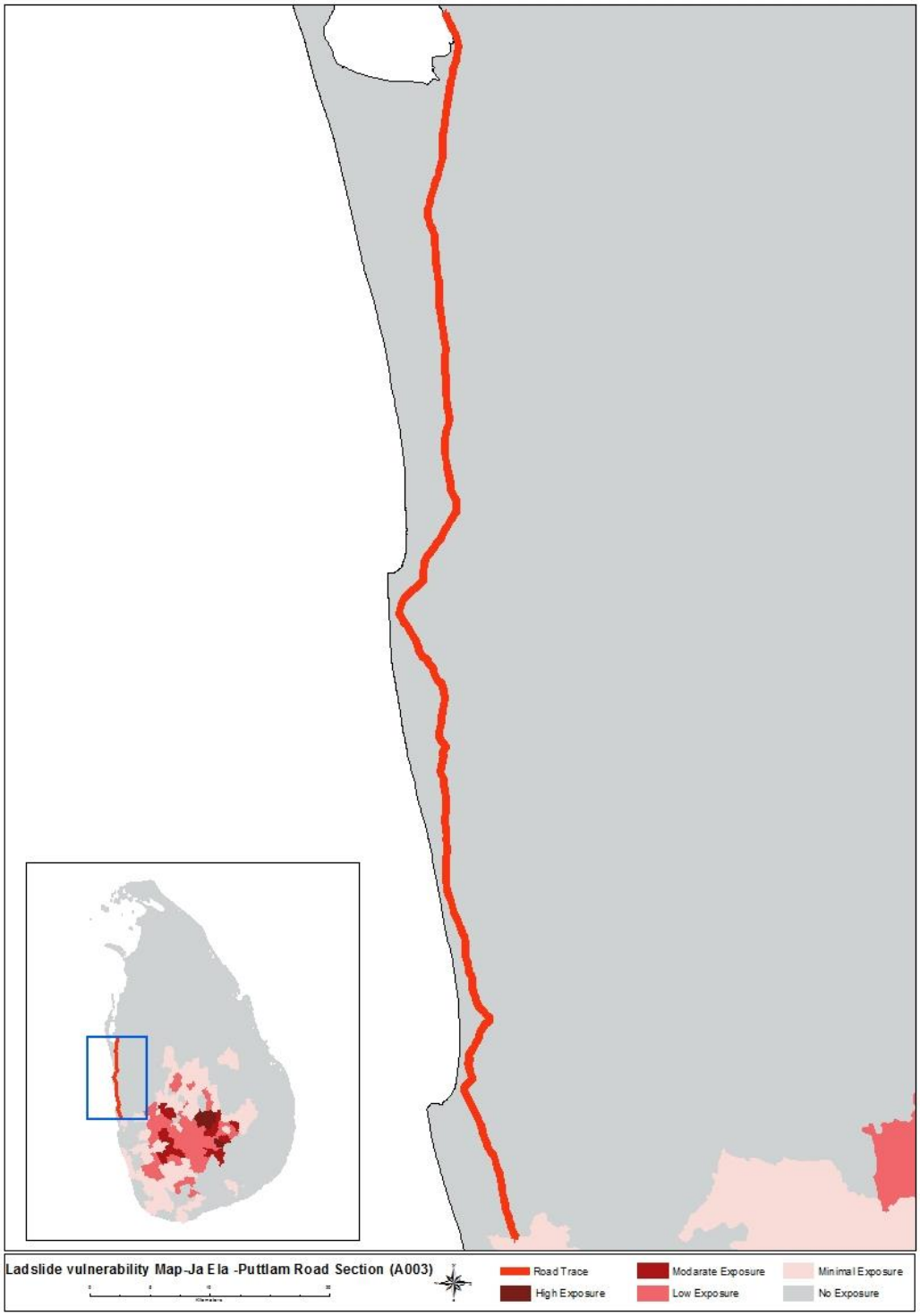

Figure 3-4, Landslide Vulnerability Map of the Project area (A003 Road)

3.2.6 Drought Exposure

Nearly half of the sections of the candidate road (A003) is observed to be affected with varying levels of exposures such as high, moderate and low and exposed minimal in very few areas of the trace. (refer figure 3-5) Exposure to droughts implies that the road could get exposed to high temperature for a long time

According to Chandrapala and Feranando there is an ascending trend in the temperature in most of the climatic stations in Sri Lanka and the details are provided in table 3-2. The closest station to the A003 road is Colombo which has recorded an increase of $0.0164C^0$ per year.

Table 3-2, Trends of Temperature in few key locations of Sri Lanka

Trends of air temperature (1961-1990)

LOCATION	SLOPE – ^{0}C/year	r^2
Ratnapura	0.0175	0.88
Badulla	0.0217	0.85
Kandy	0.0185	0.72
Nuwara Eliya	0.0146	0.56
Colombo	0.0164	0.67
Hambantota	0.0104	0.81
Anuradhapura	0.0364	0.79
Kurunegala	0.0173	0.42
Jaffna	0.0180	0.61

Chandrapala & Fernando, 1995

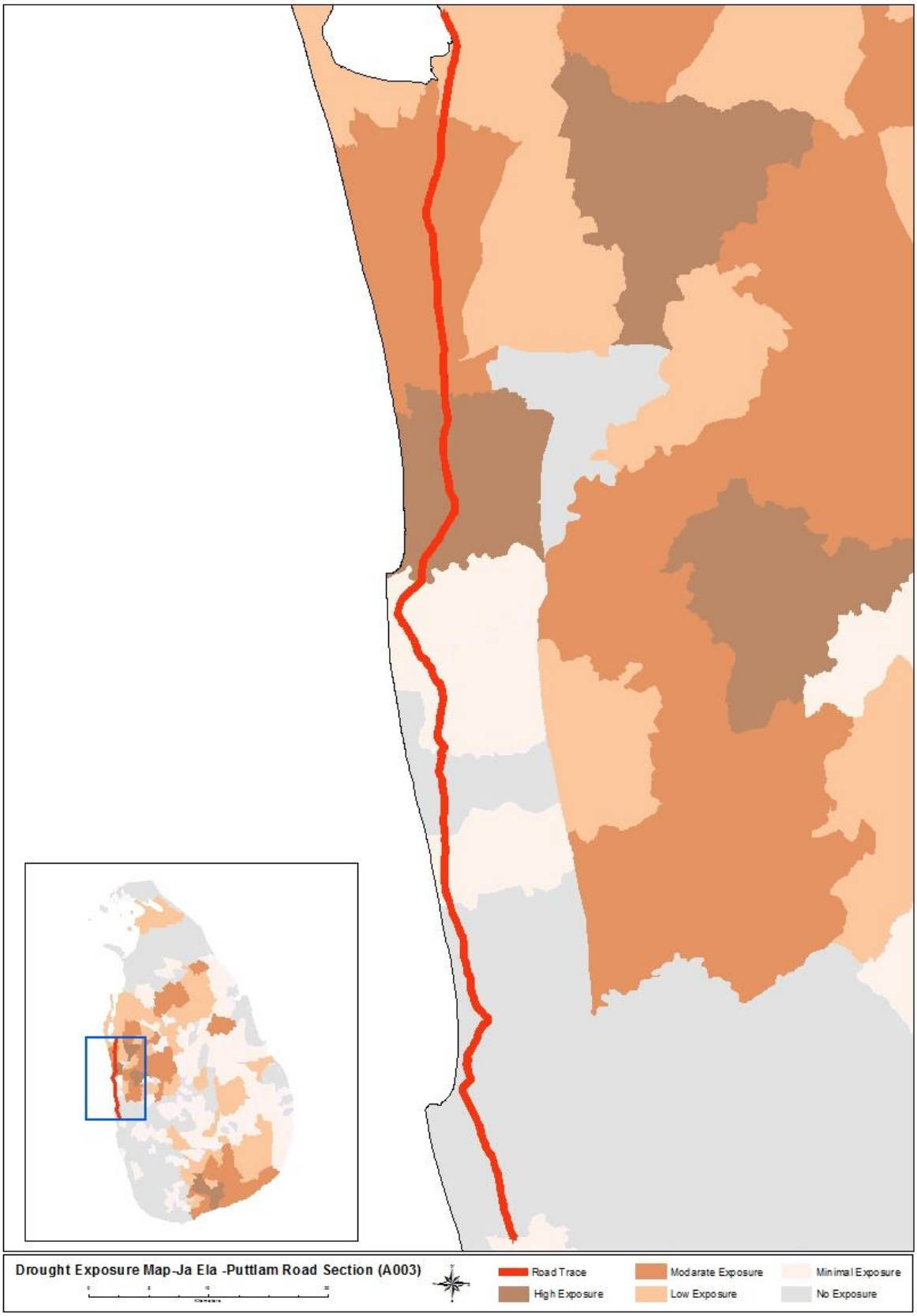

Figure 3-5, Drought Exposure of the Project area (A003)

Given below is a checklist for the road which shows the nature of climate change impacts in respect of the indicators, climate zone shift, flood vulnerability, landslide vulnerability, sea level rise vulnerability and drought exposure.

3.2.7 Summary of Climate Change Vulnerability Status for A003 Road

The preponderant climate change vulnerability factors for A003 Road are;

a) Flood Vulnerability
b) Drought Exposure
c) Climate Zone shift
d) Sea Level Rise

The road is not vulnerable to landslides (as this road does not straddle hilly areas) hence special adaptation measures are not necessary. (See Table 3-3 below) Adaptation measures have been in built to the road design in order to mitigate the impact on flood vulnerability and drought exposure.

Table 3-3, Checklist for Road Vulnerability to Climate Parameters

ROAD NAME	CLIMATE CHANGE PARAMETERS				
	Climate zone shift vulnerability	**Flood Vulnerability****	**Land slide Vulnerability**	**Sea Level Rise Vulnerability**	**Drought Exposure**
A003	Vulnerable to climate zone shifts	High, Moderate and low levels of exposure along the various section of the trace	No exposure	Moderate level of exposure closer to the southern and northern ends of the trace	High to Minimal level of exposure along the 50% of the trace

3.2.8 Implications of Climate Change Risk Factors to the Proposed Project

Implications from Climate Zone Shift and Drought Exposure

Because of climate zone shifts the exposure area of the road to the dry zone and intermediate zone will increase. This will result in increased exposure to temperature and also increase exposure to intense rains during North East Monsoon periods. The increase in temperature will increase the drought exposure and the road pavement design should take into account the increased amount of temperature of the design road lifetime

Implications from Flood Vulnerability

As given in Table 3-3 above the road will be subjected to various levels of flood vulnerability along various sections of the trace. Because of the increase of the rainfall intensity more frequent road inundations of the road could be expected. As recent hydrological research has revealed that short duration rains have higher intensities because of climate change short duration intense rain will impose higher inundation levels of the road. Higher amount of road raising and larger opening sizes for small and medium culverts will be necessary.

The rainfall intensity curves for the relevant stations such as Katunayaka and Puttlam will have to be updated and used during the hydrological studies to reflect the possible increased levels of exposure. The future drainage system should be able to cater to the increased volumes of runoff which could take place in short durations to avoid road inundations and resulting road damages.

Implications of Sea Level rise Exposure

Only the road segments close to Negombo Lagoon has shown moderate exposure to sea level rise and because of sea level rise there is a possibility of moderate inundation. At present there is no standard practice or policy in Sri Lanka to consider this impact and to propose mitigation measures probably due to the fact that sea level rise impact quantification is not scientifically firm yet, as there are uncertainties in the methods used. The required mitigation measure is to raise the road to take this impact into account. In any case for the rehabilitation process the road levels will be generally raised by about 0.3m and this raising will partly cover the required mitigation measure for sea level rise impacts.

3.3 Drainage Related Impacts (Baseline Impacts)

Identification and collection of the site specific drainage issues is the most important task in the hydrological study. Prevailing drainage issues were identified through joint site reconnaissance with the staff if the Executive Engineers of RDA as they are very familiar with the existing drainage issues. During joint site inspections additional information related to floods, inundation depth etc. were also collected from the roadside stakeholders. On screening prevailing drainage issues following baseline hydrological impacts for A003 Road were screened.

- Road overflow because of low road profile, large upstream catchment area and inadequate number and capacity of culverts and minor bridges
- Drainage congestion because of no proper drainage continuity between upstream catchment, hydraulic structures and downstream lead away outlets. Encroached and blocked lead away drains.
- Poor side drain system for longitudinal drainage and poor nexus with adjoining culverts
- Upstream drainage congestion and resultant backwater from under capacity culverts.
- Road overflow from large river side flows during less frequent floods.
- Blockage of siphoned side drains under large irrigation canals.
- Culverts/Bridges suspected as inadequate in capacity
- Places of water pooling on shoulders and pavement where there are no side drains or inadequate drainage capacity

Main drainage Issues in A003 Road are summarized in the table 3-4 below

Table 3-4 Main drainage Issues in A003 Road

Issue Type No.	Approximate Location/s	Prevailing Drainage Issue
1	19+400km-19+600km	Road overflow by floods
2	35+700km-35+900km 42+700km-43+000km	Waterlogging at roadside
3	45+200km	New culverts needed
4	60/1 (Inlet to Mahawewa),48/1	Suspected as under capacity culverts
5	62/5	Irrigation canal. Side drain siphoned under canal and this siphon has blocked and malfunctions.

Issue Type No.	Approximate Location/s	Prevailing Drainage Issue
6	Mundalama Town, 45km-47km (Wennappuwa Town) , 19kmm-23km	Concrete side drains needed. The entire road needs some form of side drains
7	25/2,28/3,29/2,33/1,33/2,34/1,34/240/2,0/ 3,42/1,42/4,43/1,43/3,50/1,54/1,60/3, 62/6,62/7,63/1,63/3,69/1	Lead away drains blocked, weeded or narrow

3.4 Construction Impacts

3.4.1 Erosion and sediment runoff

Soil erosion is less common along the proposed road area because the A004 road traverse through low lands most of the time and the roadside has got stabilised over time. The road rehabilitation process under an OPRC contract may have following construction activities which could trigger erosion.

- Filling of the road shoulders in some areas in order to widen the road embankment.
- Removal of existing culverts (pipes etc.) cutting trenches and replacement by new pipes or boxes.
- Backfilling of the culvert structures, near side drains etc.
- Excavation and temporary piling of earth by roadside.
- Excavations of the upstream & lead-away paths of the drainage crossings to avoid water stagnation.

All these activities could cause temporary erosion & siltation if non-compacted earth surfaces are left exposed if the construction activities are carried out during the rainy season. The sediment could drift away and get silted up in the side drains and the adjoining streams, lead away drains etc.

3.4.2 Effects to water ways, drains and adjacent lands

When bridges are rehabilitated coffer damming will become a necessity and coffer damming could retard the water in the streams and also river banks could overflow because of the constrictions created by coffer damming. Coffer damming also could lead to erosion.

The road inundation during the rainy season in flood prone areas often causes traffic jams and the road becomes impassable and the commuters face severe hardships in attending to schools, work places etc. If the road construction activities take place during this rainy season time, these hardships will get aggravated.

3.4.3 Impacts on existing road structures (bridges culverts etc.)

Some of the culverts and minor bridges will be demolished and reconstructed with a wider span. Such construction works will lead to temporary drainage congestion, high velocities, upstream or downstream ponding and backwater impacts.

3.4.4 Impacts on Irrigation schemes

There are many minor irrigation schemes by the road site which could be prominently sited as paddy grown areas. There is one major irrigation scheme Thinipiti Wewa Irrigation Scheme (62+000km) of which a mail canal crosses A003 Road. There are also many minor tanks belonging to these minor irrigation schemes close to the candidate road. Refer Table 2-11 for details.

Following hydrological impacts could be expected especially during the construction stage

1. Hindrance to irrigation water issues to farm lots in paddy areas during the rehabilitation of culverts which convey irrigation water.
2. Soil erosion and wash off deposition in paddy fields , irrigation and drainage canals and lead way canals
3. Closure of small and minor stream paths and resulting water logging
4. Water logging on the upstream of the road embankment because of poor drainage

3.4.5 Ecological impacts due to removal/ pruning of vegetation (direct, long term negative impact)

A considerable number of trees have to be removed or pruned (See annex 1 and Annex 2). The trees ear-marked for felling/ pruning are mostly of some importance (i.e. fruit trees, medicinal trees, trees that have timber value or medicinal value or ornamental value) and mostly located in home gardens (that includes, houses, schools, religious sites, commercial sites etc.). Balance of the ecological environment can get affected and the adverse impacts will be medium to high if removal/pruning of vegetation is not properly planned. Unplanned pruning can also cause uprooting of pruned trees under heavy rainy and windy conditions.

3.4.6 Ecological impacts of siltation on the environment (indirect, long term negative impact)

Generation of soil is expected during development of side drains, leader ways and culverts and also during the removal of unsuitable soil from the roadway. This may increase siltation of streams and other waterways including Dandugam Oya, Kelani Ganga and Ja-Ela in the area as silt materials in soil may be carried to these aquatic habitats during heavy rains in particular. This will affect the photosynthesis of the aquatic habitats leading to harmful effects to its biota.

3.4.7 Ecological impacts of the release of harmful construction wastes on the environment (indirect, long term negative impact)

An operation that can bring considerably harmful waste would be from the cleaning of concrete batching equipment (used in the construction of side drains etc.). This wastewater will contain sand, silt and cement particles that will increase the turbidity if released into waterways will result in the reduction of photosynthesis in water. This will affect the organisms in the aquatic food chains. In addition, the suspended matter that can clog the gills of fish may impair their breathing that may even cause death by suffocation. However, this problem does not arise if ready-made concrete and asphalt will be utilized for construction work.

Leakages of oil, fuel and lubricants from construction equipment can also lead to oil pollution of the waterway in the study area. This will result in surface oil film formation which in turn will limit the light penetration and subsequent primary production. They also can cause toxic effects to fauna and flora. However, an effective regular maintenance and prevention of leakages can avoid the potential of adverse impacts caused by the same.

In addition, some harmful hazardous and risky chemical will have to be used and may cause impact due their discharge into waterways or other ecosystems.

3.4.8 Anticipated problems related to solid waste disposal (direct, short term negative impact)

Solid wastes such as plastics, polythene, excess sand, boulders, coarse and fine aggregate, cement bags, cut pieces of materials, various chemicals paints etc. will bring adverse effects through visual pollution and by settling on different aquatic and terrestrial habitats, if not properly managed. In addition, if solid waste is disposed haphazardly, it will lead to an increase in the populations of nuisance animals such as stray dogs, cats and crows in the area. This will be a health hazard to the people living in the area.

3.4.9 Anticipated problems related to labour camps (direct, short term negative impact)

The labour camps can be an environmental hazard and a nuisance if they are not strategically sited and hygienically maintained.

3.4.10 Impacts to any rare, threatened, endemic flora and fauna in the study area (direct, long term impact)

The project area has no rare, threatened or endemic fauna. But there is one near threatened reptile species, Crocodilus porosus (S: Gata kimbula) inhabiting the Dandugama Oya in project area. However, it is very unlikely that the construction work to have any direct adverse effect on this species as it has alternative habitats to move into connected to the Oya.

In project area, there are plant species that are important which include two nationally endangered (EN) species, *Diospyros ebenum* (S: Kaluwara) (only 3 trees) and *Buchanania axillaris* (S: Kiripalu) (1 tree); three nationally near threatened (NT) species, namely, *Albizia lebbeck* (S:Mara), *Madhuca longifolia* (S:Mee*) and Pouteria campechiana* (S:Rata lawalu)and two nationally vulnerable (VU) species, namely, *Phyllanthus emblica* (S: Nelli) and *Ficus tinctoria* (S: Wal ehetu) considered under the National Red List 2012 of Sri Lanka (MOE 2012). These species that are within RoW (road-side planting) may have to be removed/pruned in order ensure safety of the road users. It is recommended that efforts should be made to save these plants as much as possible. In the event they have to be removed, possibility of root-balling and moving to a safer public space or planting the same in a public area will need to take place.

3.4.11 Ecological impacts on protected areas and other sensitive habitats (indirect, long term, negative)

Although several sensitive habitats that are alongside the A003 road, none of these are within the 5m boundary from the existing road sections where the road widening are planned. Therefore, there are no ecological impacts from this project to the above mentioned sensitive ecosystems.

The planned project activities that are to be carried out in selected sections do not have any protected areas but one sensitive areas have been identified. They are the Dandugama Bridge and the surrounding area (Dandugama Bridge to Periyamulla junction).

Construction activities may increase the siltation of Dandugam Oya bridge area and its surroundings as silt materials may be carried to these aquatic habitats during heavy rains in particular. This will affect the photosynthesis of the aquatic habitats leading to harmful effects to its biota. An operation that can bring considerably harmful waste during construction activities would be from the cleaning of concrete batching equipment (used in the construction of side drains etc.). This wastewater will contain sand, silt and cement particles that will increase the turbidity if released into waterways and it will result in the reduction of photosynthesis in water. This will affect the organisms in the aquatic food chains. In addition, the suspended matter that can clog the gills of fish may impair their breathing that may even cause death by suffocation. However, this problem does not arise if ready-made concrete and asphalt will be utilized for construction work.

Leakages of oil, fuel and lubricants from construction equipment can also lead to oil pollution of the waterways. This will result in surface oil film formation which in turn will limit the light penetration and subsequent primary production. They also can cause toxic effects to fauna and flora. However, an effective regular maintenance and prevention of leakages can avoid the potential of adverse impacts caused by the same. In addition, some harmful hazardous and risky chemicals will have to be used and may cause impact due their discharge into waterways or other ecosystems. Solid wastes such as plastics, polythene, excess sand, boulders, coarse and fine aggregate, cement bags, cut pieces of materials, various chemicals paints etc. will bring adverse effects through visual pollution and by settling on different aquatic and terrestrial habitats, if not properly managed.

3.5 Hydrological Impacts during the operational stage

Most of the operational impacts are common to any road after rehabilitation. The following operational hydrological impacts are possible for this A003 road. Operational impacts are extremely important in view of the OPRC contracts where service levels indicators will be established.

- Creation of potholes etc. on the road surface & resulting traffic & social problems.
- Road inundation overflow of side drains etc. because of poor drainage especially in semi urban areas. After a proper rehabilitation process this type of impact is minimum. However as the maintenance period is long in an OPRC contract these impacts could occur during the later parts of the maintenance period. Road inundation could specially occur
- Clogging of culverts & side drains by sediment & other debris.

During the operational stage openings (including lead in and lead away canals) could get silted and flow will get impeded resulting in upstream backwater and delay in flood recession causing protracted water logging on the upstream of the road embankment.

3.5.1 Impacts on Raw Material Supply Sources and Dumping operations

Existing quarries that are already in operation with the required environmental clearances have been recommended for this project. No new quarries are proposed and hence no major impacts, which arise in making new quarries operational, are likely.

Road construction materials such as rubble, metal aggregate, sand and soil required for the construction activities will be obtained from quarries, rivers and land. Since substantial quantities of these materials will be required for the rehabilitation of the road, the availability and sustainability of such resources at the extraction sites will be negatively affected, as they are not renewable in the short term. In addition, the sites from which the materials will be extracted may be significantly affected in several ways including landscape changes, displacement of people, intrusion into settlement, animals and vegetation, poor visual quality and opening of depressions on the surface leading to destruction of agricultural crops, several human and animal health impacts

Impacts due to quarrying will last for the construction period. The aggregate for construction shall be procured from licenced quarries only. Use of river sand will be substituted by quarry dust, which will be procured from licensed metal crushers. Current suppliers and locations with capacities are given below.

Deshani Metal Crusher, 33rd KM post Bangadeniya Anamaduwa road; Tel: 077033069	Supplying ability of aggregate based course (ABC) is 70 cubes/d (200m^3/d) while ¾" size metal is 50 cubes/d (150m^3/d).
Mr. Sumith; 22nd KM Post, Anamaduwa road, Bangadeniya	Gravel Quarry, Meta! Quarry & sand supplier
Mr. Bandula; Thonigala 102nd KM Post, Kandy Puttalam road Tel: 0777228753	Current raw material supplier for RDA with supplying ability of 40 to 50 cubes/d (100 – 150m^3/d) of ABC, quarry dust, ¾" & ½" size metal and asphalts.
Mr. Sudesh, Saliyawewa 31 KM Post Puttalam Trincomalee road; Tel: 0773512935	Supplying ability of aggregate based course (ABC) is 90 to 100 cubes/d (250 – 300m^3/d) while quarry dust, ¾" & ½" size metal and asphalts are 20 -25 cubes/d (50 – 75m^3/d).

Senerath Engineering (Pvt) Ltd, Maddumulla Estate, Pannala, Tel: 071436218	Supplying ability of ABC 150 cube/d (425m^3/d), ¾" & ½" size metal 50 to 60 cubes/d (150 – 175m^3/d), Quarry dust 40 cube/d (100m^3/d) & Asphalt 1500 – 800 tons/d
Sri Ram Construction, Angampitiya, Waikkala, Tel: 0773475766	Installed capacity of asphalt plant at Waikkala is 150 tons/h & at Pannala 120 tons/h while cumulative capacity of metal crushers for production of ABC, ¾" & ½" size metal & Quarry dust are 750 tons/h for each product.
Suriya Metal Crusher; Mr.Gamini	Supplying ability is 40 to 50 cubes/d (100 – 150m^3/d) of ¾" size metal
Sampath Metal Crusher, Kottukachchiya	Supplying ability is 8 cubes/d (25m^3/d) of ¾" size metal & 3 -4 cube/d (5 – 10m3/d) of quarry dust.

For the construction of shoulder and pavement considerable amount of earth material is required. Material considered for the same will be procured from present licenced suppliers. The debris of the project will be dumped with the approval of relevant local authority and transported the shortest possible distance from the site.

Provision has been made to reuse spoil generated needed for filling and other purposes while no river banks or fertile agriculture lands will be used as dumping site.

Material extraction pits, can form stagnant pools and pose health hazards to prevent which redevelopment of borrow areas need to be worked out. Additionally, they can also act as breeding ground for vectors like mosquitoes just after monsoon. It is expected that the implementation of the mitigation measures for borrow area redevelopment proposed as part of the project will reduce these impacts to acceptable levels.

Proper protections measures need to be worked out for the minimising of such impacts during the haulage of borrow materials. Rehabilitation of borrow areas from which earth has been excavated can be a major potential problem. In addition to visual blight, the other problems more down-to-earth are the safety issues. At borrow area locations where the owners are willing to create ponds for fisheries etc, proper protection measures for the drainage of the surrounding land and slope protection measures need to be worked out.

The soils along the corridor are in general capable to produce high yielding agricultural produce and may be negatively impacted if unduly borrowed. The loss of productive topsoil due to road construction is a direct adverse long-term impact. The concessionaire should ensure that in all such locations topsoil must be stacked aside and replaced after the borrowing activity is over. The soil heaps should be periodically compacted and sprinkled with water to avoid loss. Emphasis should be laid on maximum use of the stripped topsoil in medians, road junctions, redevelopment of borrow areas and additional landscaping works in the road project. The project shall take enforcement measures to prevent/ minimise the use of topsoil from other locations such as borrow areas, stockyards, lands for diversions.

3.5.2 Impact of Quarry Operation

Construction stage

Construction materials required for the project will be available at quarries located within the distance 50km from the project site. Potential quarry identified above are outside the project area. Project proposes that the quantity of stone aggregates for the road construction (pavement and concrete) works is to be sourced from the above existing quarry sites and hauled to work sites. As these quarry sites are sufficient to the requirement of road construction, there is no need to open a new quarry site. Therefore no major additional impact on environmental from quarrying is anticipated.

Though the quarry materials are to be transported over long distances to the construction sites, almost all the quarries identified have proper access roads, therefore, no major impacts during the hauling of materials is envisaged. The issue of dust generation etc along the haul roads needs to be addressed through proper enforcement of dust suppression measures.

A major source of dust during the construction stage is from stone crushing operations from the crusher and the vibrating screen. The dust, in addition to being a health concern also reduces visibility thereby increasing safety concerns. As no new quarry needs to be opened for this project (majority of the material shall be from cut operations, reuse of old materials and existing quarries within the site itself), therefore, no new impacts are likely to arise due to quarrying operations. Since these existing quarries already taken steps to mitigate noise & air quality impacts at present operation no additional precautions are required with the increase of supply capacity since most of the plant presently not utilized their full production capacity.

Operation stage

As discussed earlier no quarry sites are getting to be exhausted since the available stone materials are more than sufficient. During the operation phase there will be least impact on quarry sites as the stone requirement during the operation phase will be negligible because material required for maintenance of the road are very less.

3.5.3 Air Quality Impacts

Construction stage

No major cutting or filling expected along the entire up-gradation corridor. Air quality along the project corridor will be adversely impacted during construction even though no massive cutting or filling involved, since, effects of increasing the particulate matter (PM10) and VOC concentrations during material unloading, earthworks and overlaying with asphalt will dominate the construction stage impacts. Localized degradation in air quality will occur in areas close to hot-mix plants and batching plants.

Generation of Dust

Generation of dust is the most likely impact during construction stage due to:

- Quarrying operations
- Handling and storage of aggregates in the asphalt plants:
- Concrete batching plants;
- Asphalt mix plants due to mixing of aggregates with bitumen; and
- Construction, asphalt overlaying and allied activities

Generation of gases

Generation of gaseous pollutants is likely during the construction stage due to movement of heavy machinery, oil tankers etc. High levels of SO_2, VOC and NOx are likely from hot mix plant operations. In the construction period the type of effect is limited to construction vehicles like dumpers, trucks and other construction vehicles. The movement of these heavy vehicles through haulage roads will have air and noise pollution problems in pollution free areas. Particulate matter would be the predominant pollutant affecting the air quality during the construction phase. Mostly the construction heavy vehicles will generate undesirable gases such as SO_2, NOx, and CO. However, this would not lead to any tangible effects, as the expected traffic volume is very low and are mostly concentrated to the construction camp areas, haulage roads etc.

Volatile & toxic gases are released through heating of bitumen during the production of hot mix. Although the impact is much localised, (with in 500m) the effect shall be felt in the downwind direction.

Due to faster movement (60 km/h) and good pavement condition impact on air quality in terms of concentration of carbon monoxide, Oxides of nitrogen and Hydrocarbon (Volatile Organic Carbon) will be insignificant due to adequate dispersion. Vehicular emission is a major contributor to the air pollution both in urban and rural environment. The vehicular emissions are determined by several factors like fuel composition, level of engine maintenance, vehicle age, speed and congestion, traffic and road condition. Human health, terrestrial flora and faunal health are the most immediate receptors of the vehicular pollution/emissions.

The construction of improved highway will provide improved speed for the traffic and reduction in congestion of traffic and improved pavement. So the project development will not have any significant impact on the air quality along the roadside as compared to present situation.

Major impact on air quality during operation stage will be due to plying of vehicles. The impacts on air quality will, at any given time depend upon traffic volume/ rate of vehicular emission within a given stretch and prevailing meteorological conditions. Since even at the end of the design life the vehicular traffic is unlikely to increase significantly than the present, the level of emissions of concern from the traffic during operation phase is quite low

Dumping of Debris

Since there is no substantial cutting is envisaged along the up-gradation corridor and fill sections, the disposal of the excess cut or excavate material will not poses a significant problem for the project. Both, transportation and tipping of the material are sources of dust into the environment. Potential sites for dumping have been selected in such a way that these are away from the habitation and hence impact of dust on humans due to dumping of debris is not anticipated. The impacts due to disposal of debris shall be minimised by enforcing requisite precautions by the contractor. The impacts will mostly be concentrated in the Right of Way. It is likely that impacts due to dust generation are felt downwind of the site rather than on the site itself. Villagers within the settlements along the road will be affected by the dust which may give rise to dust related health problems like- cough, bronchitis, and pulmonary diseases. Trees along the road will also be impacted due dust deposition on their leaves which will reduce their photosynthesis capacity. Generation of dust will trigger further secondary impacts which are likely to be more severe, prime among which is impact on health of construction workers, especially workers in quarries, borrow areas and stone crushing units.

3.5.4 Impact on Water Resources

Surface water resources

The entire up-gradation corridor crosses many streams listed above. These streams are perennial and shall be subject to adverse impacts especially during the construction period as there are chances of improper drainage of wastewater from the construction sites and thereby the formation of stagnant pool. The stagnant pool will promote breeding of mosquitoes and create generally insanity conditions. If this waste water get channelized in to the stream it will contaminate the streams. During construction of culverts, in addition to disposal of the spoils in to the riverbed, the increased sediment load due to the constricted waterway and consequent increased sediment load will cause increased turbidity downstream of the bridge location. Discharge of culvert construction wastewater with high concentration of suspended solid load will disturb the aquatic ecosystem of the receiving water body. Impact on the river system can be minimized if the culvert construction is taken up in the lean flow season

Liquid and solid waste discharges from petroleum; oil and lubricant storage areas, work force camps and all other operational areas may impact the water quality of the receiving water body if disposed off directly.

Construction workers' camps pose another major problem unless located in a planned manner. Sewage generated from these camps, unless disposed in a safe manner, can lead to problems of contamination of surface water sources.

Effluents from the hot-mix plants in the form of oil, grease, etc., if not contained and disposed properly could lead to pollution of land and water in the adjacent areas.

3.5.5 Impacts on lagoon:

Along the project corridor four lagoons were located among two (Negombo & Puttalam lagoons) were adjoining to the road corridor are likely to be impacted during construction. The mechanism of contamination of the lagoons will be same as discussed for streams.

Operation Stage

Accidental spillage and highway runoff containing hazardous material may contaminate the receiving surface water body and the aquatic ecosystem may be disturbed. Garbage dumping on highways may also contaminate the aquatic eco-system. Waste discharge from the wayside amenities and the storm water run-off from the Project highway may impact the watercourses.

3.5.6 Impacts on Ground Water Resources

Construction Stage

In addition to these surface drainage channels, there are number of wells located along the up-gradation corridor which are used by the local community. However no significant impact expected for ground well most of them are properly secured to avoid surface runoff. Even though the ground water table is lowered in nearby streams also being highly dynamic with large flows seeping into the streams, impact on the ground water quality due to the project, is insignificant. The area lost for recharge due to construction of paved road is restricted to the right of way. Hence; the impact on ground water recharge is also not significant.

Construction workers' camps pose another major problem unless located in a planned manner. Sewage generated from these camps, unless disposed in a safe manner, can lead to problems of contamination of the ground water. Due to good availability of surface water resources along the project road throughout the year the construction water demand will be mainly depended on surface water not on Ground Water Resources. Therefore, there will be no potential impacts on ground water due to the construction works.

Operation Stage

During operation of the highways there will be no any impact on the ground water sources except percolation of accidental spillage or hazardous material, if any in future.

3.5.7 Noise and vibration impact

Construction Stage

Potential noise affected receptors in the road corridor include various construction activities. There will be temporary noise impacts in the immediate vicinity of the project corridor. The construction activities will include excavation for foundation and construction of structures and facilities. Crushing plants, asphalt production plants, movement of heavy vehicles, loading, transportation and unloading of construction materials produce significant noise during construction stage. Typical noise levels associated with various construction activities and various construction equipment are presented in the table below.

Table 3-5 Typical noise levels of principal construction equipment's (Noise Level in dB (A) at 50 Feet)

CLEARING		STRUCTURE CONSTRUCTION	
Bulldozer	80	Crane	75-77
Front end loader	72-84	Welding generator	71-82
Jack hammer	81-98	Concrete mixer	74-88
Crane with ball	75-87	Concrete pump	81-84
		Concrete vibrator	76
EXCAVATION & EARTH MOVING		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98
Backhoe	72-93	Bulldozer	80
Front end loader	72-84	Cement and dump trucks	83-94
Dump truck	83-94	Front end loader	72-84
Jack hammer	81-98	Dump truck	83-94
Scraper	80-93	Paver	86-88
GRADING AND COMPACTING		LANDSCAPING AND CLEAN-UP	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
PAVING		Front end loader	72-84
Paver	86-88	Dump truck	83-94
Truck	83-94	Paver	86-88
Tamper	74-77	Dump truck	83-94

Source: U.S. Environmental Protection Agency. Noise From Construction Equipment and Operations. Building Equipment and Home Appliances. NJID. 300.1. December 31. 1971

Noise generated from these machines will have impact on the potential receptors as mentioned above. Though the noise levels presented for various construction activities far exceed the permissible standards, it is important to note that the construction noise is generally intermittent and depends on the type of operation, location and function of the equipment. Though the noise level is within permissible limit in project area, the construction traffic and the use of construction machinery will increase the noise level causing, disturbance to the local residents.

Operation stage

The operation stage impacts are of relatively less significance since the anticipated traffic volumes are quite low. Though the level of discomfort caused by noise is subjective, there is a definite increase in discomfort with an increase in noise levels. Road noise depends on factors such as traffic intensity, the type and condition of the vehicles plying on the road, acceleration/deceleration/gear changes by the vehicles depending on the level of congestion, smoothness of road surface and grade of the road. Thus, the increased noise levels are restricted to the construction phase only.

3.5.8 Vibration

Sources of vibration include blasting, operation of heavy construction plants, compactor operation and movement of construction traffic during construction.

3.5.9 Impacts on sensitive places

Construction Stage

During the construction there will be temporary disturbances for the activities of the particular sensitive places such as Schools, Hospitals, Temples, churches etc. Religious and other Statues adjacent to the road will expose to dust and may affect from vibrations of the machineries where such road improvements take place. In addition, there are possibilities of access restrictions in places where rehabilitation work takes place.

Operation stage

During the operation road will be in good condition and hence accessibility for the places will be enhanced.

CHAPTER 4

4. Mitigation Measures for Identified Environmental Issues

4.1 Pre-Construction Stage Mitigation Measures

4.1.1 Formulation of mitigation measures (by design) necessary to alleviate drainage related impacts

Once the baseline drainage impacts were identified the first line of mitigation measures which should be implemented will be the mitigation measures which could be effected through the design. Some of the applicable mitigation measures which could be effected through design are;

When the road project drainage is taken into account drainage issues come in several domains.

- Cross drainage of the road (bridges & culverts)
- Longitudinal drainage of the road surface (side drains)
- Road inundation owing to overflow of side drains and other minor & medium streams crossed. (in semi urban areas)

A comprehensive drainage management plan for this road has to be formulated at the construction stage. The following key items must be included in the drainage management plan.

1. Identification of all cross drainage outlets & relevant structure along the road. Their dimensions & structural status should be noted.
2. Delineation of catchments areas of the drainage outlets (1:10,000 maps could be used for this purpose)
3. Identify road inundation areas if any. (the areas which are inundated owing to inadequate cross or longitudinal drainage)
4. Design the longitudinal & side drainage opening sizes to suitable drainage standard(100 year return period for major bridges, 50 Year return period for minor bridges, 10 year return period for minor & medium culverts & 5 year return period for side drains)
5. Liaise with the relevant line agencies such as Irrigation Department, Local authority in identification drainage issues.
6. Enlargement of the culvert openings which are suspected or observed as under-capacity to increase their flow capacity. Based on the flow conditions and easy maintenance possibilities minimum culvert widths or diameters will be suggested. For box culverts the minimum width for 4 lane sections could be 1.5m and that for two lane section could be 1.0m-1.2m depending on the circumstances. Larger widths for culverts are necessary for town areas as tendency towards culvert blocking through garbage is greater. Box culverts will be more suited for town areas and low lying areas. Minimum diameter for pipe culverts will be 900mm. Caution should be exercised in proposing 1200mm diameter culverts as technical issues of construction may arise because inadequate cover (bedding).
7. Provision of side drains at places where longitudinal drainage is poor. Such side drains will be necessary at places where there are townships.

8. Provision of new culverts at necessary places. Few such places have been preliminarily identified in A03 Road.
9. Raising the road profile in sections subjected to inundation by frequent floods. If the inundation is at a manageable level and the inundation is frequent such sections will have to be raised. Such sections exist in all candidate roads.
10. Improvement of upstream inlet drains and downstream lead away drains which in low capacity. This activity will also be a very important one and it will be necessary to delve into the areas outside the Right of Way (ROW). All major inlet and lead away drain issues will be separately identified and reported along with the proposed improvements. Necessary surveys will be proposed to map the drainage network.
11. It is necessary to update the IDF curves of relevant rainfall stations to reflect climate change impacts. There is a general observation that the intensity of short duration rains have increased during the recent years.

The final drainage management plan should come as a comprehensive set of plans showing the new opening sizes for the proposed structures, and necessary drainage layouts. A general drainage map showing the encompassed catchment areas, major streams, side drainage paths, flood prone areas etc.

4.1.2 Special Provisions for an OPRC Contract

For the purpose of an OPRC contract, in a hydrological and drainage perspective, suitable hydrological and drainage indicators will have to be developed. The main philosophy of the OPRC contract is to carry out the work in the **end user perspective**. Service level indicators/performance criteria should be used based on the hydrological information.

Such criteria/indicated will be provided in easily understandable simple terms according to the way it should be presented within a standard OPRC contract.

Possible indicators will be;

- Expected road surface condition to withstand flood cross flow
- Expected road embankment heights to keep lower return period flood overflow at bay
- Expected dimensions for hydraulic structures to have capacity for selected return periods (e.g. 100 year for bridges according to RDA Bridge design manual)
- Typical side drain types, dimensions and suitable locations

4.1.3 Findings and Recommendations given in Past Reports of Climate Change Secretariat Sri Lanka regarding Road Sector

Recent reports by Climate Change Secretariat has indicated the following;

[A] Napa Report [1]

The main roads (which includes some provincial roads) in the country are generally surfaced with pre-mix bitumen or asphalt. Increased ambient temperatures could cause surface flow of asphalt, distortion of road markings, and bleeding of bitumen making old road surfaces brittle. This may necessitate heavy investment on repair and maintenance.

Similarly, increased rainfall intensity as a result of climate change could exacerbate flooding of roadways, particularly as many canals and drainage outfalls are already in disrepair or have been planned for lower rates of flow. Increased levels of damage to land-transportation infrastructure will cause direct costs for repair and rehabilitation, and also result in substantial losses across many other sectors that are dependent

on the road and rail network. Vulnerability of transport infrastructure to the expected increase in frequency and intensity of floods due to climate change is widespread and prevalent in many parts of the country.

To minimize impacts of climate change on road infrastructure the following remedial measures;

[B] Sector **Vulnerability Profile [2]** has indicated the following phenomena related to climate change

Temperature

Intervention	Performance Indicator	Key Partners	Activity Type
A Minimize impacts of climate change on infrastructure			
i Identify climate change risks on transport infrastructure, and invest in adaptive measures A detailed risk assessment and survey of roads/ highways within regions identified as vulnerable, together with the development of engineering solutions and a pipeline of investments to adapt critical infrastructure is needed.	• Investments in climate-proofing road infrastructure deployed	RDA, CCD Local Gov. Agencies	RPD, PhI
ii Update standards/guidelines for infrastructure design and development Revision of and issuance of new planning and design guidelines which factor-in climate change considerations, such as updated rainfall intensity curves, bridge and road construction manuals, etc. needs to be undertaken on an urgent basis. Climate resilience criteria should be included in guidelines for all national infrastructure development programmes, such as Gama Neguma.	• Revised guidelines and manuals developed and adopted • Revised manuals become industry standard.	RDA, Met. Dept, Universities, DMC	RPD, PI

- Air temperature in Sri Lanka has increased by 0.640C over the past 40 years and 0.970C over the last 72 years, which revealed a trend of 0.140C per decade. However, the assessment of a more recent time band of 22 years has shown a 0.450C increase over the last 22 years, suggesting a rate of $0.20C^0$ per decade.
- Consecutive dry days are increasing in the Dry and Intermediate Zones.
- Ambient temperature (both minimum and maximum) has increased.
- The number of warm days and warm nights has increased, while the number of cold days and cold nights has decreased.

Rainfall variability

- The precipitation patterns have changed, but conclusive trends are difficult to establish.
- A trend for rainfall decrease has been observed historically over the past 30-40 years, but this is not statistically significant.
- There is a trend for the increase of one day heavy rainfall events.
- An increase in the frequency of extreme rainfall events are anticipated, which would lead to more floods.

Drought

- The increased frequency of dry periods and droughts are expected.
- The general warming trend is expected to increase the frequency of extreme hot days.

Climate change related issues and vulnerability of transport infrastructure

Vulnerability is the degree to which a system is susceptible to, or unable to cope with adverse effects of climate change. Vulnerability is a function of the character, magnitude and rate of climate variation and its effects to which a system is exposed, its sensitivity, and its adaptive capacity. Exposure means the nature and degree to which a system is exposed to significant climatic variations. Sensitivity is the degree to which a system is affected either adversely or beneficially by climate related stimuli. Adaptive capacity is the ability of the system to adjust to climate change to moderate potential damages, to take advantage of new opportunities or to cope with the consequences.

The main transport infrastructure in Sri Lanka consisting of roads, railway, airports and sea ports are vulnerable to some impact of climate change, especially as most have not been designed to accommodate the consequences.

Possible impacts of increased temperature and rainfall intensity:

The main roads in the country are generally surfaced with pre-mix bitumen or asphalt. Increased ambient temperatures could cause surface flow of asphalt, distortion of road markings, bleeding of bitumen in bitumen surfaced roads, making old road surfaced brittle. This may necessitate heavy investment on repair and maintenance of the transport infrastructure.

Increased rainfall intensity as a result of climate change could exacerbate flooding of roadways, particularly as many canals and drainage outfalls are already in disrepair or have been planned for lower rates of flow.

[C] Urban Development, Human Settlements and Economic Infrastructure SVP – Part II [3]

Possible impacts of increased frequency/intensity of natural disasters:

- Risks to Sri Lanka's transport infrastructure will increase with the expected increase in both the frequency and intensity of disaster events, particularly landslides and floods.
- Potentially increased levels of damage to land-transportation infrastructure will cause direct costs for repair and rehabilitation, and also result in substantial losses across many other sectors that are dependent on the road and rail network.
- The problems associated with climate change are not distributed evenly across the country. Vulnerability varies substantially by the characteristics of the region and the nature of the sector under consideration. The following are some of the factors that translate into higher levels of climate change vulnerability of infrastructure in Sri Lanka's transport sector:
- The length of roads in a geographic area is proportionate to the scale of impact that can be expected due to climate change impacts or natural hazards. As the potential cost of damage is high, areas with extensive investments in transportation infrastructure may tend to be more vulnerable.
- A higher road density (km of roads/ km^2) would indicate that in the event of a major problem, the presence of alternative routes is more likely to provide better access. Areas with low road density per km^2 will thus be more vulnerable.
- Urban areas in Sri Lanka are generally better organized, and their populations are better equipped to either mobilize themselves or the government to provide help to address transport- infrastructure related problems. Conversely, concerns of communities with relatively small populations will be more often neglected, rendering them more vulnerable to climate change impacts on their transportation infrastructure.

4.2 Construction stage mitigation measures

4.2.1 Erosion and sediment runoff

Following measures should be adopted to mitigate the impact of erosion siltation & run off.

- Construction activities should be carried out during non-rainy days.
- All temporary soil dumps should be removed from site to a suitable disposal place which should be identified with the concurrence of relevant line agencies.
- If temporary soil dumps are left at the site for a long time those dumps should be covered with thick polythene sheet.
- All fills & back fills should be compacted immediately to reach the specified degree of compaction.
- Slopes of the fills if any, especially the sections close to the edges should be compacted well as these sections are susceptible to erosion.
- Suitable local drainage measures should be established to properly drain the water in the construction area to the nearby water way.
- Establishment of a suitable mulch to cover the slopes of fills if any
- Paddy area filling should be done systematically layer by layer after compacting each layer to avoid eroded materials falling into paddy fields.
- Necessary slopes and drainage provisions should be provided for hillside road cuts.

4.2.2 Effects to water ways, drains and adjacent lands.

- Construction of the side drains should be carried out first so that the water collected on the road surface in the construction area could be lead to the nearest waterway through the side drains.
- The upstream and lead-away channels of the bridge and culvert structures should be cleaned in order to conduct the water smoothly to the downstream to avoid drainage congestion.
- Detailed drainage studies for the road crossings should be done to check the adequacy of the opening size and proper opening sizes should be adopted when drainage structures are demolished or rehabilitated.
- It is pertinent to adopt 1m x1m as the minimum box culvert opening size. For pipe culverts minimum pipe diameter should be at least 900mm so that maintenance of these structures becomes easy.
- When constructing the bridges and culverts the RDA should adopt the “Bridge design manual of RDA” which specifies bridges to be constructed using data of 100 year flood return period and for culverts a 50 year return period.
- Suitable mitigation measures including monitoring will be provided for construction impacts. Mitigation measures such as controlling the heights of coffer dams, phased construction work, providing temporary side drains, providing silt traps and silt fences will be suggested.

4.2.3 Impacts on existing road structures (bridges culverts etc.)

Impacts on road structures should be mitigated by allowing flow through the drainage paths unhindered using side channels. Coffer dams should be placed to heights on par with the possible flood levels and coffer dam heights should not be excessive. There should be a contingency arrangement to breach coffer dams and also overtopping coffer dams should be allowed.

4.2.4 Impacts on Irrigation schemes

Sedimentation of paddy areas should be avoided using silt traps, silt fences. Irrigation water issues through culverts or any other irrigation structure should not be hindered without permission of the relevant line agency (e.g. Irrigation Department, Department of Agrarian Development). Construction plans for the areas within minor irrigation schemes should be discussed with the line agencies given above.

4.2.5 Mitigatory measures to minimize adverse ecological impacts of removal/ pruning of vegetation

1. Considerable number of trees will be subjected either to felling or to pruning. Care should be taken to minimize the felling and to minimize felling of trees identified as endangered, near threatened or vulnerable.
2. When working in sensitive areas, care should be taken to minimize damage caused to them. It is recommended to move more onto the land side along the Puttalam Town RB1 RHS A003, A012-125th km stretch in order to minimize disturbance to the Puttalam estuary as well as to the mangrove forest.
3. When pruning of trees is done, expert advice should be sought to do the pruning in

Such a manner to prevent them from uprooting during bad weather conditions.

4.2.6 Mitigatory measures to minimize adverse ecological impacts of siltation

1. It is recommended to carry out excavations before the onset of monsoons. This will minimize the spread of excavated material into the surrounding habitats.
2. Whenever, possible the excavated material should be reused for refilling or should be removed and dumped immediately in recommended dump sites only. During transportation, the trucks carrying them must be properly covered.
3. If stockpiling is essential, it should be carried out without disturbing the natural drainage system of the project area and should be kept covered until removed, to prevent washing away.
4. During excavation, attention should be paid to maintain 2m deep roadside LHS/RHS downward slopes in 1: 4 ratio in both RHS and LHS embankments between 18+200-18+300 and 18+420-18+550 sections of the road trace and grass turf to avoid soil erosion. In addition, it is also recommended to erect toe walls in both RHS and LHS covering this section.
5. To avoid soil erosion, in the roadside downward slope, it is proposed to fill the roadside eroded/erodible slopes with suitable soil and grass turf on the filled slopes. It is also proposed to erect retaining walls/toe walls to avoid soil erosion from the downward slopes.
6. Stripped top soil during edge widening should also be re-used to refill the areas where topsoil has been removed. Anything in excess must be distributed in adjoining barren areas and the workers should be made aware of the importance of top soil to minimize the removal of the same.
7. A proper drain system should be introduced to prevent soil erosion in the excavated areas during heavy rains. However, these paths should not be directly sent to streams, other water bodies or to the sea
8. Silt traps will have to be constructed when the side drains are connected to roadside leader ways. Silt traps will minimize silt entering waterways.

4.2.7 Mitigatory measures to minimize adverse ecological impacts of the release of harmful construction wastes

1. There must be adequate disposal facilities during construction.
2. Accidental spillage of oil and lubricant from construction equipment must be prevented.
3. Arrangements should be made by the contractor to keep harmful hazardous and risky chemicals in designated areas until use and dispose of only at designated sites by the CEA.

4.2.8 Mitigatory measures to minimize adverse ecological impacts of solid waste disposal

1. Solid waste generated during construction work such as plastics, polythene, excess sand, boulders, coarse and fine aggregate, cement bags, cut pieces of materials, various chemicals paints etc. should be removed from work sites in a very effective manner.

4.2.9 Mitigatory measures to minimize adverse ecological impacts of labour camps

1. The labour camps should not be established too close to ecologically sensitive areas such as water bodies or mangrove areas.
2. Labour camps should be provided with proper sanitation measures such as water supply, wastewater, sewage and solid waste disposal etc.

4.2.10 Mitigatory measures to minimize adverse impact to rare, threatened, endemic flora and fauna

As for the plant species that are important in terms of their IUCN red list categories, following mitigatory measures are proposed.

1. Care should be taken to remove these important plants as little as possible (the locations of such plants are indicated in Annex 4 and 5).
2. If cut down, a strategy should be adopted to do a replanting of such species in suitable place along the roadside.

4.2.11 Mitigatory measures to minimize adverse impact on protected areas and other sensitive habitats

1. The mangrove habitat in the Puttalam town and the Puttalam estuary (Puttalam Town RB1 RHS A003, A012-125th km) are two sensitive areas. It is proposed to shift the widening towards landside to minimize the damage.

4.3 Mitigation of Air Quality Impacts

Impacts on air quality are expected to be of far more serious concern during the construction period than during the operation phase. Several avoidance and mitigation measures have been considered and adopted as part of the environmental management plan to control pollution during the construction period.

4.3.1 Mitigation of dust generation and its impact

The asphalt plants, crushers and the batching plants are existing plant established with environmental clearance and operate with EPL that required to be renew periodically. Hence, air quality impacts expected to be managed effectively at present operation. However it is necessary to ensure adequate measures have been taken to control the dust pollution. Some common measures required to be established are given below. A distance of a minimum 500m to 1km from the nearest settlement should be maintained in order to ensure that the concentration of the pollutants from these emissions diffuse enough to be within acceptable limits at settlement locations.

- All precautions to reduce the dust emissions from the hot mix plants, crushers batching plants and other transportation of materials will be taken up including:
- Provision of wind breaking wall, bamboo screens around the sources of dust such as the vibrating screens, conveyors, etc. should be made and regularly checked for all stone crushers used to supply material for the project.
- Vehicles delivering loose and fine materials like crusher dust and soil/spoils shall be covered to reduce spills on existing roads

- Water will be sprayed on earthworks, temporary haulage and detour roads on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation.
- The hot mix plant will be fitted with dust extraction units.
- In addition, quarterly monitoring shall be conducted at locations where earthworks or slope cutting operations are taking place.

4.3.2 Generation of Exhaust gases

Generation of exhaust gases is a concern especially from hot mix plants. To ensure the control of exhaust gas emissions from various construction activities, the contractor shall take up the following mitigation measures

- An adequate cyclone/scrubber to control emissions from the stack of hot mix plants will be provided. Other measures as planting of vegetation around periphery of the construction sites shall be taken up.
- To ensure efficacy of the mitigation measures suggested, air quality monitoring shall be carried out at least once a month during the period the plant is in operation.
- Contractors also should be required to renew EPL regularly
- All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels.

4.4 Mitigation of Impact on Surface Water Resources

The construction process is likely to have a significant adverse impact on water resources along the upgradation road unless adequate measures are framed and executed for the same as part of the EMP. The following mitigation measures shall be adopted to minimize impacts.

4.4.1 Silt Fencing at Rivers and Water Bodies

To prevent any degradation of water quality of various surface and ground water resources due to the proposed project, the contractor shall work out the following measures during the construction period:

- Construction work close to the streams or water bodies must be avoided during monsoon. Discharge standards promulgated under the Environmental regulation on discharge effluent for inland surface water bodies will be strictly adhered to.
- Silt fencing consists of geotextile with extremely small size supported by a wire-mesh mounted on a panel made up of angle frame. The frame will be installed at the edge of stockpile of material at water body along which construction is in progress. The number of such units to be installed will be decided depending upon the length of the water body along the side of the road construction.

4.4.2 Oil Interceptors at Fuel Storage areas/Construction Camps

Oil and Grease from road run-off is a concern during construction. During construction, discharge of Oil and Grease is most likely from vehicle parking areas of the contractors' camps. Thus, the source is well defined and restricted.

- Location of all fuel storage and vehicle cleaning area will be at least 300 m from the nearest drain/ water body.

- In addition, the maintenance and repairs of vehicles will be carried out in a manner such that contamination of water bodies and drainage channels can be avoided.
- Oil and grease interceptors will be provided in the fuel storage and vehicle cleaning areas, as well as workshop, repair and parking areas. In the interceptor, oil from water is separated by gravity. Enough detention time is provided for run-off entering the chamber to allow oil to float on to the surface
- The slopes of embankments leading to water bodies will be modified and re-channelized to prevent entry of contaminants into the water body

4.5 Mitigation Measures during Quarrying Operations

Materials will be procured from quarries having EPL holders only.

Redevelopment plans for quarry areas from which material is extracted and have exhausted in the construction period, shall be developed by the RDA and implemented in co-ordination with the GSMB.

The existing stone quarries, from where materials may be sourced, may or may not have environment management plan. So it has been proposed that contractor will submit environmental due diligence report of the stone quarries, if materials will be sourced from the prior approval of the project environmental specialist.

New quarry, if needed during construction, can only be opened with prior approval of quarry management plan by the environmental specialist and supervision consultant as well as by the Environmental Authority. No quarries inside protected forests will be allowed under the project.

4.6 Mitigation Measures for Disposal of Debris / Construction Spoil

The debris generated will be re-used/ utilized in construction works such as filling, construction of retaining walls, embankments, filling pedestrian foot-path in settlement area, creating parking spaces, etc. However, a large quantum of debris will still remain to be disposed. Dumping sites have been identified to ensure environmentally safe disposal of the construction debris. The locations of dumping sites have to be selected such that –

- No residential areas located in downwind of the site
- Dumping sites are not located in bio diversity rich or sensitive locations,
- Dumping sites do not contaminate any water sources, rivers etc, and
- Dumping sites have adequate capacity equal to the amount of debris generated.

Any new dumping site that may be proposed during construction will be screened by Environmental Specialist, site plan reviewed by the environmental specialist

4.6.1 Provision of Toe Walls to contain dumping spread.

Toe Walls shall be provided to lend back support to the excavated rock/soil dumped on the valley side. Depending on the extent of dumped material toe walls shall be designed

The slope of the dumped material will be protected from erosion by grass plantation as well as by diverting surface water away. In addition the contractor shall take the following precautions during disposal of debris:

1. During the site clearance and disposal of debris, contractor will take full care to ensure that public or private properties are not damaged/ affected and that the traffic is not interrupted.

2. Contractor will dispose the debris only to dumping locations having prior approval of Engineer-in-Charge of works.
3. Contractor will also dispose the debris for improvement of public utilities with the consent of villagers and approval of Engineer-in-Charge of works.
4. In the event of any spoil or debris from the sites being deposited on any adjacent land, the contractor will immediately remove all such spoil/debris and restore the affected area to its original state to the satisfaction of the Engineer-in-Charge of works.
5. The contractor will at all times ensure that the entire existing streams, watercourses and drains within and adjacent to the site are kept clean, safe and free from any debris.
6. Contractor will utilize effectively, water sprays during the delivery and handling of materials when dust is likely to be created and to dampen stored materials during dry and windy weather.
7. Materials having the potential to produce dust will not be loaded to a level higher than the side and tail boards and will be covered with a tarpaulin in good condition.
8. During cutting disposal of debris proper warning signs will be installed to the satisfaction of Engineer-in-Charge of works.
9. Any diversion required for traffic during disposal of debris shall be provided with traffic control signals and barriers after the discussion with local people and permission of Engineer-in-Charge of works.
10. During the debris disposal, contractor will take care of surrounding features and avoid any damage to it. During the debris disposal contractor will take care about wind direction and situation of the settlements, so that any dust problem will be avoided. Debris disposal shall be monitored by the representatives of local people of habiting nearest to the dumping location. Reporting of the activity shall be done regularly by the NGO's village council presidents.

4.7 Mitigation for Noise and Vibration

Noise and vibration during construction is a significant impact especially around settlements and inhabited areas. Following mitigation measures need to be worked out by the contractor for the noise impacts associated with the various construction activities:

- Noise standards will be strictly enforced for all vehicles, plants, equipment, and construction machinery. All construction equipment used for an 8-hour shift will conform to a standard of less than 90 dB (A). If required, machinery producing high noise as concrete mixers, generators etc, must be provided with noise shields and their usage timings can be regulated.
- Machinery and vehicles will be maintained regularly, with particular attention to silencers and mufflers, to keep construction noise levels to minimum
- Workers in the vicinity of high noise levels must wear earplugs, helmets and be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90dB(A) per 8-hour shift.
- No hot mix, batching and aggregate crushing plants shall be located within 500m of sensitive land uses as schools, hospitals etc.
- Blasting when required shall be restricted to daytime hours. All the statutory laws, regulations, rules etc, pertaining to acquisition, transport, storage, handling and use of explosives will be strictly followed. Blasting will be carried out only during fixed hours as permitted by the Engineer.
- During the operation stage, sensitive receptors will be clearly marked by providing regulatory signage. Enforcement of these will be the responsibility of the local authorities.
- If any sensitive place got affected due to vibration necessary repairs should be done with an agreement of the relevant parties and if the place is an archeologically important, will forced to consult the Archaeological department before any construction activity.

4.8 Post Construction Stage Mitigation Measures

4.8.1 Mitigatory Measures for Operational Impacts

Mitigation measures for operational phase will be under an OPRC contract. Hence monitoring the road system during monsoons, responses by climate changes (e.g. temperature, sea level increase, an increase of rainfall intensity etc.) and expected of working conditions of hydraulic structures in terms of non-silting, non-scouring conditions, optimum height of vegetation to avoid flow hindrances and erosion should be taken as prime considerations (Service Level Indicators).

The most common drainage related operational impact is the periodic siltation of culverts and inlet and lead away drains. There could also be road damage by infrequent heavy floods. Operational impacts could also be mitigated by the proposed mitigation measures by design. Other mitigation measures such as periodic maintenance of streams will be proposed. Involvement of Local Authorities will also be necessary for this process.

The OPRC contractor should have a lead role in the mitigation of operational impacts as there is a long maintenance period under an OPRC contract.

Creation of potholes etc. on the road surface & resulting traffic & social problems

The problem could be minimised if good construction methods are adopted. Maintenance facilities should be ready with the contractor at the operational stage.

Road inundation and overflow

There should be a recurrent maintenance programme for cleaning clogged culverts, lead aways etc.

Clogging of culverts, side drains and lead aways by sediment & other debris including solid waste

The culvert designs should be undertaken to minimise sediment deposition, the minimum culvert sizes should be maintained as stated above, recurrent maintenance programmes should be in effect.

Stagnation of water at culverts during heavy rains due to siltation and blocking of opening with debris (direct, long term negative impact)

Regular cleaning/ clearing and maintenance of all culverts to reduce the chances of failures and blocking due to debris should be carried out.

Noise and Vibration Impacts during operational period

During the operation stage, sensitive receptors will be clearly marked by providing regulatory signage. Enforcement of these will be the responsibility of the local authorities.

Redevelopment Plans for Abandoned Quarry Sites, borrow pits and dump sites.

Redevelopment plans for quarry areas from which material is extracted and have exhausted in the construction period, shall be developed by the contractor and implemented in co-ordination with the GSMB.

Redevelopment plans for borrow pits from which material is extracted shall be developed by the contractor and implemented in co-ordination with the local authority.

All construction debris dump sites will be redeveloped at the end of dumping satisfactory to the owner of the land.

Vegetation that impacts the aesthetics and safety

Weeds that may grow within the RoW and inside earth drains required to be removed regularly. Branches of trees that may be of safety hazard should be pruned.

CHAPTER 5

5. Environmental Management and Monitoring Plan (EMMP)

5.1 Environmental Management Plan (EMP)

The Environmental Management Plan (EMP) given below is a summary of the major impacts that may arise during the rehabilitation and upgrading of the selected sections of the A003 road .The EMP also indicates the proposed mitigation measures required, in order to avoid and/or minimize the potential environmental impacts, along with the parties responsible for implementation of the mitigation measures as well as for monitoring of implementation of the EMP.

The EMP should necessarily form part of the Bid Documents and should be taken into consideration along with the specifications. The mitigation measures indicated in the EMP should be made mandatory and contractually binding. While the contractor will be primarily responsible for implementation of the EMP, sub-contractors should also be made aware of the requirements in the EMP. The EMP should be contractually binding on the contractor, and the Road Development Authority requires to monitor the implementation of the EMP on a regular basis. Central Environmental Authority will be required to monitor implementation of the Environmental Management Plan independently.

During the bidding process, contractors are expected to take into consideration the requirements in the EMP during the construction stage. The measures included in the EMP are an integral part of the construction process and the cost of implementation of the measures should be taken into account during Bid preparation. The cost of implementation of the mitigation measures suggested in the EMP should therefore be included under each item of work.

The contractor should maintain records of the progress of implementation of the measures suggested in the EMP. A dedicated Environmental Officer should be available with the contractor in order to ensure the timely and proper implementation of the EMP. The contractor should regularly report progress on implementation of the EMP to the Road Development Authority and also immediately rectify any shortcomings in implementation of the EMP as informed to him by the RDA.

The Road Development Authority should require the contractor and the Monitoring Consultant to report on a regular basis the status of implementation of the EMP and should verify compliance through regular inspections.

The following table provides the EMP for the project

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
Construction Stage Impacts **1. Erosion And Siltation Due To Sediment Runoff** During construction erosion and siltation could result in adverse impacts on water ways, drains and adjacent lands- sediment eroded from open soil dumps deposition in adjacent waterways, water retardation by coffer dams.	**Mitigation Measures Proposed** a. Construction activities should be carried out during the dry season in order to minimize erosion and siltation. b. All temporary soil dumps should be removed from site to a suitable disposal site which should be identified with the concurrence of relevant line agencies.(RDA,CEA, Local Authority) c. If temporary soil dumps are left at the site for a long time those dumps should be covered with thick polythene sheets/tarpaulin… d. Fills & back fills should be compacted immediately to reach the specified degree of compaction. e. Slopes of the fills if any, especially the sections close to the edges should be compacted well as these sections are susceptible to erosion. f. Suitable local drainage measures should be established to properly drain the water in the construction area to the nearby water way. g. Establishment of a suitable mulch to cover the slopes of fills if any h. Paddy area filling should be done systematically layer by layer after compacting each layer to avoid eroded materials falling into paddy fields. i. Necessary slopes and drainage provisions should be provided for hillside road cuts. j. Specified degree of compaction to be ensured. k. Work should be done during dry periods.	**Phase:** Construction Phase and Maintenance Phase. **Location:** Throughout the trace including hydraulic structure locations Special attention in areas where waterways are located.	Included in Design/ cost	OPRC Contractor	PIU, RDA(ESD), LA(EO), CEA

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	l. Soil dumps should not be left uncovered covered. m. Silt traps, silt fences should be provided as required n. Specific designs should be adopted for coffer Dams o. .				
2. Flooding Damages & hindrance to road works by major and minor floods during construction.	a. Flood vulnerable areas should be identified. b. Construction activities should be avoided during high rainfall months. c. Provision of coffer dams. d. Provide unhindered flow through culverts as far as possible. All drainage paths and drains should be cleared of blockages at all times. e. If flooding or stagnation of storm water is caused by the contractor's activities, the contractor shall prevent loss of access to any land or property and prevent any damage to land or property. f. The Contractor shall compensate for any loss of income or damage as a result of any flooding caused by his activities. g. When working in flood prone areas, all precautions should be taken by the contractor to ensure that his activities do not lead to aggravation of the flood situation.	**Phase:** Construction and Maintenance **Location:** At flood prone locations. (See Annexure 2)	Included in Engineering cost	OPRC Contractor	PIU, RDA(ESD), Contractor, LA(EO), SLLRDC
3. Blockage of Irrigation Canals, Siltation of Paddy	a. Maintenance of continuous irrigation flows through culverts to be maintained.	**Phase:** During construction operational and	Included in Engineering cost	OPRC Contractor	PIU,RDA (ESD) ID DAD

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
Areas Causing Hindrance to Cultivation	b. Provision of silt traps/ silt fences as required. c. Ensure close liaison with Irrigation Department, Department of Agrarian Development in order to avoid problems.	maintenance phases. **Location**: The road segments near paddy grown areas.)			
4. Impacts on Existing Road Infrastructure	a. Allow flow through the drainage paths unhindered using side channels. b. Coffer dams should be placed to heights on par with the possible flood levels and coffer dam heights should not be excessive. c. There should be a contingency arrangement to breach coffer dams and also overtopping coffer dams should be allowed.	**Phase:** During both construction and maintenance phases. **Location:** At all bridges and culvert locations as given in annexure 1	Included in Engineering cost	OPRC Contractor	PIU,RDA (ESD)
5. Impacts on Irrigation Schemes	a. Use of silt traps, silt fences to prevent sedimentation of paddy areas. b. . Irrigation water issues through culverts or any other irrigation structure should not be hindered without permission of the relevant line agency (e.g. Irrigation Department, Department of Agrarian Development). c. Contractor shall not divert, close or block existing canals, waterways or water paths which affects downstream users. If closure or blocking of canals or water ways is required for execution of work, the contractor must obtain the approval from the agency which is responsible for maintenance of the canal/water way/ water supply intake, as well as the engineer. Closure of such canals should not be done	**Phase:** During both construction and maintenance phases. **Location:** At all irrigation areas during both construction and operation and maintenance	Engineering cost and O & M cost.	OPRC Contractor	PIU,RDA (ESD), Irrigation Department

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	during cultivation periods of agricultural lands. d. Construction plans for the areas within minor irrigation schemes should be discussed with the line agencies given above.				
6.FLOW HINDRANCE DURING HYDRAULIC STRUCTURE CONSTRUCTION	a. Allow flow through the drainage paths unhindered using side channels. b. Coffer dams should be placed to heights on par with the possible flood levels and coffer dam heights should not be excessive. c. There should be a contingency arrangement to breach coffer dams and also overtopping coffer dams should be allowed. d. Contractor should not close or block existing canals, water ways or water paths permanently. In the event diversion or closure of canals, water ways or streams is required, the prior approval of the relevant government agency and the engineer should be obtained. e. The drainage path should be restored to its original status once the work is completed.	**Phase:** During both construction and maintenance phases. **Location:** At all culvert locations. (See Annexure 1) Location: at all water ways and streams identified along the trace.	Included in Design cost	OPRC Contractor	RDA(ESD), PIU, SLLRDC
7. CREATION OF POTHOLES ETC ON ROAD SURFACE resulting in traffic & social problems	a. Quality assurance of construction work. b. Maintenance programme under the OPRC contract	**Phase:** During both construction and operational phases. **Location:** Throughout the trace at sporadic locations	O&M Cost	OPRC Contractor	RDA(ESD)

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
8. CLOGGING OF CULVERTS AND SIDE DRAINS BY SEDIMENT AND OTHER DEBRIS	a. Regular de siltation of culverts and side drains to be carried out. b. Maintenance program to be carried out under the OPRC contract.	**Phase:** Construction operational and maintenance phases **Location:** At all culvert locations. (See Annexure 1 of EIA Report) **Operational**	To be included in the O & M Cost	OPRC Contractor	RDA(ESD), LA
9. DAMAGE TO ROAD BY INUNDATION WITH MAJOR AND MINOR FLOODS	a. Prompt attention to be paid to repairs.	**Phase:** Operational **Location:** At flood prone locations (See Annexure 2 of the Report)	O & M Cost	OPRC Contractor	RDA(ESD), LA
10. FLOW RETARDATION BY WEED GROWTH IN LEAD AWAY DRAINS.	Periodical trimming of plants / weeds.	**Phase:** Operational **Location:** lead away canals (at culvert locations within RoW) (See Annexure 1 of the Report)	O & M Cost	OPRC Contractor	RDA(ESD),PIU,LA
11. EFFECTS TO WATER WAYS, DRAINS AND ADJACENT LANDS.	a. Construction of the side drains should be carried out first so that the water collected on the road surface in the construction area could flow into the nearest waterway through the side drains b. The upstream and lead-away channels of the bridge and culvert structures should be cleaned in order to conduct water smoothly to the downstream and to avoid drainage congestion.	**Phase:** Construction and maintenance phases **Location:** All along the route. .	Included in engineering and O&M cost.	OPRC Contractor	RDA(ESD), PIU,SLLRDC, LA

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	c. Detailed drainage studies for the road crossings should be done to check the adequacy of the opening size and proper opening sizes should be adopted when drainage structures are demolished or rehabilitated. d. It is pertinent to adopt 1m x1m as the minimum box culvert opening size. For pipe culverts minimum pipe diameter should be at least 900mm so that maintenance of these structures becomes easy. e. When constructing bridges and culverts RDA should adopt the "Bridge Design Manual of RDA" which specifies bridges to be constructed using data of 100 year flood return period and for culverts a 50 year return period				
12.REMOVAL OF VALUABLE PLANTS	1. Removal of valuable plants whose locations are indicated in annexures 4 and 5, of the main report should be minimized as far as possible. 2. If removal plants in annexes 4 and 5 cannot be avoided, a strategy should be adopted in order to root ball and move the plants and/or replant such species at suitable locations in public areas.	**Phase:** During both construction and O &M phases **Location:** Locations of Valuable plants are indicated in annexures 4 and 5 of the report.	Included in Construction and Maintenance cost	OPRC Contractor	PIU,RDA (ESD), CEA, LA, Forest Department
13. IMPACTS ON SENSITIVE HABITATS **Destruction of sensitive habitats** .	1. Road widening and rehabilitation could have adverse impacts on the sensitive mangrove habitat in the Puttalam town and the Puttalam estuary) which are two sensitive areas 2. Road widening to be carried out on the landside in order to avoid damage to the sensitive mangrove areas.	**Phase:** During both construction and O &M phases **Phase:** During both construction and O &M phases **Location:** (Puttalam Town	Included in Construction and & Maintenance cost	OPRC Contractor	PIU, RDA(ESD), LA, CEA, Forest Department, Coast Conservation Department

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
		RB1 RHS A003,A012-125th km			
14.IMPACTS ON SENSITIVE HABITATS **Due to solid waste and wastewater discharges from labour camps.**	a. Ecologically sensitive areas such as water bodies to be avoided during the establishment of labour camps. b. Labour camps to be provided with proper sanitation measures such as water supply, wastewater, sewage and solid waste disposal etc.	**Location:** Environmentally sensitive areas as depicted in sensitive area maps (Annex 6) **Phase**: During construction and maintenance phases	Construction and Maintenance cost	OPRC Contractor	PIU, RDA(ESD), CEA, FD,LA
15.Disposal of Debris/ Construction Spoil	a. Spoil material and debris should only be disposed of at locations with the prior approval of the Local Authority/CEA and the Project Director/Engineer b. Spoil material and debris should not be disposed of on the sides of the road and left after completion of construction work, as it may be washed off into nearby water bodies and paddy fields. Locations for spoil material and debris should be carefully selected in consultation with the Local Authority and the CEA. c. Dumping site should not be located in environmentally sensitive areas or protected areas d. Dumping sites selected should have adequate capacity to hold the material. e. Toe walls should be provided depending on the extent of dumped material in order to	**Phase**: During construction and maintenance phases **Location:** At all debris disposal sites.	Included in construction and O and M cost.	OPRC Contractor	RDA(ESD), PIU, CEA, LA

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	lend back support to the excavated rock/soil dumped on the valley side f. Contractor should ensure that nearby streams rivers and other water courses and drains are kept clean and free from debris g. In the event that any spoil or debris is deposited in adjacent lands without prior approval, the contractor shall immediately remove such spoil debris and restore the affected area to original state. h. Contractor should utilise water sprays during handling and transport of debris / spoil material and during dry weather periods in order to prevent dust emissions. i. It is recommended to carry out excavations before the onset of monsoons. This will minimize the spread of excavated material into the surrounding habitats. j. Whenever, possible the excavated material should be reused for refilling or should be removed and dumped immediately in recommended dump sites only. During transportation, the trucks carrying them must be properly covered. k. Excavated material and other debris should not be allowed to accumulate and should be disposed of at regular intervals. l. Transportation of debris and other unwanted material should be carried out in covered vehicles in order to minimize generation of dust and pollution. m. If stockpiling is essential, it should be carried out without disturbing the natural drainage system of the project area and should be kept covered until removed, to prevent washing away.				

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	n. During excavation, attention should be paid to maintain 2m deep roadside LHS/RHS downward slopes in 1: 4 ratio in both RHS and LHS embankments between 18+200-18+300 and 18+420-18+550 sections of the road trace and grass turf to avoid soil erosion. In addition, it is also recommended to erect toe walls in both RHS and LHS covering this section. o. To avoid soil erosion, in the roadside downward slope, it is proposed to fill the roadside eroded/erodible slopes with suitable soil and grass turf on the filled slopes. It is also proposed to erect retaining walls/toe walls to avoid soil erosion from the downward slopes. p. Stripped top soil during edge widening should				
16.BURROW MATERIAL	a. Burrow material should be obtained only from sites approved by the GSMB and CEA. b. Burrow areas should be situated away from water bodies and residential areas as far as possible. c. During material exploitation, the removal of land cover in natural slopes should be restricted in order to maintain slope stability. Any excavated slopes should be maintained at stable angles depending on type of soil at site. After excavation sloe should be maintained d. The License conditions stipulated by the GSMB/CEA regarding the quantity of material to be obtained, as well as the extent of the pit and depth of excavation	**Location:** At all burrow sites **Phase:** during construction and maintenance phases. .	Included in the construction and maintenance cost.	OPRC Contractor	RDA(ESD), PIU, CEA, GSMB

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	should be strictly in compliance with the conditions stipulated in the above Licenses. e. Under no circumstances should burrow areas be located within protected or environmentally sensitive areas as declared by the Forest Department, Department of Wildlife Conservation or CEA. f. Stability of slopes in burrow pits should be ensured by the contractor at all times. g. Burrow activities and/or transportation of burrow materials should not cause any danger or nuisance to nearby residents at any time. h. All burrow pits should be rehabilitated as per GSMB and CEA guidelines once the operations are over.				
17.QUARRY OPERATIONS	a. Quarry material should be procured only from quarries possessing an EPL from CEA and GSMB License. b. If new quarries required to be opened during construction required approvals from the CEA & GSMB should be obtained. The new quarries should have an Environmental Management Plan. c. If there are nearby structures (<500m) pre blasting surveys should be carried out of such structures in order to clearly identify damages which may occur due to blasting operations. d. When operating quarry sites near sensitive locations, approved chemicals maybe used instead of explosive materials. e. Blasting when required shall be restricted to day time hours. All statutory laws, regulations pertaining to the acquisition,	**Phase:** Pre construction and Construction and maintenance phases. **Location:** At all quarry sites	No cost involved. Only compliance required unless contractor opens up his own quarry.		RDA(ESD), PIU, CEA, LA, GSMB

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	transport storage and handling and use of explosives should be strictly fallowed. f. Blasting should be carried out only during fixed hours as permitted by the engineer. g. Nearby residents should be made aware of dates, locations and times of blasting. Warning sirens should be used during blasting hours in order to warn nearby residents.				
18.SILTATION/POLLUTION OF WATER BODIES	a. Adequate measures should be adopted in order to prevent wastewater arising from construction sites from entering into rivers, streams or lagoons, wetlands or other water bodies. b. All wastewater from construction sites should comply with the relevant standards as prescribed by the CEA, and should be disposed of at locations with adequate dilution factor as stipulated in the CEA standards. c. Wastewater from vehicle/plant maintenance and service stations and all construction sites should comply with the relevant standards prescribed by the CEA prior to disposal into the environment. Action should be taken to ensure that excess oil and grease is removed from the wastewater through installation of efficient oil filtering mechanisms. The wastewater from vehicle and machinery service and maintenance stations should be periodically tested through a recognized laboratory, in order to ensure that it is in conformity with the standards prescribed by the CEA.	**Phase:** Construction and maintenance phases. **Location:** At all work sites along the route and from vehicle maintenance and service stations.	Engineering and O & M cost.	Contractor	RDA(ESD), PIU, CEA, LA

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	d. Construction work close to streams and water bodies must be avoided during the monsoon period e. Silt fencing Consisting of geotextile supported by wire mesh mounted on a panel made up of angle frame to be installed at edges of stockpiles near water bodies. f. locations of fuel storage and vehicles cleaning area should be at least 300m from the nearest water body /drain g. Oil & grease interceptors should be provided in fuel storage and vehicles cleaning areas. h. Slopes of embankments leading to water bodies should be modified and re channelled to prevent pollution of water-bodies.				
19.NOISE AND VIBRATION FROM EQUIPMENT & MACHINES	Equipment and machinery a. Construction equipment, machinery and vehicles should be maintained in optimum condition in order to ensure minimum noise generation. Particular attention should be paid to silencers & mufflers. To keep noise level to a minimum. b. Noise arising from the use of construction equipment should not exceed the maximum allowable noise levels stipulated by the CEA during construction. All construction equipment used for a 8 hours shift should conform to a noise level less than 90dB(A) c. Machinery producing high noise such as concrete mixers, generators etc must be provided with noise shields and their usage timings should be regulated.	**Location**: At all work sites along the route. **Phase**: During both construction and maintenance phases	Included in the engineering and O & M cost.	OPRC Contractor	RDA, PIU, CEA,LA

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	d. Working hour should be strictly in accordance with the hours stipulated by the CEA in the Site Clearance/EPL/IEE approval as the case may be. e. Construction work generating high noise levels should not be carried out during the night time. f. All machinery should be used according to the manufacturer's instructions and specifications regarding noise reduction. High noise generating equipment should be mounted or secured in such a manner as to minimize noise levels. g. Workers involved in high noise generating activities should be provided with adequate ear protection devices. h. High noise generating equipment should not be used in close proximity to schools, hospitals, places of worship and other noise sensitive locations. i. Periodic noise level monitoring should be carried out through a recognized laboratory at the construction sites, in order to determine whether noise levels are in conformity with levels stipulated by the CEA. j. If the noise level monitoring reveals that the noise levels exceed the levels stipulated by the CEA, the contractor should adopt appropriate measures in order to reduce noise levels. k. If there are complaints regarding high noise levels, the contractor should promptly respond to such complaints and take required action to bring the noise levels to acceptable levels. VEHICLE NOISE l. Vehicles transporting construction material should be maintained in optimum condition in				

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	order to minimize noise and air pollution from vehicular emissions.				
20.POLLUTION AND NUISANCE FROM LABOUR CAMPS	a. Any labour camps to be established should be sited away from protected areas such as Conservation Forests, Sanctuaries, National Parks or Environmental Protection Areas as declared by the CEA. A minimum distance of 250M should be maintained from schools, hospitals, places of worship as well as culturally and archaeologically significant areas. b. Temporary resting rooms, huts, offices and storage areas should be located away from inland water bodies and residential areas. A minimum distance of 150m should be allowed. c. The surrounding area of labour camps should be maintained in a sanitary manner in order to prevent the breeding of mosquitoes and other disease carrying vectors. d. Wastewater from labour camps should not be disposed of into nearby waterways or into the ground in order to prevent soil and water pollution. e. All labour camps should be provided with the required sanitary facilities including sewage disposal. Properly designed sewerage system should be installed and properly maintained in order to ensure no sewage pollution or contamination of nearby water bodies occurs. f. The sewerage system has to be designed, built and maintained in such a manner that	**Project Phase**: During both construction and maintenances phases **Location**: At all work sites along the route.	Included in the engineering and O & M cost.	OPRC Contractor	RDA(ESD), PIU, CEA and LA

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	no contamination of soil or nearby water bodies will take place. g. Solid waste from the labour camps should be properly managed by separating the biodegradable component from the non-bio degradable components such as polythene, glass and metal. A suitable arrangement should be made with the relevant Local Authority to periodically remove the accumulated waste for recycling or final disposal. h. Solid waste should not be allowed to accumulate for long periods of time within the labour camps under any circumstances. i. All labour camps should be provided with first aid facilities and all precautions should be adopted in order to ensure workers health and safety at all times. j. The contractor should ensure proper disposal of sludge from septic tanks through a suitable arrangement with the relevant Local Authority. Sludge disposal should not be done in a haphazard manner, and should be done only at specific locations approved by the LA. k. Labour camps should have adequate bathing and toilet facilities for workers according to the number of workers in residence. Toilets should be properly maintained and cleaned at regular intervals. l. Adequate water should be provided in all labour camps for toilet and bathing purposes as well as for drinking purposes. m. After completion of construction work, all labour camps, temporary resting places,				

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	office and storage areas shall be restored to the original condition.				

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
21. Extraction of water	a. The contractor is responsible for providing an adequate supply of water for all project purposes including labour camps, throughout the construction and maintenance period.no water should be obtained from public or community water supplies without the prior approval of the relevant authority. Such extraction should be carried out under the supervision of the engineer and only prior approved quantities of water shall be extracted. b. No ground water or surface water shall be extracted without prior approval of the engineer and the relevant authority(Divisional secretary and Water Resources Board respectively for surface and ground water) c. Construction over irrigation canals should be undertaken only with the prior approval of the Provincial Irrigation Engineer/Agrarian Services Department. c. The contractor will be fully responsible for settlement of any claims arising out of conflicts with other users of water from natural water sources.	**Phase:** Construction and maintenance phase. **Location**: at all work sites and natural water bodies	Included in design cost.	OPRC Contractor	RDA, PIU, Divisional Secretary, Water Resources Board
22.WORKERS SAFETY AND HEALTH	a. All provisions in the Factories Ordinance in relation to workers health and safety shall be complied with by the contractor at all times. b. Workers in the vicinity of high noise level area should be with provided ear plugs , helmets and be engaged in diversified activities in order to prevent prolonged exposure to noise levels of 90dB(A) per 8 hours shift.	**Phase:** During both construction and maintenance phases **Location:** At all work sites along the route.	Included in the engineering and O & M cost.	OPRC Contractor	RDA, PIU, Labour Department, Occupational Hygiene Division

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	c. Sufficient trained personnel and equipment should be available at all worksites in order to handle any medical emergency or accident. d. First aid kits should be made available at all work sites.				
22.COMPLAINTS HANDLING	a. The contractor should employ a qualified and experienced environmental officer in order to handle any environmental issues or public complaints regarding the project activities. The Environmental Officer should interact closely with the community in all matters relating to environmental and social issues. b. The primary responsibility of the Environmental officer should be the proper implementation of the Environmental Management Plan (EMP). c. The Environmental officer must periodically report to the Project Director/Engineer regarding the progress in implementation of the EMP.	**Phase:** During construction and maintenance phases. **Location:** All along the route and at work sites.	Cost included in construction and maintenance costs.	OPRC Contractor	RDA(ESD), PIU, CEA, LA
23.DUST AND AIR POLLUTION	a. A distance of a minimum 500m to 1km from the nearest settlement should be maintained between dust emitting operations and material storage areas, in order to ensure that the concentration of the pollutants from these emissions diffuse enough to be within acceptable limits at settlement locations and other sensitive areas such as schools, hospitals and religious locations . b. Material storage areas and dust generating equipment should be located downwind of	**Phase:** During both construction and maintenance phases **Location:** At all work sites along the route.	Included in the engineering and O & M cost.	OPRC Contractor	RDA, PIU, CEA

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	residential and other sensitive areas mentioned in above. c. All precautions to reduce the dust emissions from the hot mix plants, crushers batching plants and other transportation of materials should be taken up including: d. Provision of wind breaking wall, bamboo screens around the sources of dust such as the vibrating screens, conveyors, etc. should be made and regularly checked for all stone crushers used to supply material for the project. e. Vehicles delivering loose and fine materials like crusher dust and soil/spoils shall be covered to reduce spills on existing roads f. Water should be sprayed on earthworks, temporary haulage and detour roads on a regular basis. During and after compaction of the sub-grade, water will be sprayed at regular intervals to prevent dust generation. g. The hot mix plant should be fitted with dust extraction units. h. In addition, quarterly dust monitoring shall be conducted at locations where earthworks or slope cutting operations are taking place. i. .All necessary precautions shall be adopted by the contractor in order to minimize dust generation at work sites. j. Construction material stockpiles, spoil and debris from land clearing should be well covered at all times. k. Water sprinkling and other dust suppression methods should be adopted in order to minimize the generation of dust.				

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	l. Vehicles used for transportation of construction materials should be well maintained in order to minimize vehicular emissions. m. During construction material transportation, materials such as sand, and quarry material should be properly covered with tarpaulin sheets in order to minimize dust generation and spills. n. Vehicle speed limits should be strictly maintained in order to prevent accidents and also to minimize dust generation. o. Batching /Hot Mix Plants should be established at locations which do not cause nuisance or pollution. p. Siting of such plants near schools, hospitals, places of worship, culturally or environmentally sensitive or protected areas should be avoided. q. Batching and Hot Mix Plants should be located at suitable locations according to CEA guidelines. r. All such plants should obtain the site clearance and the Environmental Protection License (EPL) from the CEA or relevant LA as required by law. s. The operations of Batching Plants/Hot Mix Plants should be carried out strictly in accordance with the conditions and standards specified by the CEA in the EPL. All plant emissions should be in compliance with the standards stipulated by the CEA t. If dust levels are found to exceed the levels stipulated by the CEA, expert advice should be obtained from a recognized agency on dust suppression methods to be adopted				

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
24.Pollution from crusher plants , hot mix plants and batching Plants	a. All crusher plants are required to obtain a site clearance and EPL from the CEA prior to commencing operations. b. Crusher plants hot mix plants and batching plant should be operated strictly in accordance with the conditions stipulated in the Site clearance and EPL. c. Crusher plants, hot mix plant, batching plants should be located at least 500m away from residential areas, schools, hospitals, places of worship as well as environmentally sensitive areas. d. Dust suppression measures such as water sprinkling should be practiced at crusher' plants in order to minimize dust pollution. e. Aggregate piles from asphalt and concrete plants should be frequently wetted and covered with tarpaulins in order to minimize dust generation. f. Storage areas where there is vehicular movements should have a consolidated surface, which should be kept clean and in good repair, or should be kept wet. g. A reliable source of water should be available at all crusher, hot mix and batching plants in order to be utilized for dust suppression. h. Periodic dust measurements should be carried out at locations where earthworks or shape through a recognized laboratory i. For stone crushers provision of wind breaking walls , bamboo screens around sources of dust such as vibrating screens, conveyers should be installed and regular checked	**Location:** At all crusher plant sites, hot mix plants and batching plants. . **Phase:** During construction and maintenance phases.	No cost involved. Only compliance required. However, if contractor is operating his own plants, cost to be included in construction and maintenance cost	OPRC Contractor	RDA, PIU, CEA

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
	j. Vehicles delivering loose and fine material such as soil /crusher dust/spoil should be covered k. Water should be sprayed on earthworks temporary haulage & detour roads on a regular basis l. All hot mix plant to be fitted with dust extraction units. Also refer 23a, 23b, 23c, 23f,23m, 23h, 23o, 23p,23q, 23y				
25.USE AND DISPOSAL OF TOXIC/HAZARDOUS MATERIALS	a. A complete list of the chemicals to be used and in storage including their respective quantities should be provided to the Project Director/Engineer. b. Any hazardous or toxic chemicals to be used by the contractor for project activities should be stored in a safe manner at secure locations. Storage of incompatible material should not be allowed. Storage containers should not be stacked on top of each other and the storage area should be well ventilated. c. Material Safety Data sheets of all chemicals to be used should be readily available at the work sites, in order to respond immediately and correctly to an accidental spill or poisoning incident. d. All disposal sites for contaminated soil, unused chemicals or empty chemical containers should have the prior approval of the CEA. e. Any spills of hazardous/toxic chemicals should be cleaned up immediately by the contractor in a manner recommended in the Material Safety Data Sheets.	**Phase:** Pre Construction, Construction and maintenance phases. **Location**: At all work sites.	No cost involved. Only compliance required.	OPRC Contractor	RDA(ESD), PIU, CEA

Environmental Issue	Protection and Preventive Measure	Location / Project phase	Mitigation Cost	Institutional Responsibility	
				Implementation	Monitoring/Supervision
26.SOIL CONTAMINATION/POLLUTION	a. Untreated wastewater from work sites and labour camps should not be discharged into the ground under any circumstances. b. Oil and other chemicals should be stored in a secure manner with containment in case of spills. The storage areas should include containment areas around them, in order to ensure that any spillages of such material will be contained and not spread into the environment. c. Storage locations should not be located in close proximity to waterways. They should have proper ventilation and not be directly exposed to sunlight, devoid of ignition sources and should not be subjected to floods.	**Location**: At all work sites along the route. **Phase:** During both construction and maintenance phases.	Cost included in engineering and O&M Cost	OPRC Contractor	RDA, PIU,CEA,Local Authority
27.EMERGENCIES	a. The contractor should prepare a comprehensive Emergency Preparedness Plan (EPP) in order to respond promptly to emergency situations such as fire, explosions, chemical spillages, medical emergencies and accidents within the project sites. b. The EPP should be periodically updated.	**Phase**: During both construction and operational phases. **Location:** At all work sites along the route.	Cost included in Engineering and O & M cost.	OPRC Contractor	RDA, PIU, CEA, Local Authority

Abbreviations for EMP: EO= Environmental Officer; LA = Local Authority; ESD = Environmental and Social Division; ID= Irrigation Department; SLLRDC = Sri Lanka Land Reclamation and Development Corporation; DAD = Department of Agrarian Development

5.2 Standards and Regulations to be complied with By the Contractor/Sub Contractors

During Road Construction and Maintenance

1. National Environmental (Noise Control) Regulations Gazette No 924/12 of 23.05.1996
2. Hazardous Waste Management Regulation Gazette No 924/13 dated 23.05.1996 and its subsequent amendment by the CEA under the National Environmental Act
3. National Environmental (Protection & Quality) Regulations (EPL) Gazette No 595/16 dated 02.02,1990 and its subsequent amendment in 2000.
4. National Environmental (Procedure for approval of projects) regulations no 1 of 1993- Gazette no 772/22 (EIA regulation) and its amendments nos 1104/22 and 1108/1 in 1999(Only applies when road rehabilitation involves involuntary resettlement or intrusions into protected or environmentally sensitive areas.
5. Vehicle Emission Control regulations-Gazette numbers 817/6 of 03.05.1994,
6. National Environmental (Air Emissions, Fuel & Vehicle Importation standards)Regulations 2000, Gazette no 1137/35 of 23.06.2000
7. National Environmental (Air Emissions, Fuel & Vehicle Importation standards) Amended Regulations, Gazette no 1295/11 of 30.06. 2003

Permits and Licenses required to be obtained by Contractors/Sub Contractors during Road Construction and Maintenance

1. OPRC Contractor-
    - IEE/EIA Approval (if relevant-please refer 4 above)
    - EPL
    - Hazardous Waste management License from CEA for management of hazardous waste, oil etc
2. Burrow Pits-
    - Geological Survey and Mines Bureau License, Environmental Protection License (EPL) from the CEA
3. Quarry Sites-
    - EIA approval for A category quarries,
    - Geological Survey and Mines Bureau License
    - EPL from CEA

5.3 Environmental Monitoring Plan (EMoP)

Environmental Component	Project Stage	Parameters	Location[1]	Frequency	Standards	Rate	TotalCost	Implementation	Supervision
Air Quality	Design and Construction stage	TSPM, PM10, NO_x , CO, SO_x , Pb	Archealogical site and sample of sensitive sites	Design: 1 time Construction: once every quarter	NAAQS of Sri Lanka	USD 120 per sample	Based on the detailed design and construction plan	Contractor through approved monitoring agency	RDA(ESD)/ PMU/MC
	Operation stage	TSPM, PM10, NO_x, CO, HC, Pb, SO_x	Archealogical site and sample of sensitive sites	Once annually	NAAQS of Sri Lanka	USD 120 per sample	Based on the detailed design and operation and maintenance plan	Contractor through approved monitoring agency	RDA(ESD)/ PMU/MC
Water Quality	Design and Construction stage	EC, pH, DO, TSS, BOD, Oil and grease, Lead, E. Coli	All key surface water bodies	Design: 1time Construction: once every quarter	CEA advisory guidelines	USD 100 per sample	Based on the detailed design and construction plan	Contractor through approved monitoring agency	RDA(ESD)/ PMU/MC
	Operation stage	EC, pH, DO, TSS, BOD, Oil and	All key surface water bodies	Once annually	CEA advisory guidelines	Rs 100 per sample	Based on the detailed operation and	Contractor through approved monitoring	RDA(ESD)/ PMU/MC

Environmental Component	Project Stage	Parameters	Location[1]	Frequency	Standards	Rate	TotalCost	Implementation	Supervision
		grease, Lead, E. Coli					maintenance plan	agency monitoring agency	
Noise Levels	Design and Construction stage	dB levels	Archealogical site and sample of sensitive sites	Design: 1 time Construction: once every quarter	National Environmental (Noise Control) Regulations 1996(no. 924/12)	USD 150 per sample day	Based on the detailed design and construction plan	Contractor through approved monitoring agency	RDA(ESD)/ PMU/MC
	Operation stage	dB levels	Archealogical site and sample of sensitive sites	Once annually	National Environmental (Noise Control) Regulations 1996(no. 924/12)	USD 150 per sample day	Based on the detailed operation and maintenance plan	Contractor through approved monitoring agency	RDA(ESD)/ PMU/MC
Flora	Design and Construction stage	Plants to be removed and replanted	State-owned public land closer to the road	Year 1 of planting: Once a month	Diversity of species replanted	USD 150 per visit	Based on the timing of removal and replanting	Contractor	RDA(ESD)/ PMU/MC
	Operation stage	Survival of trees	State-owned public land closer to the road	Year 2 -3 sicne planting: Once every quarter	Percentage of survival	USD 150 per visit	Based on the timing of replanting	Contractor	RDA(ESD)/ PMU/MC

Environmental Component	Project Stage	Parameters	Location[1]	Frequency	Standards	Rate	TotalCost	Implementation	Supervision
				Year 4-5 sicne planting: Once a year					
Fauna	Design stage	Diversity of species	Project influencing area.	1 visits	Diversity of species	USD 150 per visit	Based on the detailed design plan	Contractor	RDA(ESD)/ PMU/MC
	Construction stage	Diversity of species	Project influencing area	Once every quarter	Diversity of species	USD 150 per visit	Based on the detailed construction plan	Contractor	RDA(ESD)/ PMU/MC
	Operation stage	Diversity of species	Project influencing area	Once a year	Diversity of species	USD 150 per visit	Based on the detailed design and operation and maintenance plan	Contractor	RDA(ESD)/ PMU/MC

Note: TSPM = Total Suspended Particulate Matter, PM10 = Respirable Particulate Matter < 10μm diameter, NO_x = Oxides of Nitrogen, CO = Carbon Monoxide, SO_x = Oxides of Sulphur, Pb = Lead, HC = Hydro Carbons, EC = Electrical Conductivity, DO = Dissolved Oxygen, TSS = Total Suspended Solids, BOD = Biological Oxygen demand, ESD = Environmental and Social Division, RDA = Road Development Authority, MC= Monitoring Consultant

[1] Number of replicates and sampling locations could be varied according to the requirement once the EMOP is implemented

[2] Water quality will be measured both in up stream and down stream

CHAPTER 6

6. Institutional Arrangements

The Environmental and Social Division (ESD) of the Road Development Authority was established in year 2006 and implements environmental and social safeguards compliance strategies at different levels of road construction projects. The ESD will provide safeguards compliance related services for all the road development activities in the organization, beginning at project identification stage, all the way through implementation and post implementation evaluation. The ESD's active involvement in upstream planning and downstream processing and implementation would be significantly aided on all safeguard compliance related aspects of road sector development in Sri Lanka. Consequently, with ESD's assistance any social or environmental compliance related issues would be brought to the attention of the authorities' right at the outset, thereby preventing major issues from emerging during implementation.

6.1 Institutional Roles and Responsibilities

Institutional Roles and Responsibilities for implementation of safeguards are summarized below:

Road Development Authority (Project executing agency).

Overall responsibility of executing all road rehabilitation, upgrading and maintenance work through designated Executive Engineers of the areas under guidance of the Maintenance, Management and Construction Division of RDA.

Director, ESD and Field Monitoring Assistants (FMAs) of ESD: To observe and report the level of safeguards compliance maintained during road maintenance work to RDA.

Director Lands/ESD and Resettlement Assistants of the Land Division/ESD of the RDA: Ensure land Acquisition should be as per the guidelines stipulated in LAA, NIRP and World Bank operational policy on Involuntary Resettlement; and the resettlement could be done according to RAP. Acquisition is carried out it will follow normal acquisition procedure without following the section 38A Proviso, which is the emergency procedure of the LAA.

Provincial Director/RDA: Mitigation of safeguard impact and Implementation of Grievance redress mechanism (as the Chairman of the GRC). Direct and guide Executive Engineer (EE) in complying with safeguards during road works through the respective Chief Engineer, RDA

Chief Engineer/ RDA: Conducting Grievance redress Meetings. Coordination with line agencies. Guide EE in complying with safeguards

Executive Engineer/ RDA: Act as the Secretary of the GRC. Public consultation and awareness raising. Coordination with line agencies to replace all structures, affected parties located within the RoW. Assist to DS of the area to implement land acquisition process under the LAA. Monitoring and Evaluation of environmental and social mitigation activities and progress implementation. Coordination with utilities agencies. Ensure the safeguards are complied during any road maintenance work.

Project Management Unit

Project Director: Overall responsibility/ supervision for implementation of RAP and providing necessary assistance and guidance for the project staff to implement social safeguards successfully.

Environmental Specialist: Ensure the implementation of EMP; Providing training on environmental safeguards to RDA staff, contractors and other relevant stakeholders; Conducting public awareness; Providing guidance to implement environmental safeguards; Monitoring environmental safeguards implementation of the project; Supervision of Implementation of grievance redressal mechanism.

Monitoring Consultant Office

Resident Engineers: Coordination with the PMU, RDA to implement environmental safeguards policies of the project. Responsible for implementation of Grievance Redress Mechanism.

Environmental Specialists: Take actions to implement the EMP. Monitoring the progress of environmental safeguards taken to minimize negative social impacts. Preparation of progress reports on environmental safeguards; Liaise closely with Environmental Specialists of PMU and contractor to ensure environmental requirements of the project are fully met.

Site engineers and Technical officers. Making changes to the designs to avoid significant environmental issues; Manage good relationship with affected parties and general public.

OPRC Contractor

Overall responsible to update the EA and EMP parallel to the detailed design of the project based on the EA and EMP provided in this document and conceptual design. The updated EA/EMP will need to be submitted to PMU through the Monitoring Consultant for clearance. The contractor is also responsible to prepare the Environmental Methods Statement (EMS) in line with the EA/EMP. The Contractor will assign qualified Environmental Specialists to manage day-to-day implementation of the EMP/EMS. The contractor is also responsible to ensure self-monitoring of the implementation of EMP/EMS and report to the employer through the monitoring consultant.

6.2 Monitoring and Reporting

A robust monitoring and reporting system will be established by the Environmental and Social Safeguards Division of the RDA. The monitoring and reporting system will integral to safeguards and the Project will establish a monitoring and reporting system for ensuring efficient and effective implementation performance of the delivery of the project safeguard program.

The monitoring and reporting system of ESD will be responsible for the systematic collection of information on the progress of the application of the safeguards program and reporting the findings to the stakeholders through the RDA. Overall the objective of monitoring and reporting will be to ensure that the proposed mitigation measures are producing the intended results. The monitoring of environmental safeguards will be done using the EMP, which provides the monitoring indicators and frequency.

Internal monitoring

Internal monitoring will be done by the RDA and ESD and will be focused on timely execution of safeguard activities in line with the EMP/EMS implementation. In addition, monitoring will also focus on scheduling with civil works, monitoring the role of contractors, managing safeguards consultants and their outputs, documentation of progress with regard to eligibility list preparation, disclosure and consultation, grievance registration and resolution, etc. In addition to this PMU, and Monitoring Consultant will be also responsible to ensure regular monitoring of safeguards performance and compliance.

External Monitoring

As a long-term project, based on critical timing of project activities such as rehabilitation and maintenance, independent environmental audits should be conducted. Such audits are expected to take place at least once during rehabilitation works and twice during maintenance.

6.3 Capacity Building

Environmental management is not a new task for RDA, ESD and the PMU. Therefore, the capacity building needs are mostly focused on the contractor and new staff that may get assigned from RDA (especially at the field level). Based on the capacity assessment, it was noted that the capacity building activities can be managed in-house using resources of ESD and PMU. Capacity building activities will be conducted during the first 2 years of the project. The following is the proposed training program for the project:

Activity	Details	Location	Key Participants	Schedule
Project-wide introductory environmental safeguards training workshop	Purpose: Introduce RDA key staff to environmental safeguards of the project and implementation responsibilities Responsibility: Environmental Specialist of PMU with support from ESD Duration 1 day	RDA	RDA head office staff involved in the project RDA Provincial and Regional staff Monitoring consultant staff	First quarter of year 1: USD 5,000
Contractor training	Purpose: Introduce contractor staff to environmental safeguards of the project and implementation responsibilities Responsibility: Environmental Specialist of PMU with support from ESD Duration 1 day	RDA	Contractor staff including safeguard specialists, safety officers and engineering staff	First quarter of year 1: USD 5,000
Regional level follow-up training	Purpose: Follow-up discussions on environmental safeguards of the project, implementation responsibilities and practical training on site Responsibility: Environmental Specialist of PMU with support from ESD Duration 1 day	TBD	RDA Provincial and Regional staff Monitoring consultant staff Contractor staff including safeguard specialists, safety officers and engineering staff	Last quarter of year 1 and third quarter of year 2: USD 15,000

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ANNEX 1

CULVERT LOCATIONS


CULVERT LOCATION MAP (A 03 ROAD)
(CH. 18+000 ~28+000)
LEGEND
A-03_ROAD
Existing_Culvert
Proposed Culvert
Flood Area
FLOOD AREA
0 425 850 1,700 Meters
SHEET : 01 0F12
28+000Km
27+000Km
26+000Km
25+000Km
24+000Km
23+000Km
22+000Km
21+000Km
20+000Km
19+000Km
18+000Km
28/3
28/2
28/1
27/2
27/1
26/3
26/2
26/1
25/2
25/1
24/3
24/2
24/1
23/2
23/1
22/2
22/1
21/3
21/2
21/1
20/2
20/1
19/3
19/1
Bandaranayake International Air Port
KATANA DIVISION

CULVERT LOCATION MAP (A 03 ROAD)
(CH. 28+000 ~38+000)
FLOOD AREA
LEGEND
A-03_ROAD
Existing_Culvert
Proposed Culvert
Flood Area
0 425 850 1,700 Meters
SHEET : 02 0F12
39/1
38/3
38/2
38/1
37/1
36/1
35/2
35/1
34/2
34/3
34/1
33/2
33/1
31/4
31/3
31/2
31/1
30/4
30/3
30/2
30/1
29/3
29/2
29/1
28/3
28/2
28/1
38+000Km
37+000Km
36+000Km
35+000Km
34+000Km
33+000Km
31+000Km
30+000Km
29+000Km
28+000Km
NEGOMBO
DIVISION
KATANA
ALUTHKURU


CULVERT LOCATION MAP (A 03 ROAD)
(CH. 38+000 ~48+000)
PROPOSED CULVERT
FLOOD AREA
48/1
48+000Km
47+000Km
46+000Km
45+000Km
44+000Km
43/3
43+000Km
43/2
43/1
42/4
42+000Km
42/3
42/2
42/1
41/3
41/2
41/1
41+000Km
40/2
40/3
40/1
40+000Km
39/2
39/1
39+000Km
38/3
38+000Km
LEGEND
A-03_ROAD
Existing_Culvert
Proposed Culvert
Flood Area
0
425
850
1,700 Meters
SHEET : 03 0F12


CULVERT LOCATION MAP (A 03 ROAD)
(CH. 48+000 ~57+000)
57+000Km
57/1
56+000Km
56/1
55+000Km
54/1
54+000Km
53+000Km
52+000Km
51+000Km
50+000Km
50/1
49+000Km
48/1
48+000Km
LEGEND
A-03_ROAD
Existing_Culvert
Proposed Culvert
Flood Area
0 425 850 1,700 Meters
SHEET : 04 0F12

CULVERT LOCATION MAP (A 03 ROAD)
(CH. 57+000 ~66+000)
N
66+000Km
66/1
65/4
65+000Km
65/3
65/2
65/1
64+000Km
64/2
64/1
63+000Km
63/4
63/3
63/1
63/2
62/7
FLOOD AREA
62/6
62+000Km
62/4
62/3
62/2
62/1
61/5
61+000Km
61/4
61/3
61/2
61/1
60+000Km
60/4
60/3
60/2
60/1
59+000Km
58+000Km
57+000Km
57/1
LEGEND
A-03_ROAD
Existing_Culvert
Proposed Culvert
Flood Area
0 425 850 1,700 Meters
SHEET : 05 0F12

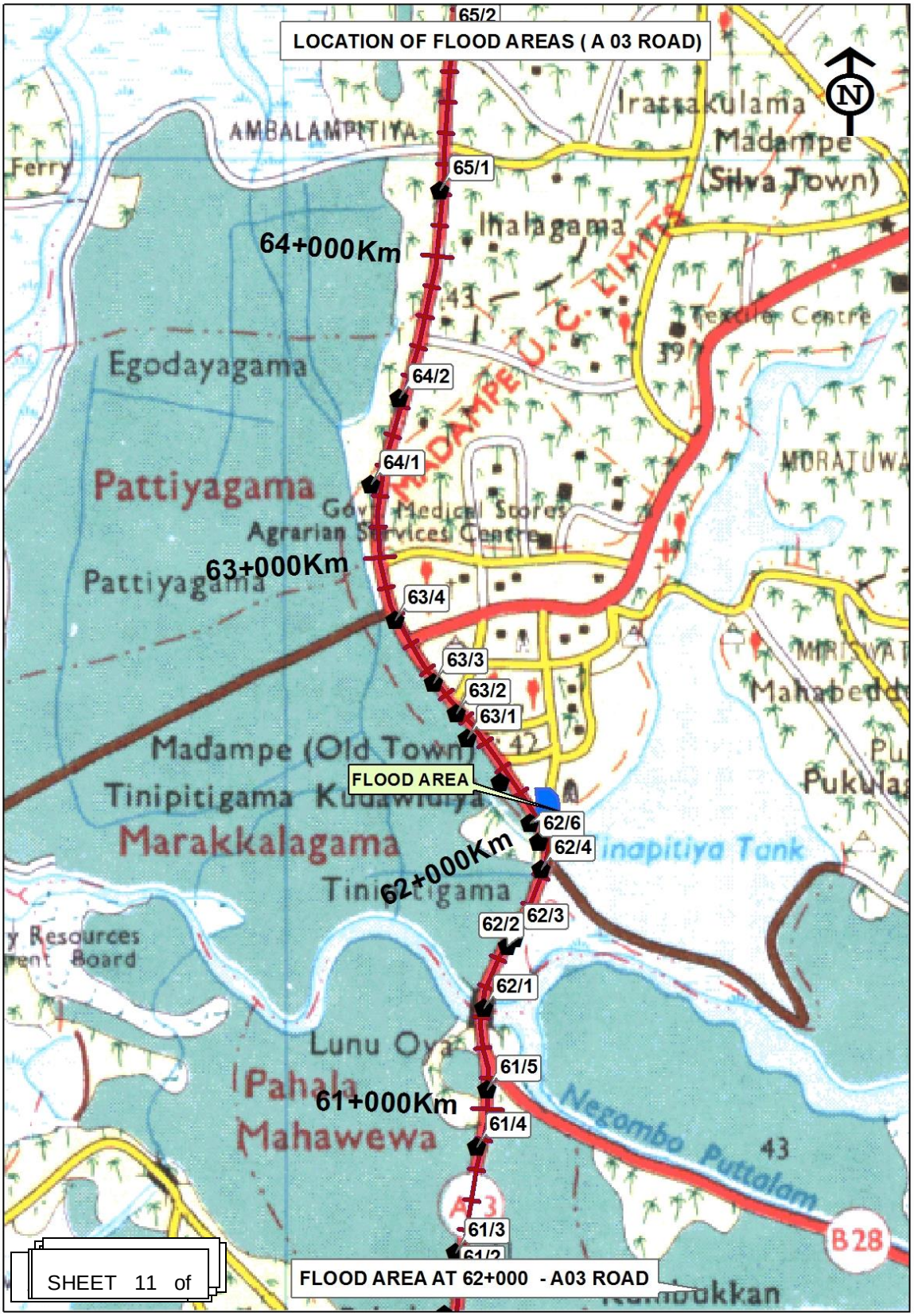
ANNEX 2

DETAILS OF FLOOD AREAS


LOCATION OF FLOOD AREA S - A03 ROAD
N
22/1
21/3
21+000Km
21/2
Mill
Fair
Seeduwa
Bandarawatta
21/1
Mukalangamuwa
Radio Transmission Station
20+000Km
20/2
20
FLOOD AREA
20/1
Alawatupiciya
19/3
19+000Km
Fibre Mill
19/1
Kindigoda
18+000Km
Dandugama
SHEET 1 of 11
FLOOD AREA AT18+000-19+000 - A03 ROAD


LOCATION OF FLOOD AREAS (A 03 ROAD)
39/1
38+000Km
38/2
38/1
37+000Km
37/1
36+000Km
FLOOD AREA
36/1
35+000Km
35/2
35/1
34+000Km
34/2
34/3
Kochchikade
Kammaltotupola
Kammaltura
Bendarawatta
Toppuwa
Oritiyawa
Nalayandaluwa
Pallansena North
Perutota
Pallansena South
NEGOMBO
Daluwakotuwa
Oil Mill
DIVISION
Wellhena
SINNAMOLE
HOTAM
Palangature
LEOFARM
ANNESLYNNE
Kattuwa
Ettukala (Part)
Ettukala
SHEET 2 of 11
FLOOD AREA AT 35+000-36+000 - A03 ROAD


LOCATION OF FLOOD AREAS (A 03 ROAD)
Thaldeka
Cemetery
Dummaladeniya East
Mampitiya
44+000Km
Agrarian Services Centre
A S P Office
Cemetery
Nainamadama West
FLOOD AREA
43/3
43+000Km
Nainamadama East
43/2
Ice Factory
43/1
Kammala North
42/4
42+000Km
Ranganmulla
Bridge
42/2
42/1
Kammala South
41/3
Hotel Dolphin
41/2
SHEET 3 of 11
FLOOD AREA AT 43+000 - A03 ROAD


LOCATION OF FLOOD AREAS (A 03 ROAD)
N
65/2
65/1
64+000Km
64/2
64/1
63+000Km
63/4
63/3
63/2
63/1
FLOOD AREA
62/6
62/4
62+000Km
62/3
62/2
62/1
61/5
61+000Km
61/4
61/3
AMBALAMPITIYA
Ferry
Irattakulama
Madampe
(Silva Town)
Ihalagama
Egodayagama
Pattiyagama
Agrarian Services Centre
Madampe (Old Town)
Tinipitigama
Marakkalagama
Lunu Oya
Pahala
Mahawewa
Negombo Puttalam
B28
SHEET 11 of
FLOOD AREA AT 62+000 - A03 ROAD

ANNEX 3

CULVERT PHOTOS

LOCATION:A003 Road 30/1 culvert

DESCRIPTION: Inadequate side drains

LOCATION: A003 Road 43/2 culvert

DESCRIPTION: Culvert blocks

LOCATION: A003 Road 43/3 culvert

DESCRIPTION: Culvert blocks

LOCATION: A003 Road 43/3 culvert

DESCRIPTION: Culvert blocks

ANNEX 4

Number of trees from each species subjected either to felling or pruning during road widening at Project Area

Annex 4: Number of trees from each species subjected either to felling or pruning during road widening at Project Area -((Dandugama bridge to Periyamulla junction in Corridor 1B - Ja-Ela to Puttalam Section of Peliyagoda - Puttalam road -A03)

5th 2km segment towards Negombo. A temple at 7.14033°N 79. 87467℃. Two Christian statues at 7.14917°N 79. 87312℃ and at7.14345°N 79. 87411°E.A temple (Sri Wishudhdharamaya) at at7.1314033°N 79. 87467°E		4th 2km segment towards Negombo. A Buddha statue and aBo tree at at7.13545°N 79. 875491°E. Seeduwa hospital and a Christian statue at at7.13545°N 79. 87549°E		3rd 2km segment. towards Negombo.**Dandugama bridge** and a Christian statue at 7.110478°N 79. 88241°E .A temple (Gangaramaya) at7.11421°N 79. 88167℃, Buddha statue at at7.11313°N 79. 88191°E		2nd 2km segment towards Negombo. .Jaela St. Mary's church is located at 7.08925°N 79. 88970°E.) and school at7.09750°N 79. 88611°E		1st 2km segment from Ja-ela town towards Negombo. Jaela bridge (at 7.080047°N 79..89020℃) and 4 Christian statues in the same location		Site description and special features including sites of special significance	
7.15574°N 79 87159℃ 7.13794°N 79.87506°E		7.13794°N 79.87506°E- 7.12259°N 79. 89020°E		7.12259°N 79. 89020°E - 7.10474°N 79. 88392°E		7.10474°N 79. 88392°E - 7.08761°N 79..89020°E		7.08761°N 79.89020°E - 7.06991°N 79.89357°E		GPS location	
Land side	Sea side	Land side	Sea side	Land side	Sea side	Land side	Sea side	Land side	Sea side	Side of the road	Number of trees from different species recorded within 5 meter width from RDA boundary (common names of the tree species are given)
			1		1		1			Del	
	12				1		1			Puwak	
1	1	1	8	3	7	2	1	1	4	Kos	
10	23	14	27	10	19	10	7	3	13	Kottamba	
	23		5	3	3	8	3	3		Kohomba	
	3	4	2	2	1		1			Ahala	
23	28		28	7	27		18		5	Pol	
				1			1			Nuga	
2		1			4		3			Acacia	
1					1					Rambutan	
	1	1	2	1	2		3		3	Suriya mara	
2	7	1	9	1	10				5	Pare mara	
			3	1	1					Attikka	
4			2	2					1	Araliya	
	1				1	1	1	3	1	Heen nuga	
4	4	6			6					Tabebuia	
1				2		1				Rukattana	
	2		3	4	2		13	11	3	Willow	
12		5			1					Kumbuk	
2	3	3	3	10	4	4	4	1	3	Pihimbiya	
					1					Hik	
23	18	8	42	34	42	17	33	15	18	Amba	
2			1	1	2					Ambarella	
4			3		2					Pera	
					1	1				Naa	
		4	2	2	11	1			1	Thekka	
4		8	14	9	1		8	3		Palm sp.	
					1					Lunumidella	
					1					Kaju	
		2							1	Jambu	
		4		2		1			1	Thekka	
			2	2		2			1	Kitul	
2			1		2					Kaha Una	
			1					1		Thal	
									1	Katurumurunga	
							2			Kurundu	
									1	Katuaththa	
						2	1			Beli	
		16								Magul karanda	
		1								Asoka	
2		2							1	Ipil ipil	
1										Pinus sp.	

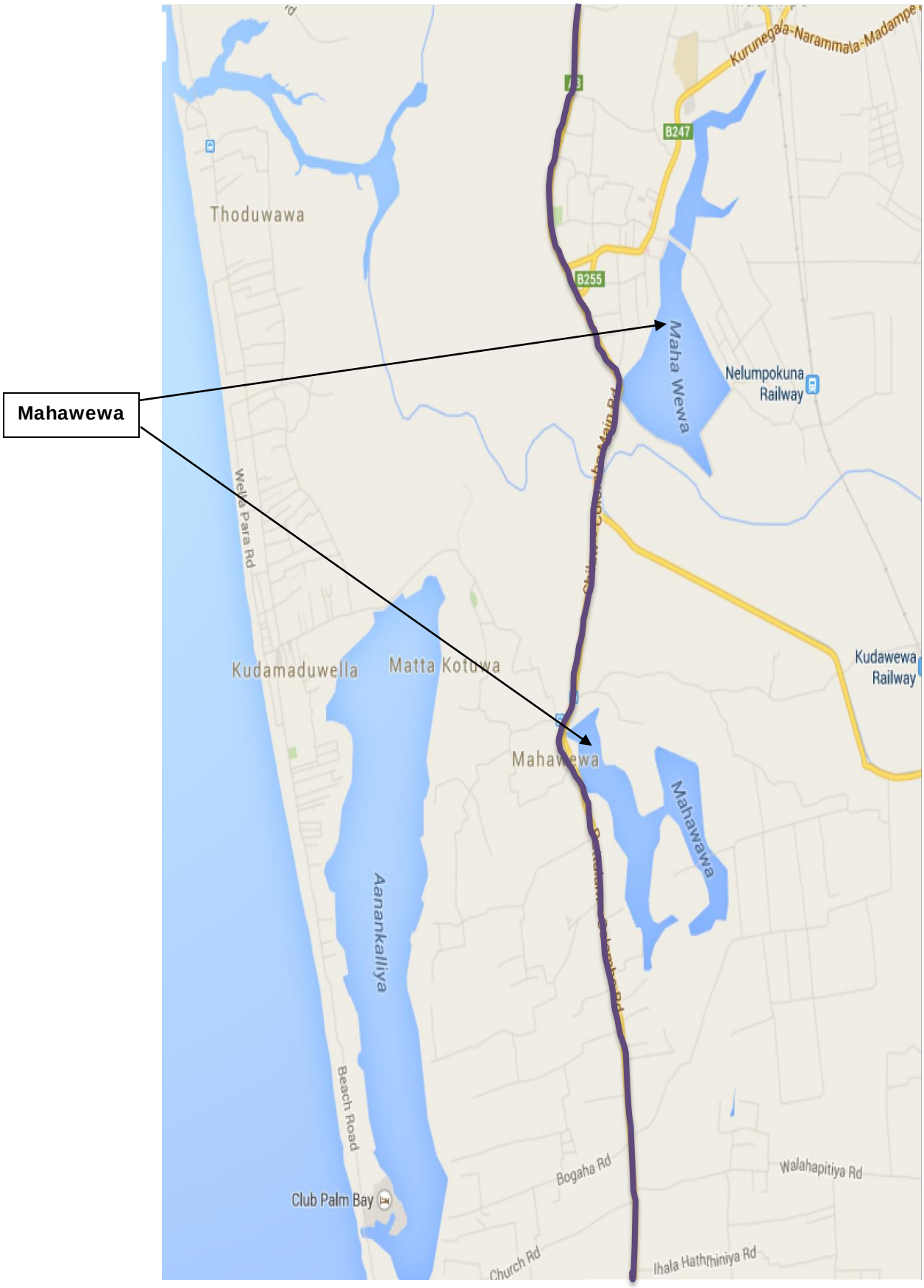
5th 2km segment towards Negombo. A temple at 7.14033°N 79. 87467°E. Two Christian statues at 7.14917°N 79. 87312°E and at7.14345°N 79. 87411°E.A temple (Sri Wishudhdharamaya) at at7.1314033°N 79. 87467°E		4th 2km segment towards Negombo. A Buddha statue and aBo tree at at7.13545°N 79. 875491°E. Seeduwa hospital and a Christian statue at at7.13545°N 79. 87549°E		3rd 2km segment. towards Negombo.**Dandugama bridge** and a Christian statue at 7.110478°N 79. 88241°E .A temple (Gangaramaya) at7.11421°N 79. 88167°E, Buddha statue at at7.11313°N 79. 88191°E		2nd 2km segment towards Negombo. .Jaela St. Mary's church is located at 7.08925°N 79. 88970°E.) and school at7.09750°N 79. 88611°E		1st 2km segment from Ja-ela town towards Negombo. Jaela bridge (at 7.080047°N 79..89020°E) and 4 Christian statues in the same location		Site description and special features including sites of special significance	
7.15574°N 79 87159°E 7.13794°N 79.87506°E		7.13794°N 79.87506°E- 7.12259°N 79. 89020°E		7.12259°N 79. 89020°E - 7.10474°N 79. 88392°E		7.10474°N 79. 88392°E - 7.08761°N 79..89020°E		7.08761°N 79..89020°E - 7.06991°N 79.89357°E		GPS location	
Land side	Sea side	Land side	Sea side	Land side	Sea side	Land side	Sea side	Land side	Sea side	Side of the road	Number of trees from different species recorded within 5 meter width from RDA boundary (common names of the tree species are given)
							1			Thelambu	
	2	2	2	3		1	1			Ambul nelli	
1									2	Nelli	
1	2	7				1	1			Kasa	
							3			Sooriya	
			1							Siyambala	
			1					1		Kone	
			3							Kaluwara	
1			1	2		1			1	Pini jambu	
					1					Sapadilla	
1			3			1				Weralu	
	1	1	1	1				3	1	Bo	
								1		Mangoosetin	
								1		Mee	
						1				Kiripalu	
				1		1				Aththa	
						1				Ornamental cyperus	
	1	2	4		4	1		5	2	Jam	
	2		1				1			Damba	
			1			1	1			Divul	
		7	2				1			Mahogany	
				1						Domba	
				1						Velvet apple	
				2						Anoda	
				1						Maila	
				1						Ugurassa	
		1								Halmilla	
1										Kahata	
		16								Koboleela	

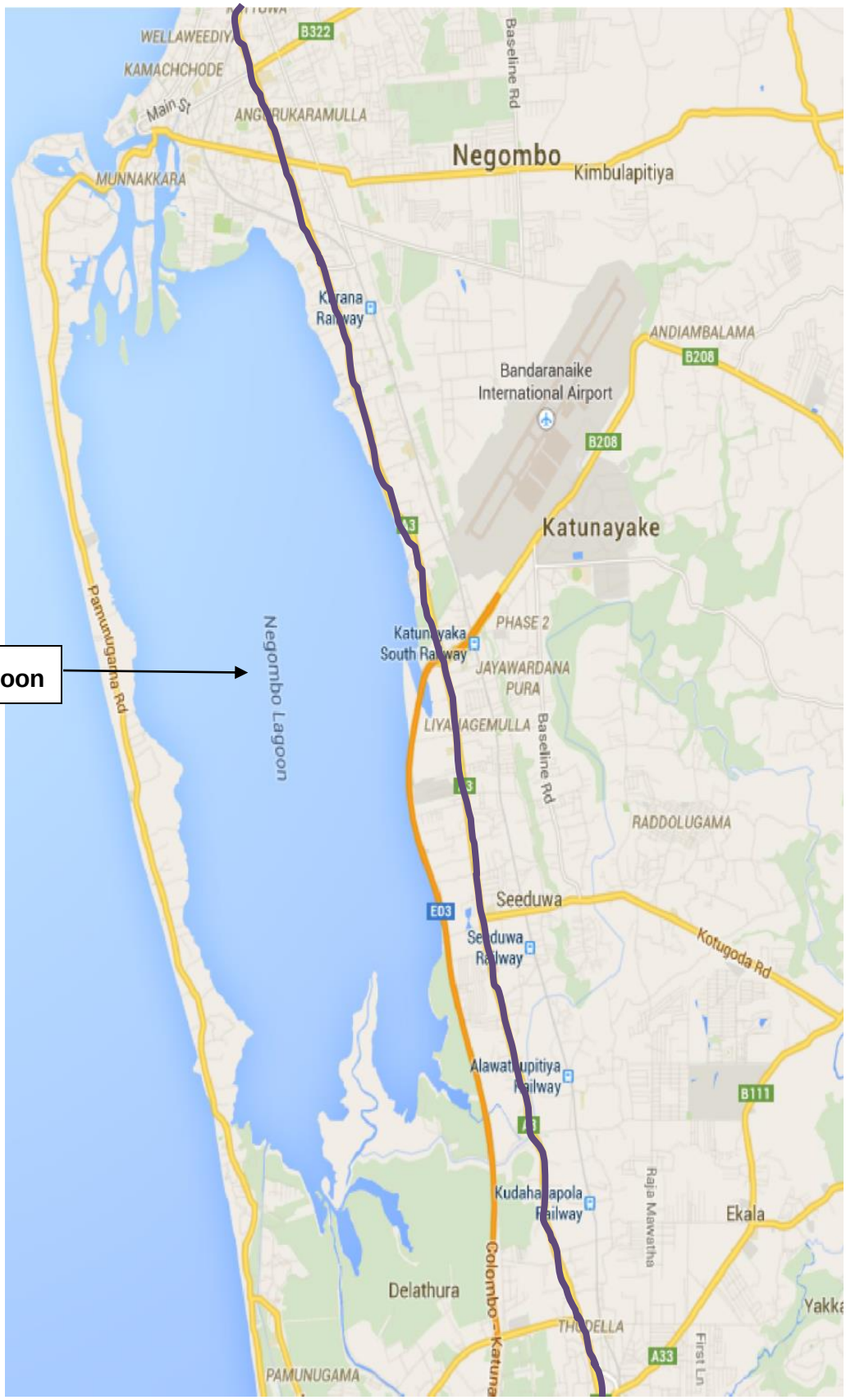
10th 2km segment towards Periyamulla junction fromnegombo town. Cemetery at 7.23862°N 79.84810°E St. Francis church at 7.23455°N 79.84916°E Christian statue at 7.24138°N 79.84933°E		9th 2km segment Negombo town .Mari Stella College and Negombo hospital at 7.21297°N 79.84782°E Mosque at 7.22495°N 79.84979°E		8th 2km segment Negombo town . Municipal Council office at 7.20575°N 79.85112°E Christian statue at 7.20076°N 79.85348°E Catholic church at 7.19630°N 79.85551°E Christian church 7.20841°N 79.84993°E		7th 2km segment towards Negombo. Christian statue at 7.18981°N 79.85843°E St. Philip's shrine at 7.18221°N 79.86072°E Catholic church at 7.17778°N 79.86235°E Methodist church at 7.17647°N 79.86269°E		6th 2km segment towards Negombo. Buddha statue at 7.13545°N 79.87549°E and a Christian statue at 7.12719°N 79.87720°E		Site description and special features including sites of special significance	
7.24138°N 79.84933°E - 7.22495°N 79.84979°E		7.22495°N 79.84979°E - 7.20841°N 79.84993°E		7.20841°N 79.84993°E - 7.19253°N 79.85725°E		7.19253°N 79.85725°E - 7.17446°N 79.86370°E		7.17446°N 79.86370°E - 7.15574°N 79.87159°E		GPS location	
Land side	Sea side	Land side	Sea side	Land side	Sea side	Land side	Sea side	Land side	Sea side	Side of the road	Number of trees from different species recorded within 5 meter width from RDA boundary (common names of the tree species are given)
	1	1				1	2		2	Del	
	3				3		5	1	1	Puwak	
3	3	3	2	4	2	1	7	2	6	Kos	
2	4	12	7	6	16	10	7	9	6	Kottamba	
4	2	2	6	8		1	10	1	4	Kohomba	
1				2						Ahala	
13	13		13	9	27	16	25		25	Pol	
							1			Nuga	
				5	1			1	4	Acacia	
			1	1						Rambutan	
		1	1	2			1			Suriya mara	
		1							8	Pare mara	
									1	Attikka	
1			2		1			3	2	Araliya	
1	4	5	3	2		2			2	Heen nuga	
										Tabebuia	
1	2	3	1		3		4		2	Rukattana	
1	9	2	7	1	5	2		4	4	Willow	
								1	4	Kumbuk	
8	4	3	9	8	3	6	8	8	1	Pihimbiya	
1										Hik	
38	38	24	31	22	37	42	24	24	48	Amba	
		1			1	1				Ambarella	
						1		1	3	Pera	
3		2	1		2	1				Naa	
5		2		2	1	1	6			Thekka	
6		43	1	11		7			14	Palm sp.	
										Lunumidella	
1										Kaju	
	2									Jambu	
	2			1			2			Lovi	
							2			Kitul	
2		3		3	1	2		22	1	Kaha Una	
		1			1					Thal	
					1					Katurumurunga	
										Kurundu	
		1								Katuaththa	
							1			Beli	
										Magul karanda	
1										Mai	
								1		Ipil ipil	
										Pinus sp.	
			1				1			Bulu	
		1								Dodam	

10th 2km segment towards Periyamulla junction fromnegombo town. Cemetery at 7.23862°N 79.84810°E St. Francis church at 7.23455°N 79.84916°E Christian statue at 7.24138°N 79.84933°E		9th 2km segment Negombo town .Mari Stella College and Negombo hospital at 7.21297°N 79.84782°E Mosque at 7.22495°N 79.84979°E		8th 2km segment Negombo town . Municipal Council office at 7.20575°N 79.85112°E Christian statue at 7.20076°N 79.85348°E Catholic church at 7.19630°N 79.85551°E Christian church 7.20841°N 79.84993°E		7th 2km segment towards Negombo. Christian statue at 7.18981°N 79.85843°E St. Philip's shrine at 7.18221°N 79.86072°E Catholic church at 7.17778°N 79.86235°E Methodist church at 7.17647°N 79.86269°E		6th 2km segment towards Negombo. Buddha statue at 7.13545°N 79.87549°E and a Christian statue at 7.12719°N 79.87720°E		Site description and special features including sites of special significance	
7.24138°N 79.84933°E - 7.22495°N 79.84979°E		7.22495°N 79.84979°E - 7.20841°N 79.84993°E		7.20841°N 79.84993°E - 7.19253°N 79.85725°E		7.19253°N 79.85725°E - 7.17446°N 79.86370°E		7.17446°N 79.86370°E - 7.15574°N 79.87159°E		GPS location	
Land side	Sea side	Land side	Sea side	Land side	Sea side	Land side	Sea side	Land side	Sea side	Side of the road	Number of trees from different species recorded within 5 meter width from RDA boundary (common names of the tree species are given)
										Thelambu	
1					1		1	2	1	Ambul nelli	
	1		2				1			Nelli	
1		2						1		Kasa	
										Sooriya	
									1	Indi	
									1	Siyambala	
1										Pinus	
										Kaluwara	
		1	1						1	Pini jambu	
	1		1	2						Sapadilla	
	1		1		1	2		4		Weralu	
2					2				1	Murunga	
									2	Bo	
										Mangoosetin	
					1		1			Mee	
										Kiripalu	
1										Aththa	
										Ornamental cyperus	
3	2	2	4	1	3	2	3	3	8	Jam	
	1									Damba	
							3			Divul	
11	1			2	2	1			2	Mahogany	
										Domba	
										Velvet apple	
										Anoda	
										Maila	
1	1									ugurassa	
									1	Halmilla	
										Kahata	
										Weralu	
										Koboleela	
			2		2				1	Naran	
	1							1	1	Alipera	
1	1		1				3			Kanda	
1					1					Karapincha	
	1	1								Attikka	
				1						Ranawara	
				1						Lavalu	
		1								Ambul pera	

ANNEX 6

Environmentally Sencitive Areas


Mahawewa
Kurunegala-Narammala-Madampe
B247
B255
Thoduwawa
Maha Wewa
Nelumpokuna
Railway
Wella Para Rd
Kudamaduwella
Matta Kotuwa
Kudawewa
Railway
Mahawewa
Mahawawa
Aanankalliya
Beach Road
Club Palm Bay
Bogaha Rd
Walahapitiya Rd
Church Rd
Ihala Hathminiya Rd


Negombo lagoon
WELLAWEEDIYA
KAMACHCHODE
Main St
MUNNAKKARA
B322
Baseline Rd
Negombo
Kimbulapitiya
Kurana Railway
ANDIAMBALAMA
B208
Bandaranaike International Airport
Katunayake
Pamunugama Rd
Negombo Lagoon
Katunayaka South Railway
PHASE 2
JAYAWARDANA PURA
Baseline Rd
RADDOLUGAMA
Seeduwa
E03
Seeduwa Railway
Kotugoda Rd
Alawatugoda Railway
B111
Kudahakapola Railway
Raja Mawatha
Ekala
Delathura
Colombo–Katuna
THUDELLA
A33
PAMUNUGAMA

ANNEX 7

Analytical Reports

1. Surface Water

INDUSTRIAL TECHNOLOGY INSTITUTE (ITI)

P. O. Box, 787, 363, Bauddhaloka Mawatha, Colombo 7, Sri Lanka.
Telephone: 0094 011 2379800 Fax: 0094 011 2379850
120/4 A, Vidya Mawatha, Colombo 7, Sri Lanka.
Telephone: 0094 011 2379800 Fax: 0094 011 2379950

TEST REPORT

Reference No: SS 1503912

Report to :

Consulting Engineers & Architects Associated (Pvt) Ltd,
No. 500/5, Thalapathpitiya Road,
Madiwela,
Kotte.

Issued by :

Chemical and Microbiological Laboratory
Industrial Technology Institute

2015/05/10

The Report is issued under the following conditions:

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TEST/CALIBRATION METHODS: In the absence of a specific request from the customer, ITI will adopt any appropriate national/international standard method for conducting the test/calibration. In the absence/non accessibility of standard methods, ITI may adopt any other relevant published test/calibration method or follow a method developed at ITI.

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COPIES OF REPORT: Only one copy of the report will be made available to the customer. Extra copies if necessary could be requested by customer at the time if submission of job and will be provided on the payment of an extra charge. Additional copies of the report endorsed by the Authorized signatory could be made available at the request of the customer within a period of 01 year from the date of issue of report, on a written request by the customer and on payment of an extra charge. No third party can obtain such a report without written authorization from the customer to ITI.

QUERIES ON REPORT: Customer queries on reports will be entertained only up to a period of 01 year from the date of issue of the report.

RETENTION OF TEST ITEMS: Perishable items will be destroyed immediately after testing, other items after 01 month from the date of issue of the report.

RETURN OF TEST ITEMS: Test items will be returned to the customer at the sole discretion of the ITI only on a written request by the customer.

LOSS OR DAMAGE: While the ITI exercises every care in respect of work entrusted to the Institute by customers, the Institute is not liable for any loss/damage howsoever caused to person/property, including property entrusted by customer to the Institute whether such loss, damage or delay may have been caused by reasons beyond the control of the Institute or otherwise.

LITIGATION: All costs associated with litigation or dispute for oral or written testimony or preparation of same or for any other purpose related to work provided by the ITI shall be paid by the customer. Such costs include, but are not limited to hourly charges, travel and accommodation, mileage, counsel, legal fees and all other expenses associated with the said litigation and dispute.

CHANGE OF CONDITIONS: ITI may at its sole discretion add to or amend the conditions of this report at the time of issue of the report and such additions or amendments shall be binding on the customer.

... Continuation Sheet

SWEDAC ACKREDITERING 1791 ISO/IEC 17025

SLAB ACCREDITED ISO/IEC: 17025 TL 004

TEST REPORT

Reference No. SS 1503912

CUSTOMER :	**Test Item : Surface water**
Consulting Engineers & Architects Associated (Pvt) Ltd, No. 500/5, Thalapathpitiya Road, Madiwela, Kotte.	**Service requested :** Sampling and analysis for parameters requested by the customer's letters dated 2015/02/11 & 2015/03/10

Collection points :

Location	Direction	GPS Coordinate
1. Puttalum lagoon	Town area	N-8^0 1'40.01", E-79^{0}49'47.66"*
2. Kalagamu oya	After Baththulu oya	N-7^0 44'17.38", E-79^{0}49'51.05"*
3. Baththulu Oya	Near bridge	N-7^0 44'17.3796", E-79^{0}49'51.0492"
4. Sengal Oya	Near bridge	N-7^0 40'39.89", E-79^{0}50'0.64"*
5. Lunu oya	After Deduru oya	N-7^0 37'3.14", E- 79^{0}48'52.49"*
6. Deduru oya	After Chilaw	N-7^0 36'13.54", E-79^{0}48'44.76"*
7. Karambalana oya (61/1, Calvet)	Mahawewa	N-7^0 27'4408", E-79^{0}49'37.977"
8. Gin Oya (Nainamadama Bridge)	Nainamadama	N-7^0 17'59.6652", E-79^{0}51'3.384"
9. Maha Oya (Thoppuwa Bridge)	Kochchikade	N-7^0 16'20.2476", E-79^{0}51'57.8988"
10. Negambo Lagoon	Katunayaka	N-7^0 9'38.3292", E-79^{0}52'11.4996"
11. Dandugam Oya	Ja Ela	N-7^0 6'36.378", E-79^{0}53'3.9516"

* GPS coordinates given by the customer

Method of sampling : Grab sampling ♣ #

Description at collection : Sample 01 to 06 -Slightly turbid liquid
Sample 07 – Pale yellow colour slightly turbid liquid
Sample 08 – Pale yellow colour turbid liquid
Sample 09 – Pale yellow colour turbid liquid
Sample 10- Turbid liquid with settleable particles
Sample 11- Turbid liquid

Quantity of samples collected : Approximately 03 litres (Samples 01 - 06)
Approximately 02 litres (Samples 07-11)

Sampling carried out by : Ms. I.A.D.A. Swarnamali and Mr. R. Chathuranga of ITI

Witness : Mr. P.P.C. Saumyasiri, Junior Design Engineer from Consulting Engineers & Architect Associated (Pvt) Ltd

Date & Time of sampling : 2015/03/18 from 9.00 a.m – 3.00 p.m (Samples 01 – 06)
2015/04/22 from 10.20 a.m – 3.00 p.m (Samples 07- 11)
(Customer was informed about the visit)

SWEDAC ACKREDITERING 1791 ISO/IEC 17025

SLAB ACCREDITED ISO/IEC: 17025 TL 004

SS 1503912

Temperature of samples at collection	: Sample 01 & 03 - 26^{0}C Sample 02 – 27^{0}C Sample 04-25^{0}C Sample 05-31^{0}C Sample 06- 30^{0}C Sample 07- 28.5^{0}C Sample 08- 32^{0}C Sample 09- 29^{0}C Sample 10- 35^{0}C Sample 11- 29^{0}C
Date & Time of reception of samples at ITI	: 2015/03/18 at 6.30 p.m (Samples 01 – 06) 2015/04/22 at 4.00 p.m (Samples 07 – 11)
Temperature of samples at reception	: 15^{0}C (Samples 01 – 06) 26^{0}C (Sample 07-11)
Condition of samples at reception	: Satisfactory

♣ **SWEDAC** Accredited # **SLAB** Accredited

TEST DETAILS :

Test Method : See Table 01

Test Dates : Sample 1 – 6 2015/03/19 - 2015/03/25
Sample 7 – 11 2015/04/24 – 2015/04/28

TEST RESULTS :

TEST / UNIT	METHOD	RESULTS						L O D	E.U % (K=2)
		01	02	03	04	05	06		
# ♣ pH at 25^{0}C	APHA 4500 – H^+B	7.19	7.31	7.89	7.33	8.11	7.47	-	-
# ♣ Total Suspended Solids at 103^{0}C- 105^{0}C mg/L	APHA 2540 D	3	5	17	5	7	19	-	3
# ♣ BOD $_5$ at 20^{0}C mgO_2/L	APHA 5210 B	2	ND	ND	ND	ND	2	2	4
# ♣ Chemical Oxygen Demand (COD) $mg/O_2/L$	Modified APHA 5220 D	19	25	39	28	13	61	-	4
Oil & Grease mg/L	APHA 5520 B	ND	ND	ND	ND	ND	ND	2	-

... Continuation Sheet

SWEDAC ACKREDITERING 1791 ISO/IEC 17025

SLAB ACCREDITED ISO/IEC: 17025 TL 004

SS 1503912

TEST / UNIT	METHOD	RESULTS					L O D	E.U % (K=2)
		07	08	09	10	11		
# ♣ pH at 25^{0}C	APHA 4500 – H^+B	6.35	6.80	6.80	6.75	6.30	-	-
# ♣ Total Suspended Solids at 103^{0}C - 105^{0}C mg/L	APHA 2540 D	10	10	22	30	20	-	3
# ♣ BOD $_5$ at 20^{0}C mgO_2/L	APHA 5210 B	ND	ND	ND	ND	ND	2	4
# ♣ Chemical Oxygen Demand (COD) $mg/O_2/L$	Modified APHA 5220 D	45	60	20	45	45	-	4
Oil & Grease mg/L	APHA 5520 B	ND	ND	ND	ND	ND	2	-

APHA – Standard Methods for the examination of water and waste water APHA, AWWA , WEF, 2005 21st edition

♣ SWEDAC Accredited test. # SLAB Accredited test E. U - Expanded Uncertainty

L.O.D – Limit of Detection ND – Not detected

Analyses was carried out by Ms. Y. Pitawela – Laboratory Technologisty and Ms. H. Sarathchandra – Technical Assistant

.....
Authorized Signatory

J.K.A. Bandulasoma Wijegunasekara
Senior Deputy Director
Chemical & Microbiological Laboratory
Industrial Technology Institute

2015/05/10
/dpc

Page 05 of 05 pages

2. Ground Water

INDUSTRIAL TECHNOLOGY INSTITUTE (ITI)

P. O. Box, 787, 363, Bauddhaloka Mawatha, Colombo 7, Sri Lanka.
Telephone: 0094 011 2379800 Fax: 0094 011 2379850
120/4 A, Vidya Mawatha, Colombo 7, Sri Lanka.
Telephone: 0094 011 2379800 Fax: 0094 011 2379950

SWEDAC ACKREDITERING 1791 ISO/IEC 17025

SLAB ACCREDITED ISO/IEC: 17025 TL 004

TEST REPORT

Reference No: SS 1503913

Report to :

Consulting Engineers & Architects Associated (Pvt) Ltd,
No. 500/5, Thalapathpitiya Road,
Madiwela,
Kotte.

Issued by :

Chemical and Microbiological Laboratory
Industrial Technology Institute

2015/05/11

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... Continuation Sheet

TEST REPORT

Reference No. SS 1503913

ISO/IEC: 17025
TL 004

CUSTOMER :	Test Item : Water
Consulting Engineers & Architect s Associated (Pvt) Ltd, No. 500/5, Thalapathpitiya Road, Madiwela, Kotte.	**Service requested :** Sampling and analysis for parameters requested by the customer's letter dated 2015/02/11

Collection points :

Location	Direction	GPS Coordinate
Rathmalyaya	In between Palavi junction & Puttalum town	N - 8^0 1'43.95", E- $79^0$49'43.4748"
Kiriyankalli	After Baththuluoya	N-7^0 45'50.0112" E-$79^0$49'43.7592"
Chilaw	After the town	N- 8^0 1'43.95", E- $79^0$49'43.4748"
Madampe	After Thaniwelle Devalaya	N- 7^0 28'24.2724", E- $79^0$49'40.6452"
Katuneriya	No. 482/2 Chilaw road, Katuneriya	N- 7^0 22'12.918", E- $79^0$49'55.344"
Kurana	No-475, Kurana, Colombo Road, Negombo	N- 7^0 11'54.3984", E- $79^0$51'16.65"

Method of sampling : Grab sampling ♠ #

Description at collection : Sample 01, 03, 04 & 05 : Clear colourless water

Sample 02 : Clear colourless water with fine settleable particles

Sample 06: Slightly yellowish water with fine settleable particles

Quantity of samples collected : Sample (01 – 03) : Six litres in a plastic can, a glass bottle & 200 mL in a sterilized bottle . (each sample)

Sample (04 – 06) : Three litres in plastic cans, a glass bottle & 200 mL in a sterilized bottle. (each sample)

Sampling carried out by : Ms. I.A.D.A. Swarnamali & Mr. R. Chathuranga of ITI

Witness : Mr. P.P.C. Saumyasiri, Junior Design Engineer from Consulting Engineers & Architects Associated (Pvt) Ltd

Date & Time of sampling : Sample (01 – 03) : 2015/03/18 from 9.45 a.m – 3.45 p.m
Sample (04 – 06) : 2015/04/23 from 10.45 a.m – 2.00 p.m
(Customer was informed about the visits)

Temperature of samples at collection : Sample (01) : 25^0C Sample (02) : 26^0C
Sample (03) : 26^0C Sample (04) : 31^0C
Sample (05) : 28.5^0C Sample (06) : 33^0C

Date & Time of reception of samples at ITI : Sample (01 – 03) : 2015/03/18 at 6.30 p.m
Sample (04 – 06) : 2015/04/23 at 4.00 p.m

Temperature of samples at reception : Sample (01 – 03) 15^0C, Sample (04 – 06) 26^0C } Stored in a cooling box

Condition of samples at reception : Satisfactory

♠ **SWEDAC** Accredited # **SLAB** Accredited

Test Dates : Sample (01 – 03) : 2015/03/18 - 2015/03/25
Sample (04 – 06) : 2015/04/23 - 2015/05/06

SS 1503913

TEST RESULTS : Sample 01

Test	Unit	Method	Results	L.O.D	E.U % (K =2)
Colour	HzU	APHA 2120 B	Not detected	5	-
# ♣ Turbidity	NTU	APHA 213 0 B	Not detected	1.0	-
# ♣ pH at 25°C*	-	APHA 4500 – H^+B	7.71	-	-
# ♣ Electrical Conductivity at 25°C	µS/cm	APHA 2510 B	2820	-	4
Chloride (as Cl)	mg/L	APHA 4110 B	201	-	-
# ♣ Total Alkalinity (as $CaCO_3$)	mg/L	APHA 2320 B	427	-	4
Free Ammonia (as NH_3)	mg/L	SLS 614 : 2013 Appendix A	Not detected	0.02	-
Nitrate (as NO_3^-)	mg/L	APHA 4110 B	163	-	-
# ♣ Total Hardness (as $CaCO_3$)	mg/L	APHA 2340 C	273	-	4
# ♣ COD	mg/L	Modified APHA 5220 D	12	-	7
# ♣ Total Solids	mg/L	APHA 2540 B	1900	-	5
Oil & Grease	mg/L	APHA 5520 B	Not detected	2	-
Phenolic compounds (as C_6H_5OH)	mg/L	APHA 5530 B & D	Not detected	0.1	-

Sample 02

Test	Unit	Method	Results	L.O.D	E.U % (K =2)
Colour (settled)	HzU	APHA 2120 B	Not detected	5	-
# ♣ Turbidity (settled)	NTU	APHA 213 0 B	Not detected	1.0	-
# pH at 26°C*	-	APHA 4500 – H^+B	7.19	-	-
# ♣ Electrical Conductivity at 25°C	µS/cm	APHA 2510 B	394	-	4
Chloride (as Cl)	mg/L	APHA 4110 B	16	-	-
# ♣ Total Alkalinity (as $CaCO_3$)	mg/L	APHA 2320 B	178	-	4
Free Ammonia (as NH_3)	mg/L	SLS 614 : 2013 Appendix A	0.10	-	-
Nitrate (as NO_3^-)	mg/L	APHA 4110 B	11.5	-	-
# ♣ Total Hardness (as $CaCO_3$)	mg/L	APHA 2340 C	168	-	4
# ♣ COD	mg/L	Modified APHA 5220 D	27	-	4
# ♣ Total Solids	mg/L	APHA 2540 B	250	-	5
Oil & Grease	mg/L	APHA 5520 B	Not detected	2	-
Phenolic compounds (as C_6H_5OH)	mg/L	APHA 5530 B & D	Not detected	0.1	-

SS 1503913

TEST RESULTS : Sample 03

Test	Unit	Method	Results	L.O.D	E.U % (K =2)
Colour	HzU	APHA 2120 B	Not detected	5	-
# ♣ Turbidity	NTU	APHA 213 0 B	Not detected	1.0	-
# pH at 26°C*	-	APHA 4500 – H^+B	7.64	-	-
# ♣ Electrical Conductivity at 25°C	µS/cm	APHA 2510 B	1416	-	4
Chloride (as Cl)	mg/L	APHA 4110 B	486	-	-
# ♣ Total Alkalinity (as $CaCO_3$)	mg/L	APHA 2320 B	95	-	4
Free Ammonia (as NH_3)	mg/L	SLS 614 : 2013 Appendix A	0.08	-	-
Nitrate (as NO^-_3)	mg/L	APHA 4110 B	13.4	-	-
# ♣ Total Hardness (as $CaCO_3$)	mg/L	APHA 2340 C	255	-	4
# ♣ COD	mg/L	Modified APHA 5220 D	11	-	7
# ♣ Total Solids	mg/L	APHA 2540 B	950	-	5
Oil & Grease	mg/L	APHA 5520 B	Not detected	2	-
Phenolic compounds (as C_6H_5OH)	mg/L	APHA 5530 B & D	Not detected	0.1	-

Sample 04

Test	Unit	Method	Results	L.O.D	E.U % (K =2)
Colour	HzU	APHA 2120 B	Not detected	5	-
# ♣ Turbidity	NTU	APHA 213 0 B	1.0	-	20
# pH at 31°C*	-	APHA 4500 – H^+B	6.64	-	-
# ♣ Electrical Conductivity at 25°C	µS/cm	APHA 2510 B	1073	-	4
# ♣ Chloride (as Cl)	mg/L	APHA 4500 –Cl B	271	-	4
# ♣ Total Alkalinity (as $CaCO_3$)	mg/L	APHA 2320 B	55	-	4
Free Ammonia (as NH_3)	mg/L	SLS 614 : 2013 Appendix A	Not detected	0.02	-
# ♣ Nitrate (as NO^-_3)	mg/L	APHA 4500 – NO_3^- B	3.2	-	4
# ♣ Total Hardness (as $CaCO_3$)	mg/L	APHA 2340 C	69	-	4
# ♣ COD	mg/L	Modified APHA 5220 D	Not detected	5	-
# ♣ Total Solids	mg/L	APHA 2540 B	572	-	5
Oil & Grease	mg/L	APHA 5520 B	Not detected	2	-
Phenolic compounds (as C_6H_5OH)	mg/L	APHA 5530 B & D	Not detected	0.1	-

... Continuation Sheet

SS 1503913

TEST RESULTS : Sample 05

Test	Unit	Method	Results	L.O.D	E.U % (K =2)
Colour	HzU	APHA 2120 B	Not detected	5	-
# ♣ Turbidity	NTU	APHA 213 0 B	Not detected	1.0	-
# pH at 28.5°C*	-	APHA 4500 – H^+B	8.32	-	-
# ♣ Electrical Conductivity at 25°C	µS/cm	APHA 2510 B	265	-	4
# ♣ Chloride (as Cl)	mg/L	APHA 4500 –Cl B	49	-	4
# ♣ Total Alkalinity (as $CaCO_3$)	mg/L	APHA 2320 B	19.8	-	4
Free Ammonia (as NH_3)	mg/L	SLS 614 : 2013 Appendix A	Not detected	0.02	-
♣ Nitrate (as NO^-_3)	mg/L	APHA 4500 – NO_3^-B	12.1	-	4
# ♣ Total Hardness (as $CaCO_3$)	mg/L	APHA 2340 C	40	-	4
# ♣ COD	mg/L	Modified APHA 5220 D	Not detected	5	-
# ♣ Total Solids	mg/L	APHA 2540 B	155	-	5
Oil & Grease	mg/L	APHA 5520 B	Not detected	2	-
Phenolic compounds (as C_6H_5OH)	mg/L	APHA 5530 B & D	Not detected	0.1	-

Sample 06

Test	Unit	Method	Results	L.O.D	E.U % (K =2)
Colour	HzU	APHA 2120 B	10	-	-
# ♣ Turbidity (settled)	NTU	APHA 213 0 B	Not detected	1.0	-
# pH at 33°C*	-	APHA 4500 – H^+B	6.02	-	-
# ♣ Electrical Conductivity at 25°C	µS/cm	APHA 2510 B	450	-	4
# ♣ Chloride (as Cl)	mg/L	APHA 4500 –Cl B	45	-	4
# ♣ Total Alkalinity (as $CaCO_3$)	mg/L	APHA 2320 B	119	-	4
Free Ammonia (as NH_3)	mg/L	SLS 614 : 2013 Appendix A	Not detected	0.02	-
# ♣ Nitrate (as NO^-_3)	mg/L	APHA 4500 – NO_3^-B	4.1	-	4
# ♣ Total Hardness (as $CaCO_3$)	mg/L	APHA 2340 C	138	-	4
# ♣ COD	mg/L	Modified APHA 5220 D	33	-	4
# ♣ Total Solids	mg/L	APHA 2540 B	290	-	5
Oil & Grease	mg/L	APHA 5520 B	Not detected	2	-
Phenolic compounds (as C_6H_5OH)	mg/L	APHA 5530 B & D	Not detected	0.1	-

SS 1503913

TEST RESULTS : Sample 05

Test	Unit	Method	Results	L.O.D	E.U % (K =2)
Colour	HzU	APHA 2120 B	Not detected	5	-
# ♣ Turbidity	NTU	APHA 213 0 B	Not detected	1.0	-
# pH at 28.5°C*	-	APHA 4500 – H^+B	8.32	-	-
# ♣ Electrical Conductivity at 25°C	µS/cm	APHA 2510 B	265	-	4
# ♣ Chloride (as Cl)	mg/L	APHA 4500 –Cl B	49	-	4
# ♣ Total Alkalinity (as $CaCO_3$)	mg/L	APHA 2320 B	19.8	-	4
Free Ammonia (as NH_3)	mg/L	SLS 614 : 2013 Appendix A	Not detected	0.02	-
♣ Nitrate (as NO^-_3)	mg/L	APHA 4500 – NO_3^-B	12.1	-	4
# ♣ Total Hardness (as $CaCO_3$)	mg/L	APHA 2340 C	40	-	4
# ♣ COD	mg/L	Modified APHA 5220 D	Not detected	5	-
# ♣ Total Solids	mg/L	APHA 2540 B	155	-	5
Oil & Grease	mg/L	APHA 5520 B	Not detected	2	-
Phenolic compounds (as C_6H_5OH)	mg/L	APHA 5530 B & D	Not detected	0.1	-

Sample 06

Test	Unit	Method	Results	L.O.D	E.U % (K =2)
Colour	HzU	APHA 2120 B	10	-	-
# ♣ Turbidity (settled)	NTU	APHA 213 0 B	Not detected	1.0	-
# pH at 33°C*	-	APHA 4500 – H^+B	6.02	-	-
# ♣ Electrical Conductivity at 25°C	µS/cm	APHA 2510 B	450	-	4
# ♣ Chloride (as Cl)	mg/L	APHA 4500 –Cl B	45	-	4
# ♣ Total Alkalinity (as $CaCO_3$)	mg/L	APHA 2320 B	119	-	4
Free Ammonia (as NH_3)	mg/L	SLS 614 : 2013 Appendix A	Not detected	0.02	-
# ♣ Nitrate (as NO^-_3)	mg/L	APHA 4500 – NO_3^-B	4.1	-	4
# ♣ Total Hardness (as $CaCO_3$)	mg/L	APHA 2340 C	138	-	4
# ♣ COD	mg/L	Modified APHA 5220 D	33	-	4
# ♣ Total Solids	mg/L	APHA 2540 B	290	-	5
Oil & Grease	mg/L	APHA 5520 B	Not detected	2	-
Phenolic compounds (as C_6H_5OH)	mg/L	APHA 5530 B & D	Not detected	0.1	-

3. Air Quality

Baseline Ambient Air Quality Monitoring Report

for

Road projects from Ja-Ela to Puttalam section of Peliyagoda / Puttalam (A 003) Road and Avissawella to Pelmadulla section of Colombo / Batticaloa Road (A 004) and Pelmadulla / Padalangala section of Pelmadulla / Nonagama Road (A 018)

Consulting Engineers & Architects Associated (Pvt) Ltd.

500/5, Thalapathpitiya Road,

Madiwela, Kotte.

Sri Lanka

Conducted by

Environmental Laboratory & Consultancy Services (ELCS)

889 1/3, Maradana Road, Colombo 10, Sri Lanka. Tel. 0094112684242

on

09 & 10 March 2015

CEA Registered Consultant / Specialist (07/LM/Cons/76/2011)

Contact us on:

manager@labenvi.com,

www.labenvi.com

0112684242, 0712733779, 0778351657, 0716400365, 0776174778

Environmental Laboratory & Consultancy Services (ELCS)
889 1/3 Room No. 3, 1st Floor, Maradana Road
Colombo 10, Sri Lanka
Tel / Fax 011 3031662

Reference No: 15030200793

Table of contents

Ambient Air Quality) Report

Puttalam & Ratnapura Road Project (A 003, A 004 & A 018), Ref: 15030200793

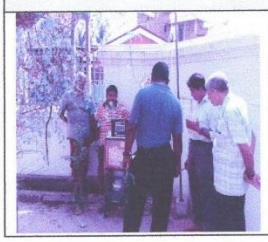
1. Introduction

M/s Consulting Engineers and Architects Associated (Pvt) Ltd of has requested to conduct baseline monitoring of ambient air quality for Ja-Ela to Puttalam section of Peliyagoda / Puttalam (A 003) Road and Avissawella to Pelmadulla section of Colombo / Batticaloa Road (A 004) and Pelmadulla / Padalangala section of Pelmadulla / Nonagama Road (A 018).

Air quality monitoring survey was conducted on 9 & 10 March 2015 by a team of ELCS / NBRO on Puttalam Road and Ratnapura Road respectively. A representative (Mr. Chamara Saumyasiri) of the client witnessed the testing at Madampe on 9 March 2015.

2. Site Description

All selected sites are located by the Puttalam Road or Ratnapura / Pelmadulla Road in order to represent the area going to be affected when construction begins and priority was given to select public gathering area for worshipping or daily works.

09 March 2015	09 March 2015	10 March 2015	10 March 2015
Madampe (Taniwelle Dewalaya)	Mundel Sri Bodi Rajaramaya	Ratnapura (Depot Junction)	Pelmadulla (Pradeshiya Sabha)
7° 15′ 36.44″N 80° 5′ 36.43″E	7° 48′ 15.34″N 79° 49′ 33.27″E	6° 42′ 29.17″N 80° 22′ 37.20″E	6° 38′ 3.91″N 80° 29′ 59.14″E
			

3. Methodology and Guidance

Please see below tables. Methods and monitoring time period (averaging time) in accordance with CEA air quality regulations.

4. Air Quality Monitoring Results

Table 1

Date: 09 March 2015					
Madampe Tani Welle Dewalaya					
Pollutant	**Averaging Time (hr)**	**Measured Results**	**Unit**	**Method**	**CEA Standard**
Particulate Matter (PM10)	24	25	µg / m3	High volume sampling & Gravimetric	100
Particulate Matter (PM2.5)	24	12	µg / m3	High volume sampling & Gravimetric	50
Sulfur Oxides (SOx)	8	12	µg / m3	Pararosanililene Method	120
Nitrogen Oxides (NOx)	8	17	µg / m3	Colorimetric using Saltzman method	150
Carbon Monoxide (CO)	8	1	ppm	Non Dispersive Infra Red (NDIR)	9

Table 2

Date: 09 March 2015					
Mundel (Sri Bodhi Rajaramay)					
Pollutant	**Averaging Time (hr)**	**Measured Results**	**Unit**	**Method**	**CEA Standard**
Particulate Matter (PM10)	18	21	µg / m3	High volume sampling & Gravimetric	100
Particulate Matter (PM2.5)	18	10	µg / m3	High volume sampling & Gravimetric	50
Sulfur Oxides (SOx)	8	9	µg / m3	Pararosanililene Method	120
Nitrogen Oxides (NOx)	8	14	µg / m3	Colorimetric using Saltzman method	150
Carbon Monoxide (CO)	8	1	ppm	Non Dispersive Infra Red (NDIR)	9

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Table 3

Date: 10 March 2015					
Ratnapura Dept Junction (Beside Omelga Hotel)					
Pollutant	**Averaging Time (hr)**	**Measured Results**	**Unit**	**Method**	**CEA Standard**
Particulate Matter (PM10)	18	69	µg / m3	High volume sampling & Gravimetric	100
Particulate Matter (PM2.5)	18	22	µg / m3	High volume sampling & Gravimetric	50
Sulfur Oxides (SOx)	8	24	µg / m3	Pararosanililene Method	120
Nitrogen Oxides (NOx)	8	64	µg / m3	Colorimetric using Saltzman method	150
Carbon Monoxide (CO)	8	3	ppm	Non Dispersive Infra Red (NDIR)	9

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Table 4

Date: 10 March 2015					
Pelmadulla Pradeshiya Sabha (beside Library)					
Pollutant	**Averaging Time (hr)**	**Measured Results**	**Unit**	**Method**	**CEA Standard**
Particulate Matter (PM10)	18	27	µg / m3	High volume sampling & Gravimetric	100
Particulate Matter (PM2.5)	18	12	µg / m3	High volume sampling & Gravimetric	50
Sulfur Oxides (SOx)	8	17	µg / m3	Pararosanililene Method	120
Nitrogen Oxides (NOx)	8	20	µg / m3	Colorimetric using Saltzman method	150
Carbon Monoxide (CO)	8	2	ppm	Non Dispersive Infra Red (NDIR)	9

5. Conclusions & Recommendations

1. Measured levels of all pollutants are below the levels stipulated by Central Environmental Authority of Sri Lanka.

G. Subasinghe
Laboratory Manager`

Susil Seneviratne
Senior Environmental Engineer

6

4. Noise

INDUSTRIAL TECHNOLOGY INSTITUTE (ITI)

P. O. Box, 787, 363, Bauddhaloka Mawatha, Colombo 7, Sri Lanka.
Telephone: 0094 011 2379800 Fax: 0094 011 2379850
120/4 A, Vidya Mawatha, Colombo 7, Sri Lanka.
Telephone: 0094 011 2379800 Fax: 0094 011 2379950

ISO/IEC 17025
TL 004-04

Monitoring of Background Noise Levels and Existing Noise Levels

Report No. SS – 1504155

Report to :
Consulting Engineers & Architects Associated (Pvt.) Ltd.
No 505/5, Thalapathpitiya Road,
Madiwela,
Kotte.

Issued By:
Noise & Vibration Group
Electro Technology Laboratory

2015 March, 31

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Monitoring of Background Noise Levels And Existing Noise Levels

Report No. SS – 1504155

1. Customer :

Consulting Engineers & Architects Associated (Pvt.) Ltd.
No 505/5, Thalapathpitiya Road,
Madiwela,
Kotte.

2. Scope of the project:

To determine the background noise levels and existing noise levels , at specified selected locations that are most affected (or that will be most affecting) by noise, from traffic noise , during the day time & night time for Ja-ela to Puttlam section of Peliyagoda Puttlam (A003) Road.

3. Locations of project :

Background noise level shall be carried out during day time & night time in following locations which are selected based on densely populated areas & near common facilities along the road.

Measurement locations are

Measurement Locations		Details
L1	Puttlam	Near buddhist center
L2	Erukkalampiddy	Near mosque - Nugawilluwa
L3	Mundal RDA depot	proposed asphalt plant
L4	Bangadeniya	Near church
L5	Jayabima ,Chillaw	Near Sama viharaya temple
L6	Chillaw	Near district general hospital
L7	Madampe	Bend near thaniwella devalaya
L8	Wennappuwa	Near St.Joseph's church
L9	Negombo	Near Maris Stella chool
L10	Seeduwa	Near Wijaya kumarathunga memorial hospital

4. Definitions

4.1 Background noise level

The background noise level is defined as the underlying level of noise present on ambient noise where all unusual extraneous noise is removed. Sounds contributing to background noise can include, sound from nearby traffic, industries, machinery, birds, insects, animals and similar sources including human activities are the normal features of the location. The background noise level is measured using $L_{A90,\ 15min}$ descriptor.

4.2 Rating background level (RBL)

The overall single figure background level representing each assessment period day, evening and night over the whole monitoring period. Rating background level is determined by the **median value** of day, evening and night.

4.3 Existing noise level (ENL)

The existing noise levels is determined as the logarithmic average of individual $L_{Aeq,\ 15min}$ levels of each day, evening and night time periods or day, evening/night time period.

4.4 Equivalent continuous sound pressure level ($L_{Aeq,T}$)

The equivalent steady sound level in dB containing the same acoustic energy as the actual fluctuating sound level over the given period, T

5. Assessment period

5.1 Three hour background and existing noise level measurements

Background noise measurements were carried out at ten locations, the period is given below.

Day Time - Two hour at each location between 0700h to 1800h
Evening/Night time - One hour at each location between 1800h to 2400h

6. Instrumentation details

The following instruments and software used to determine the background noise levels

Noise data logger : Modular precision Level Analyzer, Bruel and Keajer Type 2250, 2270 Enhanced sound analysis software BZ 7202 versions 2, Bruel and Keajer

Field calibrator : Bruel and Keajer type 4231 acoustic calibrator traceable to primary standards maintained at Korea Research Institute of Standards and Science (KRISS).

7. Measurement procedure

7.1 Noise level

The noise level measurements were carried out in accordance with the test method MM /SL/ 04- Monitoring of background noise level and existing noise level. The following steps involved in background noise level monitoring.

Calibrated the sound level analyser using acoustic calibrator at the site before environmental measurements.

Measurements carried out at least 3.5 m away from any reflecting structure other than the ground to minimize the influence of reflections. Measurement height of the microphone 1.5 m above the ground.

Monitoring of background noise levels ($L_{A90,\ 15min}$ and $L_{Aeq,\ 15min}$)

7.2 The team Involved in noise monitoring programme

L.A.M.N.Pushpakumara	Technical Officer
K.K.N.Darshana	Technical Assistant
P.N.Alagiyawanna	Technical Assistant

8. Result

The results of the measurements carried out by ITI are given in the tables below;

8.1 Summary of noise level measurement data for ten measurement locations are presented on following table (day, evening/night. – 3 hour location)

Noise Level Results - Short Term Location

Date	Measurement Location		Assessment time period			
			ENL dB(A)		RBL dB(A)	
			Day	Night	Day	Night
10th March 2015	L1	8° 01' 08" N 79° 50' 03" E	66	57	64	47
10th March 2015	L2	7° 57' 45" N 79° 49' 50" E	61	57	54	49
09th March 2015	L3	7° 47' 50" N 79° 49' 31" E	64	62	52	47
09th March 2015	L4	7° 37' 43" N 79° 49' 21" E	66	62	55	51
09th March 2015	L5	7° 35' 41" N 79° 48' 18" E	67	65	62	60
10th March 2015	L6	7° 34' 21" N 79° 47' 50" E	70	69	62	61
10th March 2015	L7	7° 28' 38" N 79° 49' 48" E	68	66	62	60
09th March 2015	L8	7° 20' 25" N 79° 50' 31" E	68	67	61	60
09th March 2015	L9	7° 12' 46" N 79° 50' 52" E	70	68	64	62
09th March 2015	L10	7° 07' 33" N 79° 52' 39" E	69	68	62	63

ENL - Existing noise level ($L_{Aeq,h}$) h-hour
RBL - Rating background level ($L_{A90,15min}$)

Day time - Two hour at each location between 0700h to 1800h
Evening/night time - One hour at each location between 1800h to 2400h

8.2 Measurement data

Annexure 1 : Noise level measurements locations (GPS co-ordinates)
Annexure 2 : Method for determining the tenth percentile value
Annexure 3 : Definitions of terms
Annexure 4 : Measurement data of Noise level

9.0 Reference documents

- NSW Industrial Noise Policy 2000 -Environmental Protection Authority, Australia.
- IEC 61672-1: (2002-05) – Electroacoustic - Sound Level Meters - Specification
- ISO 1996, International Organization for Standardization, Geneva Acoustics – *Description, measurement and assessment of environmental noise*

  Part 1. Basic quantities and assessment procedures (second edition 2003-08-01)

  Part 2. Determination of environmental noise levels (second edition 2007-03-15)
- BS 4142:1997 Method for rating industrial noise affecting mixed residential and industrial areas, British Standards Institution (BSI), London 1997.

Authorized by

C.M.KALANSURIYA
B.Sc(hons),M.Phil,MIP(SL),CPhys(SL)
Research Scientist
Electro Technology Laboratory
Industrial Technology Institute

2015, March 31

Performed by

L.A.M.N.Pushapakumara
Technical Officer

Industrial Technology Institute

Noise level measurement for base line monitoring of Ja-Ela to Puttlam section of Peliyagoda Puttlam (A003) road

Noise level measurements locations

Measurement Location	G.P.S. Point	Location
L1	8° 01' 08" N 79° 50' 03" E	Puttlam – Near buddhist center
L2	7° 57' 45" N 79° 49' 50" E	Erukkalampiddy – Near mosque - Nugawilluwa
L3	7° 47' 50" N 79° 49' 31" E	Mundal RDA depot – proposed asphalt plant
L4	7° 37' 43" N 79° 49' 21" E	Bangadeniya – Near church
L5	7° 35' 41" N 79° 48' 18" E	Jayabima ,Chillaw – Near sama viharaya temple
L6	7° 34' 21" N 79° 47' 50" E	Chillaw – Near district general hospital
L7	7° 28' 38" N 79° 49' 48" E	Madampe – Bend near thaniwelle devalaya
L8	7° 20' 25" N 79° 50' 31" E	Wennappuwa – Near St.Joseph's church
L9	7° 12' 46" N 79° 50' 52" E	Negombo – Near Maris Stella school
L10	7° 07' 33" N 79° 52' 39" E	Seeduwa – Near Wijaya kumarathunga memorial hospital

1. Method for determining the tenth percentile value

Step 1	Sort the $L_{A90,\ 15\ minutes}$ data in each assessment period in **ascending** order.
Step 2	Work out the tenth per cent **position** of the number of samples in the assessment period. This can be calculated by multiplying the number of $L_{A90,\ 15\ minutes}$ values in the assessment period by 0.1
Step 3	Determine the tenth percentile (essentially the lowest tenth per cent value). If the tenth per cent position (from Step 2) is an integer, then the tenth percentile is determined by taking the arithmetic average of the value of the $L_{A90,\ 15\ minutes}$ at the tenth per cent position and the next highest value. If the tenth per cent position (from step 2) is not an integer, then the tenth percentile is the next highest $L_{A90,\ 15\ minutes}$ value above the value at the tenth per cent position. Examples : 1. For a data set of size 40, the tenth per cent position is 4 (i.e. 0.1 x 40). As this is an integer, the tenth percentile is the average of the values at the 4th position and the 5th position, counting from the lowest value of the sorted data (from Step 1) 2. For a data set of size 44, the tenth per cent position is 4.4 (i.e. 0.1 x 44). As this value is not an integer, the tenth percentile is the value at the 5th position counting from the lowest value of the sorted data (from Step 1)

2. Method for determining Median Test

Median' is the middle value in a number of values. For an odd number of values, the value of the median is simply the middle value in a number of values ranked in ascending or descending order. For an even number of values, the median is the arithmetic average of the two middle values.

3. Method for determining the existing L_{Aeq} noise levels

Risk of noise impact	Measurement period[1]	Definition of existing level
Low risk	One day-covering the defined day/evening/night periods relevant to the periods the proposed development would operate.	The Logarithmic average[2] of individual $L_{Aeq,\ 15\ minutes}$ levels for each day/ evening/ night assessment period over the measurement period.

Notes :

1. *It is recommended that the L_{Aeq} be measured on a 15 - minute basis.*

2. *Logarithmic average* $= 10\log_{10}\left(\left(\sum_{i=1}^{n} 10^{\left(L_{Aeq,15\ min,\frac{i}{10}}\right)}\right)/n\right)$

where n = number of $L_{Aeq,\ 15\ min}$ values in each assessment period over the measurement period.

Definitions of terms

Adverse weather :
Weather effects that enhance noise (that is, wind and temperature invertions) that occur at a site for a significant period of time (that is, wind occuring more than 30% of the time in any assessment period in any season and/or temperature inversions occuring more than 30% of the nights in winter),

Ambient noise :
The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.

Assessment period :
The period in a day over which assessment are made:day (0700h to 1800h), evening (1800h to 2200h) or night (2200h to 0700h).

Assessment background level (ABL)
The single figure background level representing each assessment period-day, evening and night (that is three assessment background levels are determined for each 24h period of the monitoring period). Its determination is by the tenth percentile method described in Appendix A.

Background noise :
The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L_{A90} descriptor.

C-weighted :
C-weighting is an adjustment made to sound level measurements which takes account of low-frequency components of noise within the audibility range of humans.

Construction activities :
Activities that are related to the establishment phase of a development and that will occur on a site for only a limited period of time.

Cumulative noise level :
The total level of noise from all sources.

dB :
Abbreviation for decibel - a unit of sound measurement. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

dB(A) :
Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound level measurement to approximate the response of the human ear.

Default parameters :
In assessing meteorological enhancement of noise, refers to set values for weather parameters, such as wind speeds and temperature gradients. to be used in predicting source noise levels.

Equivalent continuous noise level:
The level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Extraneous noise :
Noises resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.

L_{A90} :
The A-weighted sound pressure level that is exceeded for 90 per cent of the time over which a given sound is measured. This is considered to represent the background noise.

L_{Aeq} :
The equivalent continuous noise level - the level of noise equivalent to the energy, average of noise levels occuring over a measurement period.

Low frequency :
Noise containing major components in the low-frequency range (20Hz to 250 Hz) of the frequency spectrum.

Median :
The middle value in a number of values sorted in ascending or descending order. Hence, for an odd number of values, the value of the median is simply the middle value. If there is an even number of values the median is the arithmetic average of the two middle values.

Meteorological conditions :
Wind and temperature inversion conditions.

Most affected location(s) :
Locations that experience (or well experience) the greatest noise impact from the noise source under consideration. In determining these locations, one needs to consider existing background levels, exact noise source location(s), distance from source (or proposed source) to receiver, and any shielding between source and receiver.

Receiver :
The noise-sensitive land use at which noise from a development can be heard.

ISO/IEC 17025
TL 004 - 04

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Noise level measurement for base line monitoring of Ja-Ela to Puttlam section of Peliyagoda Puttlam (A003) road

Measurements details – 03 hour short term background noise monitoring

Measurement point : Location L1 - Puttlam – Near buddhist center
Date of measurements : 10th March 2015
G.P.S. location : 8° 01' 08" N
79° 50' 03" E

	Time Interval (15 min.)	Measured Noise Level		Remarks
		L_{Aeq}	$L_{90,15min}$	
Day 1100h – 1300h	1	65	52	Vehicle movement – near the road
	2	64	54	
	3	64	54	
	4	68	53	
	5	65	53	
	6	64	54	
	7	66	55	
	8	66	55	
Evening/Night 2030h – 2130h	1	58	47	Vehicle movement – near the road
	2	57	47	
	3	57	47	
	4	56	46	

Measurement point : Location L2 - Erukkalampiddy –Near mosque
Date of measurements : 10th March 2015
G.P.S. location : 7° 57' 45" N
79° 49' 50" E

	Time Interval (15 min.)	Measured Noise Level		Remarks
		L_{Aeq}	$L_{90,15min}$	
Day 0830h – 1030h	1	64	55	Vehicle movement – near the road
	2	61	54	
	3	61	54	
	4	62	54	
	5	60	54	
	6	60	54	
	7	60	54	
	8	61	54	
Evening/Night 1900h – 2000h	1	56	49	Vehicle movement – near the road
	2	58	49	
	3	57	49	
	4	56	49	

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Noise level measurement for base line monitoring of Ja-Ela to Puttlam section of Peliyagoda Puttlam (A003) road

Measurements details – 03 hour short term background noise monitoring

Measurement point : Location L3 - Mundal RDA depot – proposed asphalt plant
Date of measurements : 09th March 2015
G.P.S. location : 7° 47' 50" N
79° 49' 31" E

	Time Interval (15 min.)	Measured Noise Level		Remarks
		L_{Aeq}	$L_{90,15min}$	
Day 1500h – 1700h	1	64	53	Vehicle movement – near the road
	2	63	52	
	3	63	52	
	4	64	52	
	5	65	52	
	6	65	53	
	7	64	50	
	8	65	52	
Evening/Night 2130h – 2230h	1	61	48	Vehicle movement – near the road
	2	62	46	
	3	62	47	
	4	62	47	

Measurement point : Location L4 - Bangadeniya – Near church
Date of measurements : 09th March 2015
G.P.S. location : 7° 37' 43" N
79° 49' 21" E

	Time Interval (15 min.)	Measured Noise Level		Remarks
		L_{Aeq}	$L_{90,15min}$	
Day 1230h – 1430h	1	65	55	Vehicle movement – near the road
	2	65	54	
	3	66	55	
	4	66	54	
	5	67	56	
	6	66	55	
	7	65	55	
	8	66	55	
Evening/Night 2000h – 2100h	1	62	51	Vehicle movement – near the road
	2	61	50	
	3	62	51	
	4	62	51	

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Noise level measurement for base line monitoring of Ja-Ela to Puttlam section of Peliyagoda Puttlam (A003) road

Measurements details – 03 hour short term background noise monitoring

Measurement point : Location L5 - Jayabima ,Chillaw – Near Sama viharaya
Date of measurements : 09th March 2015
G.P.S. location : 7° 35' 41" N
79° 48' 18" E

	Time Interval (15 min.)	Measured Noise Level		Remarks
		L_{Aeq}	$L_{90,15min}$	
Day 1000h – 1200h	1	66	60	Vehicle movement – near the road
	2	66	58	
	3	67	59	
	4	66	59	
	5	66	58	
	6	67	58	
	7	69	58	
	8	69	58	
Evening/Night 1830h – 1930h	1	65	56	Vehicle movement – near the road
	2	65	53	
	3	65	54	
	4	65	54	

Measurement point : Location L6 - Chillaw – Near District General Hospital
Date of measurements : 10th March 2015
G.P.S. location : 7° 34' 21" N
79° 47' 51" E

	Time Interval (15 min.)	Measured Noise Level		Remarks
		L_{Aeq}	$L_{90,15min}$	
Day 1430h – 1630h	1	70	63	Vehicle movement – near the road
	2	69	62	
	3	70	60	
	4	69	62	
	5	70	63	
	6	70	62	
	7	70	63	
	8	69	62	
Evening/Night 1900h – 2000h	1	68	61	Vehicle movement – near the road
	2	69	61	
	3	67	61	
	4	70	62	

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Noise level measurement for base line monitoring of Ja-Ela to Puttlam section of Peliyagoda Puttlam (A003) road

Measurements details – 03 hour short term background noise monitoring

Measurement point : Location L7 - Madampe – Bend near thaniwelle devalaya
Date of measurements : 10th March 2015
G.P.S. location : 7° 28' 37" N
79° 49' 48" E

	Time Interval (15 min.)	Measured Noise Level		Remarks
		L_{Aeq}	$L_{90,15min}$	
Day 0800h – 1000h	1	68	60	Vehicle movement – near the road
	2	68	61	
	3	69	61	
	4	68	62	
	5	67	62	
	6	67	62	
	7	68	63	
	8	68	62	
Evening/Night 2045h – 2145h	1	66	60	Vehicle movement – near the road
	2	66	60	
	3	61	61	
	4	66	60	

Measurement point : Location L8 - Wennappuwa – Near St.Joseph's church
Date of measurements : 09th March 2015
G.P.S. location : 7° 20' 26" N
79° 50' 32" E

	Time Interval (15 min.)	Measured Noise Level		Remarks
		L_{Aeq}	$L_{90,15min}$	
Day 1500h – 1700h	1	68	62	Vehicle movement – near the road
	2	69	61	
	3	67	61	
	4	68	61	
	5	67	60	
	6	69	62	
	7	68	61	
	8	69	60	
Evening/Night 1815h – 1915h	1	67	60	Vehicle movement – near the road
	2	67	59	
	3	66	60	
	4	68	61	

Industrial Technology Institute

Noise level measurement for base line monitoring of Ja-Ela to Puttlam section of Peliyagoda Puttlam (A003) road

Measurements details – 03 hour short term background noise monitoring

Measurement point : Location L9 - Negombo - Near Maris Stella school & hospital
Date of measurements : 09th March 2015
G.P.S. location : 7° 12' 46" N
79° 50' 52" E

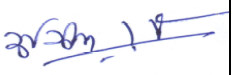
	Time Interval (15 min.)	Measured Noise Level		Remarks
		L_{Aeq}	$L_{90,15min}$	
Day 1130h – 1330h	1	71	64	Vehicle movement – near the road
	2	71	64	
	3	70	64	
	4	70	63	
	5	70	64	
	6	70	64	
	7	70	63	
	8	70	63	
Evening/Night 1945h – 2045h	1	68	61	Vehicle movement – near the road
	2	68	62	
	3	67	62	
	4	68	61	

Measurement point : Location L10 - Seeduwa – Near Wijaya kmarathunga memorial hospital
Date of measurements : 09th March 2015
G.P.S. location : 7° 07' 35" N
79° 52' 38" E

	Time Interval (15 min.)	Measured Noise Level		Remarks
		L_{Aeq}	$L_{90,15min}$	
Day 0830h – 1030h	1	69	63	Vehicle movement – near the road
	2	69	62	
	3	68	62	
	4	68	62	
	5	68	62	
	6	69	63	
	7	69	62	
	8	69	63	
Evening/Night 2115h – 2215h	1	67	61	Vehicle movement – near the road
	2	67	62	
	3	68	63	
	4	68	63	

ANNEX 8

List of Preparers

Name	Position	Qualifications	Duties carried out	Signature
Mrs. Ramani Ellepola	Team Leader	B.Sc.special degree in Chemistry M.Sc.(Environmental Science),Chartered Chemist, MSLAAS (SL), MIEP(SL)	Overall team direction, formulation of the report	
Mr. D.A.J. Ranwala	Hydrologist	B.Sc.(Eng.), M.Eng, FIE(SL), C.Eng., MIEP(SL) Chartered Environmentalist	Hydrological and drainage aspects	
Prof. Ajantha de Alwis	Ecologist	PhD, M.Sc. Degree in Fisheries Biology, B.Sc. special Degree in Zoology, MSLAAS (SL), MSLAFAR, MIOB(SL)	Ecological analysis and mitigation	
Mr. H N Gunadasa	Environmental Engineer	PG Dip - Environmental Engineering & Management, B.Sc Eng (Chemical) University of Moratuwa	Air quality- water quality, noise, vibration, waste including hazardous waste.	

ANNEX 9

Minutes of Consultation Meetings

Minutes of the Stakeholder Meeting Held at Divisional Secretariat at Mahaweva

Venue: Auditorium of the Divisional Secretariat at Maweva

Date and Time: March 02, 2015 at 2.30 pm

Number of Participants: 191 (Attendance sheets attached)

The meeting started at 2.30 as had been scheduled. Meeting was attended by a large number of stakeholders, mostly the people who have shown an interest in the proposed project. Although 191 stake holders have marked their attendance, the actual number was much more than that as many of them could not mark attendance due to overcrowding of the meeting hall.

The Divisional Secretary (DS) or the Assistant Divisional Secretary (ADS) could not be present at the meeting as they have had other arrangements. However, DS was represented by the Head Quarter Grama Niladhari.

The meeting started with a brief introduction by Mr. S. Searsinghe, Team Leader of the group of consultants for the proposed project of improving the road from Ja Ela to Puttlam. He thanked the Divisional Secretary, his staff and the Grama Nildharies who arranged such a successful meeting at a very short notice.

Mr. P.H.K. Dayaratne, upon being invited by the Team Leader, gave a comprehensive account of the proposed road project. In his address he shed some light on the importance of an improved road network for social and economic development of the country. He further elaborated on the advantage of having improved roads for poverty reduction by increasing the incomes of poor households. Since the road traverses through an area where tourism is flourishing, improvements to the road will bring about immense benefits the people of the area. Mr. Dayaratne, however, said that the proposed improvements to the road will not cause any negative impacts on the livelihoods of the people living along the road. Only 11 households will be marginally affected within the entire DS Division.

Mr. Dayaratne explained about the proposed road alignment. He said that, from the railway crossing at Palavi to Puttalam Town (1.6 km) the road will be development in to 04 lanes where the total width of the road would be 21 metres. The width of the road from Ja Ela to the railway crossing at Palavi will be 13 metres. Mr. Dayaratne observed that affected people (APs) will be well looked after by the executing agency. He elaborated on the entitlements of the APs. In conclusion of his speech Mr. Dayaratne invited participants to raise their issues and concerns about the proposed project, if any.

Responding to Mr. Dayaratne, Mr. Balasooriya of Mahaweva inquired whether the existing width of the road is not enough for proposed improvements to the road and whether there will be land acquisition involved. Mr Dayaratne said that hard shoulders on the either side of road will be built. However, final design of proposed improvements is not yet ready.

Mr. Marshall of Mahaweva said that his land is located right opposite the reservoir. He inquired, if the road is going to be widened will it be extended towards the reservoir. Mr. Dayaratne in reply said that the general policy is not to disturb natural water bodies. Mr. Marshall again raised a point that, if the number of households to be affected only 11, why such a large crowd was invited for the meeting.

Mr. Karunatillaka, Sociologist of the Team of Consultants clarified the situation and said that a large number of people from the area was invited to obtain their views, opinions and suggestions on the proposed road project.

Mr. U.N. Siri Perera inquired as to whether the pavements of the road will be within total width of 13 metres.

Mr. Dayaratne said that the total width of the road including the pavements will not exceed 13 metres.

Mr. Loreen Jayasinghe said that widening of the road along the stretch adjoining the reservoir may be problematic and he inquired as to whether the widening would be on the side of the reservoir or on the land side.

Mr. Dayaratne in reply said that the final alignment has not yet been prepared. However, he opined that, as a policy natural water bodies will be kept intact.

Mr. Marasinghe said that the RDA has already has marked boundaries of the road. He inquired as to whether, with the proposed development the road would be widened beyond the already marked boundaries.

Mr. Dayaratne said that the road alignment will be confined to a total width of 13 metres.

Mr. B.K. Harischandra, Manager of Buddhi Batiks inquired as to whether the building of the Budhdhi Batiks would be affected due to proposed road development.

Mr. Dayaratne said that, if the building is outside the monuments already placed by the RDA, the building will not be affected due to proposed road development.

Mr. P.N.A.Sebastian, Mr. Wckramasinghe, Mr. Loreen Perera Complained that their lands were acquired for the road some time back, but they have not yet received compensation in respect of those lands.

Mr. Dayaratne said that payment of compensation for the acquired land is a responsibility of the RDA. Current exercise is to identify the socio economic impacts of the proposed development of the road. However, he said that this issue will be included in the report.

Mr. Kumar Vendakoon said that their previous experience of land acquisition for the RDA was unhealthy. Valuation recommended by the Department of valuation in respect of buildings had been below the actual value. The compensation they received was not enough to reconstruct their buildings. He further opined that the proposed improvements to the road will bring benefits not only to the people of the area but to the entire nation. However, he requested that, if the lands and other properties are to be acquired, RDA should not be unfair in payment of compensation.

Mr. Dayaratne in reply said that new regulations on land acquisition have come in to effect from 2009 and according to those regulations APs should be compensated adequately. Since there were no further responses from the participants, meeting concluded at 4.00 pm.

Minutes of the FOCUSED GROUP DISCUSSION AT MAHAWEWA (62KM POST) ON

30.01.2015

Divisional Secretariat Puttlam.

Venue: Mahawawa, 62nd Km post of A03 Road

Date : 30.01.2015

Time : 10.00am

A focused group discussion was held at Mahawewa near the 62km post, with a group of people selling food on the pavement. It was noticed that their temporary stalls will not be directly affected as their stalls are mostly located just outside the ROW. However it was observed that some of the canopies need to be removed and little adjustments of their temporary structures will be necessary in developing the road section. Consultants explained the proposed road development activities to the participants and they agreed that this development is necessary.

The participants who were present informed the consultants that they started these businesses about 12-15 years ago constructed in accordance with model plans provided by the Pradeshiya Sabha using a Zink sheet. They have been selling *different kinds of fruits, King Coconut, Maize* and other food to commuters. They disclosed that their income ranges between Rs. 500 -1000 on most days. They all are from Mahawewa Village and this is their only source of income.

The Consultants told them that during the construction period their sales will be temporary disturbed and asked what assistance they require during the time that they will be disturbed. They all requested that while carrying out this construction activities if the executing agencies could fill in uneven ground (to ensure comfortable access to their outlets) it would be of great assistance to them. Consultants informed that they will keep the road planners informed about their request and try to impel them to do the needful.

Some of the pavement vendors have obtained consumer loans from Samudhi Bank (two of them) at an interest rate of 2% per month, to buy items for sale. Others said that if they need money, they borrow from at a very high interest rate of 57% at the village fair (pola) help once a week. They also informed that all their requirements can be purchased on Wednesdays at Mahawewa. For their health requirements they visit the Government Hospital at Marawila, located about 05 kilometers away from their village. School education for their children is not handicapped as the pre-schools, primary schools and secondary schools are all located at easy accessible distances.

Almost all of these villagers are Buddhists and they attend the religious observances at the Buddhist Temple in Mahawewa. Marawilla hospital is about five Kms from Mahawewa and all of them obtain their health facilities from Marawilla Government hospital. There are pre Schools and other Schools at Mahawewa and temple is also available at Mahawewa, as all most all of them are Buddhists. List of attendance and the model structure plan given to them by Pradeshiya Saba for the temporary stalls are attached.

Minutes of the focused Group Discussion held with Women Organization at the Divisional Secretariat Puttlam.

Venue: Auditorium of the Divisional Secretariat Puttlam

Date : 30.01.2015

Time : 2.00pm

Mr Dayaratne, of the Team of Consultants, explained the purpose of the meeting. He said that the road development projects accelerate development of the country while facilitating the travelling of the commuters and road users. He further said that this focused group discussion was planned with the women organizations of the Puttlam Divisional Secretary Area in order to obtain their views and proposals on the proposed development as their participation is important in this development process.

The Consultant Team informed the participants the right of way (ROW) of the proposed road, from Ja-Ela to Puttalam, except for the 1.6 km section from the railway crossing at Palavi, would be 13 meters. The ROW from the railway crossing to 126 km post would be 21 meters. Hard shoulders and drains will be within the ROWs. Mr. Dayaratne went on to explain that all Aps will be compensated in accordance with the provisions of the Land Acquisition Act and other policies adopted by the Government of Sri Lanka (GOSL).

All those who were present agreed that the proposed road development would be beneficial to them and in general to all pedestrians as their travel would be made more convenient. Several participants were concerned that when the road is developed, occurrence of accidents may be increased and some residents will lose their limited activities. The Consultants explained that the affected parties will be adequately compensated and the project will make all possible arrangements to mitigate the negative impacts and protect the affected parties to maintain their living standards equal to the pre project status, or better. The following two individuals brought up their individual cases at this meeting.

Mrs.Prilicia Malanie said their property is within the 1.5 km section, close to Puttalam town. They have been in occupation of the land for about 24 years and are running a small boutique. They have been selling King Coconut, Maize and different types of fruits. Since her husband is ill at present and she is running the business to maintain the family. They have a partly constructed house and if the entire land is going to be acquired for the road, both their livelihoods and residence will be lost. Therefore she sought some redress from the executing agency for her husband and herself.

Mrs.M.G.Katharin stated that both her husband and son both are engaged in selling of fish. They have been residing adjoining the lagoon and there is only a limited space for them to shift backwards, They expect some alternative accommodation to continue their livelihood as they were earning their living for a long period of time.

To look into their grievances, the Consultants decided to visit their premises and some other would be affected locations. Before winding up the meeting the Team Leader thanked the Divisional Secretary, his staff and other participants from the Women's Organization for participation at the meeting and requested their active participation in future activities.

Minutes of Focused Group Discussion with Iron Tools and knives vendors at Vaikkal (Rail gate)

Venue: Near the rail gate at Vaikaal.

Date : 09.02.2015

Time : 12.00pm

Consultants explained about the project to develop the Ja-Ela - Puttalam road. Those present said that they all will extend their support to the project. They explained the inconvenience under underwent during previous upgrading of the project.

The community engaged in making iron tools and knives have selling points at Vaikkala where their products were displayed on the pavements. They informed that there are several workers engaged in producing iron tools and they are mostly from the neighbouring families in the vicinity. When answering a question as to how they find raw materials for the industry, they informed that there are people collecting discarded iron from abandon vehicles and they buy from them regularly. They informed that there is a continues supply of raw materials and it is not a problem but the issue is that the price of raw materials are increasing day by day, compelling them to increase the price of the products. The commuters are their customers and they mostly depend on road side sales, and during the previous upgrading of the road they had to face serious issues by losing customers due to road blocks.

The participants informed that most of them are fairly long standing producers with 20-30 years of experience in trade and if there is any major disruptions to their businesses many families will lose their livelihood. Their main concern and request was to commence the road rehabilitation work soon and complete the work within a short period. They also hoped measures will be taken to ensure usual business is maintained during the construction period.

Minutes of Focused Group Discussion with Three Wheel Drivers

Venue: Three Wheel Stand, Liyanagemulla, Palliya Juction

Date : 09.02.2015

Time : 9.00am

Consultant explained that is has been planned to improve the road from Ja-Ela to Puttalam and requested the views and suggestions of the three wheel drivers operating at the Palliya junction of Liyanagemulla.

They conveyed that this was the first occasion where they were consulted prior to a commencement of a road project. They further expressed that because of the abundant contact they have with road users because of their job, they are familiar with the opinions and behaviors of the surrounding public.

They observed that the particular area is floods during rainy days; a stretch of approximately 1 km. The hoped the roads would be developed soon. They often had trouble finding a parking area during rainy days. The three wheel drivers wished to communicate their views and ideas to the engineers directly and not through third parties.

The RDA has neglected proper maintenance of this stretch of road and this has resulted in environmental degradation and health issues. At the same time they welcomed the proposal to improve the road and requested for its fast completion.

Photos of Consultation Meetings

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Forcus group discussions</td><td>Businessman interviewed</td></tr>
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<tr><td>Illigal structures on the pavement</td><td>Road blocks due to unauthorized business</td></tr>
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Road side venders

Desabled person blocking the road with his cart

Informal discussions at a bus halt, Madampe

ANNEX 10

Letter received from Department of Archaeology

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පණිප්පාளர் நாயகம்
Director-General

දුරකථන අංක
தொலைபேசி இல. 011-2695255
Telephone Nos.

ෆැක්ස්
பெக்ஸ் 011-2696250
Fax

E mail : arch@diamond. lanka.net
Web site : www.archaeology.gov.lk

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தொல்லியல் திணைக்களம்
DEPARTMENT OF ARCHAEOLOGY
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இலங்கை சனநாயக சோசலிசக் குடியரசு
Government of the Democratic Socialist Republic of Sri Lanka

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எனது இல.
My No. H/EXP/AIA/6913/2015

ඔබේ අංකය
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Your No.

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சேர் மாக்கஸ் பர்ணாந்து மாவத்தை,
கொழும்பு 7.
Sir Marcus Fernando Mawatha,
Colombo 7.

දිනය
திகதி
Date 2015-04-06

ව්‍යාපෘති සම්බන්ධීකාරක,
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යෝජිත පෑලියගොඩ පුත්තලම - අවිස්සාවේල්ල පැල්මඩුල්ල / පැල්මඩුල්ල ඇඹිලිපිය හරහා නෝනාගම දක්වා මාර්ගය සංවර්ධනය කිරීම.

උක්ත මැයෙන් මා ඇමතූ ඔබේ 2015.02.20 දිනැති ලිපිය හා බැඳේ.

02. එයට අදාළව ස්ථානය නිරීක්ෂණයකොට මාගේ නිලධාරීන් විසින් මා වෙත වාර්තා කර ඇත. එකී වාර්තාවට අනුව පෑලියගොඩ පුත්තලම (A 003) මාර්ගය හා අවිස්සාවේල්ල පැල්මඩුල්ල (A 004) සහ පැල්මඩුල්ල ඇඹිලිපිටිය හා නෝනාගම හන්දිය දක්වා වූ මාර්ග සංවර්ධනය කිරීමේ දී පවතින මාර්ගයම සංවර්ධනය කිරීමට පහත සඳහන් කොන්දේසි යටතේ අපගේ නිර්දේශය ලබාදෙන අතර කවර හෝ හේතුවක් නිසාවත් මාර්ගය ආසන්නයේ ඇති කිසිඳු පුරාසාධකයකට කිසිඳු බලපෑමක් නොකළ යුතුය.

03. එමෙන්ම මාර්ග ඉදිකිරීම් කටයුතු වලට අවශ්‍ය ගල්, වැලි, බොරළු හෝ වෙනත් ද්‍රව්‍ය පුරාසාධක සහිත භූමිය ආශ්‍රයෙන් ලබා ගැනීම හෝ එකී පුරාසාධක සහිත භූමි මතින් බර වාහන හෝ වෙනත් වාහන ධාවනය කිරීම නොකළ යුතු බවට ද කාරුණිකව දන්වා සිටිමි.

04. තව ද මාර්ග ඉදිකිරීම් කටයුතු වල දී යම් පුරාසාධකයක් හමු වුවහොත් සියළු කටයුතු නවතා පුරාවිද්‍යා අධ්‍යක්ෂ ජනරාල් වෙත දන්වා සිටිය යුතු අතර ඔහුගේ බලය ලත් ඕනෑම නිලධාරියෙකුට හදිසි ස්ථාන පරීක්ෂා කිරීමේ අවකාශය ද නිබිය යුතු බවට කාරුණිකව දන්වා සිටිමි.

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පිටපත් -

01. සහකාර අධ්‍යක්ෂ (වයඹ) - කරු. දැන ගැනීම සඳහා
02. සහකාර අධ්‍යක්ෂ (දකුණ) - කරු. දැන ගැනීම සඳහා
02. සහකාර අධ්‍යක්ෂ (සබරගමුව) - කරු. දැන ගැනීම සඳහා

ANNEX 10

Terms of Reference for preparing the EA/EMP

Task 1. Description of the proposed Project

Major components of the project to be described include, description of the project; covering geographical location, road route(s) road length specifying start and chainages, type of development envisaged including a description of upgrading/widening and/ or maintenance treatments. In addition, to understand the proposed project activities information on ROWs, adjustments to alignments ,including earthworks, repair/replacement of bridges widening and stabilization of embankments, improvements to drainage and service ducts, sources of materials used during proposed road works ,generation of wastes and their disposal, expected volume of use and traffic impacts, necessary rehabilitation activities resettlement, land acquisition and temporary re-routing of traffic, safety features, staffing and accommodation of employees, site clearance requirements scheduling of project activities (e.g. clearing of ditches, prevention of erosion, especially at culverts) will need to be provided as much as possible. Any information currently not available that may have a bearing on the environment or people should be also identified.

Define the road- specific influence area in consultation with the RDA and the World Bank. The basis of the next tasks should be on analyses conducted within the influence area.

Task 2. Description of the Environment

Assemble and evaluate and baseline data on the environmental characteristics of the study area. Include information on any changes anticipated before the project commences.

(a) Physical environment : geology (general description for overall study area); topography: soils: monthly average temperatures ,rainfall and runoff characteristics ; ambient air quality; noise levels; surface and ground water hydrology; identity of streams, lakes or marine waters and their flows receiving water quality. In addition identity potential natural disaster and climate change risks.
(b) Biological environment : flora and fauna; rare or endangered species within or in areas adjacent to project-related development sites and any adjustments to the present alignment ; sensitive habitats ,including wetlands, protected areas or reservations areas affected by construction, facility siting, land application or disposal; aquatic, estuarine or marine communities in affected waters; significant natural habitats; species or commercial importance in land application sites and receiving waters.
(c) Socio-cultural environment : present and projected population; present land use/ownership; planned development activities; community structure; present and projected employment by industrial category; distribution of income, goods and services; recreation; public health; cultural properties; indigenous peoples, customs and aspirations; significant natural, cultural or historic sites, etc. Identify land or water based activities such as agriculture. (Eg. paddy cultivation), fisheries etc. within the project influence area.

The consultant shall (i) collect information from primary and secondary sources that are relevant to understanding the baseline, as well as the design of mitigation and enhancement measures, as pertaining to physical, biological and socio-cultural environments defined, but not limited to the above;(ii) carry out site visits and investigations of all the protected areas , forests reserves and other environmentally sensitive

locations and document them on base maps to identify conflict points with the likely design the project; and (iii) prepare detailed specific maps showing details of candidate sites for environmental enhancements.

The consultant shall extensively use video or other records of the project road (carried out as part of the engineering surveys) as well as photo document significant sites in terms of environmental and social sensitivity and safety. All recognized environmental resources and features with in the OPRC road's influence area shall be clearly identified, and studied in relation to activities proposed under the OPRC activities. Typically, these will include stretches with significant road side trees; environmental and common property resources such as forests, wetlands, significant water bodies, and major physical cultural properties. All these may be depicted using a line diagram or a strip map.

All surveys shall be carried out including techniques, tools and samples employed for the surveys to confirm to the international practices. Environmental quality (air, water and noise) monitoring shall include an adequate number of samples so as to provide a representative sample of the entire OPRC corridors. Additional sample data for sensitive environmental/ ecological receptors, if any, shall be collected such as to analyse and predict the possible impacts to a degree and precision of acceptable professional standards. Further additional specialized surveys, such as biodiversity assessment survey, and /or hydrological surveys shall be conducted to be agreed during the inception phase.

Task 3. Legislative and Policy Considerations

Describe the pertinent laws, and standards governing water quality and use, noise levels to be maintained, air quality to be maintained pollutant discharges to surface waters and land, health and safety, protection of sensitive areas and endangered species, siting, land use control, etc. at national ,regional and local levels. The report should describe the national laws and that need to be adhered to and to be implemented during the project including, (a) The Flora and Fauna Protection Ordinance; (b) Forest Ordinance; (c) Coast conservation Act; (d) Geological survey and Mines Bureau (GSMB) established under mines and Minerals Act. Mining and exploitation for minerals including sand, must be licensed under the Act of GSMB; (e) Water Resources Board Act where promotion of afforest ration, control of soil erosion, prevention of the pollution of rivers, streams and other water sources are required; (f) State Land Ordinance Act provides guidelines to the protection of the source, course or bed of any public stream ,springs, reservoirs, lakes, ponds, lagoons, creeks, canals, aqueducts, etc., prevention of the erosion of soil and preservation of water supplies; (g) Soil Conservation Act makes provision for the conservation of soil resources for prevention or mitigation of soil erosion and protection of land against damage by floods and droughts. It is possible to declare any area define in the order to be and erodible area for the purpose of this act: (h)Prevention of Mosquito Breeding Act (i) relevant legislation/ regulation that governs the use of land, and (j) other relevant laws and regulations that should be taken into consideration.

The EA should also specify various licenses, permits and approvals and relevant authorities that are required to be maintained by the contractors for sourcing of material for road construction and site utilization. It should also specify in all cases , according to the World Bank Policy, no activity including setting up of burrowing sites, dumping sites, quarry and sites for stock piling , storage or any other facility siting related to the project within protected areas or forest reserves will be allowed even with the permits and approvals by the relevant Agency.

Task 4. Determination of the Potential Impacts of the Proposed Project

Identify all significant changes that the project is likely to generate. Distinguish between significant positive and negative impacts, direct, indirect and cumulative impacts, and immediate and long- term impacts. Include indirect impacts (eg. increased access to forests and other sensitive areas and increased urbanization). Identify impacts that may occur due to accidental events (eg. spillage of toxic materials). Identify impacts that are unavoidable or irreversible. Wherever necessary, describe impacts quantitatively, interns of environmental costs and benefits. Assign economic values when feasible. Characterize the

extent and quality of available data, explaining significant information deficiencies and any uncertainties associated with predictions of impact.

Identify any significant developments proposed in the project influence area such as township development, industrial zones, etc. that have impact on the level of road use as well as to the environmental and people and level of impacts. The EA should focus on the potential for negative environmental and social impacts caused by planned and unplanned (spontaneous) in-migration of people if applicable to the given road section; clearing of forests lands for agriculture; increased pressure on fuel wood , fodder and water resources; social disruptions and conflicts; threat to natural habitats and important wildlife species, etc.

Determine the impacts due to likely changes to hydrology due to design or construction time. Specifically describe impacts on agriculture and fisheries where applicable due to temporary and/ or long term changes to hydrology in the area.

Special attention should be given to:

- ***Air Quality***: air pollution from asphalt plants; dust; noise from construction, equipment and blasting.
- ***Land Resources***: landslides; erosion; roadside litter; material for road construction.
- ***Hydrology***: crossing of rivers, streams, canals and ravines; temporary closure of water flow (such as due to bridge construction); foreclosure of other land uses (if new alignment proposed); landslides; erosion; roadside litter; modifications to natural drainage patterns and ground water elevation; flash flooding; setting up of or clearing of lead always; upstream activities that will have impacts to the project, as well as downstream impacts.
- ***Water quality***: river/ stream and lake sedimentation; use of pesticides; fuel and oil spills; water pollution from spills or accumulated contaminants on road surfaces.
- ***Biological****:* Impacts on biodiversity caused by facilitation of access to and spontaneous settlements in natural areas; impacts on coastal/ wetland management; control of hunting and poaching/ wood cutting; removal of existing trees along the road sides.
- ***Socio-economic****:* loss of agricultural and residual lands; loss of water sources for drinking and agriculture purpose; unplanned settlements; noise; threat to cultural and historical sites or artifacts.

Task 5. Analysis of Alternatives to the Proposed Project

Describe alternatives that were examined in the course of developing the proposed project and identify other alternatives that would achieve the same objectives. The concept of alternatives extends to siting and design of new alignments, rehabilitation techniques and phasing of activities, and operating and maintenance procedures. The alternatives should be also proposed based on the experience of road rehabilitation in the recent past. Compare alternatives in terms of potential environmental and social impacts, capital and operating costs (including mitigation measures and their monitoring), and institutional, training, and monitoring requirements and recommend the best possible options. To the extent possible, quantify the cost and benefits of each alternative, incorporating the estimated costs of any associated mitigating measures.

The alternatives shall reflect “best practices” in road alignment and construction to ensure that potential negative environmental impacts are minimized (e.g. through measures to prevent soil erosion, to ensure proper drainage, and provide for waste disposal such as of cut and fill material and used oil, spoil and borrow area restoration; avoidance of cutting trees; avoidance/ control resettlement etc.), avoidance of significant socio-economic changes and safety.

Task 6. Development of an Environmental management and Monitoring Plan

For each impact predicted, feasible and cost effective mitigation measures shall be identified to reduce potentially significant adverse environmental impacts to acceptable levels. The capital and recurrent costs of measures shall be determined. The consultant shall explore and recommended environmental enhancements including roadside landscaping, separation of non-motorized lanes in an aesthetically appealing manner, provision of walking pathways, and development of cultural properties or improving access along the corridor. At this stage, it would be important to identify the need for further environmental studies for issues that cannot be dealt with during this stage, but should be undertaken by the OPRC contractor.

Estimate the site specific impacts and costs of the mitigation measures and of the institutional and training requirements to implement them. If appropriate, assess compensation to affected parties for environmental impacts that cannot be mitigated – example closure of water flow of a river that will impact the planting of paddy downstream where compensation may have to be provided to the affected communities. Prepare an EMMP, including proposed work programmes, budget estimates, schedules, staffing and training requirements, and other necessary support services to implement the mitigating measures, monitoring etc. Include measures for emergency response to accidental events. (e. g. Entry of raw sewage or toxic wastes into rivers, streams, etc.)

Prepare a detailed plan to monitor the implementation of mitigating measures and the impacts of the project during rehabilitation and operation including monitoring indicators (e.g. emission and ambient levels of pollutants where these may be detrimental to human health, soil erosion, changes in the floodplain). Include the plan and an estimate of capital and operating costs and description of other inputs (such as training and institutional strengthening) needed to implement the plan. Include a regular schedule of monitoring the quality of surface and ground waters, air quality and noise to ensure that mitigation measures are effective. Provide guidance for reporting, enforcement and conducting environmental audits.

Review the responsibilities and capability of institutions at local, provincial/ regional and national levels and recommended steps to strengthen or expand them so that the EMMP may be effectively adopted and implemented by the OPRC contractor. The recommendations may extend to agency functions, intersectoral arrangements, management procedures and training, staffing, operation and maintenance training, budgeting and financial support.

Identify environmental standards to be maintained which can be translated to environmental specification for the OPRC Contractor. Each specification should also have a measurable indicator(s) for monitoring purposes.

EMMPs should be also presented in summary as part of an appendix (es) in a format agreed with the PMU. The EMMPs should have the following sections.

- Site-specific impacts identified and mitigation measures proposed (e.g. removal of trees, need for drainage etc.)
- Standards to be maintained which are applicable throughout the road (e.g. safety measure, traffic management, noise and dust management, water and air quality maintenance etc.) and /or the site is unknown (e.g. site of the labour camp, asphalt, etc.).
- Potential list of sites for material sourcing and siting of burrowing sites, dumping sites, quarry and sites for stock piling ,storage, crusher plants ,asphalt plants, etc. In the vicinity of the road sections. Potential sites identified for stock piling, storage, crusher plants, asphalt plants, etc. should be also checked for existing necessary clearances/permits and reported. This should include information such as existing site clearance details (including the quality of the source as per the GSMB , amount available for extraction, expiry dates of the clearance/ permits if a commercial site, etc.),

as well as details of requirements of permits for such activities . Such site identification should adhere to the condition specified under the task 3, paragraph 2.

- Staffing requirement for the contractor and supervising entity.

Task 7. Assist in Inter-Agency Coordination and Stakeholder Participation

The consultant shall assist the PMU/RU in coordinating the EA with relevant agencies and the government will consult with groups likely to be affected by the proposed project and with local NGOs on the environmental and social aspects of the proposed project - the detailed consultation requirements are presented separately in the next section of the ToR. These groups should be consulted during the initial stages of the assessment as well as when a draft EA is ready. The draft EA should also be available in a public place accessible to affected groups and stakeholders. Relevant information will be provided to affected groups in a timely manner prior to consultation and in a form and language that is understandable and accessible to the groups being consulted. The Consultant should maintain a record of the public consultation and the records should indicate: means other than consultations (e.g. surveys) used to seek the views of affected stakeholders; the date and location of the consultation meetings ,a list of the attendees and their affiliation and contact address; and summery minutes. It should be also reported on how the suggestions and requirements of stakeholders have been influenced in proposing mitigation measures proposed under EMMP, as well as the conceptual design. The summary of the above should be presented as a part of the main text of the EA and detailed information including photographs should be annexed as part of the EA document.