Government of the Democratic Socialist Republic of Sri Lanka
Ministry of Megapolis and Western Development (MMWD)

ENVIRONMENTAL IMPACT ASSESSMENT FOR COLOMBO LIGHT RAIL TRANSIT (LRT) PROJECT

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Submitted to;
Central Environmental Authority

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AAGR	Average Annual Population Growth Rate
AC	Alternating Current
ABL	Assessment Background Level
AFC	Auto Fare Collection
AGT	Automated Guideway Transit
A/L	Advance Level
ATO	Automatic Train Operation
ATM	Automated Teller Machine
ATP	Automatic Train Protection
ATS	Automatic Train Supervision
AW	Added Weight
BCR	Benefit Cost Ratio
BOD	Biological Oxygen Demand
CBD	Central Business District
CBTC	Communications-Based Train Control
CCTV	Closed Circuit Television
CDM	Clean Development Mechanism
CEA	Central Environment Authority
CEB	Ceylon Electricity Board
CHEC	China Harbour Engineering Company
CIS	Centralised / Computerised Interlocking System
CMC	Colombo Municipal Council
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CoMTrans	Urban Transport System Development Project for Colombo Metropolitan Region and Suburbs
CR	Critically Endangered
DD	Data Deficient
DEM	Digital Elevation Model
DS	District Secretariat
DO	Dissolved Oxygen
EA	Environmental Assessment
E&M	Electro-Mechanical

EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMMP	Environmental Management and Monitoring Plan
EN	Endangered
E&M	Electromechanical
ENL	Existing noise level
EPA	Environmental Protection Area
EPC	Engineering, Procurement and Construction
EU	European Union
GBH	Girth at Breast Height
GCE	General Certificate of Education
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic information system
GN	Gramaseva Niladhari
GoSL	Government of Sri Lanka
HSE	Health, Safety and Environment
HHH	Household Head
IAS	Invasive Alien Species
IC	Intelligent Card (Smart Card)
IEE	Initial Environmental Examination
IRR	Internal Rate of Return
IT	Information Technology
ITI	Industrial Technology Institute
JICA	Japan International Cooperation Agency
KMC	Kaduwela Municipal Council
LAA	Land Acquisition Act
LAN	Local Area Network system
LARC	Land Acquisition and Resettlement Committee
LAeq	Equivalent noise level
LAmax	Peak noise level
LC	Least Concern
LP	Liquefied Petroleum
LRT	Light Rail Transit

MCA	Multi Criteria Analysis
MOT	Ministry of Transport
MRT	Mass Rapid Transit
MmTH	Multimodal Transport Hub
MMWD	Ministry of Megapolis and Western Development
MSL	Mean Sea Level
MW	Mawatha
NEA	National Environmental Act
NO_2	Nitrogen Dioxide
NPV	Net Present Value
NSW EPA	New South Wales - Environmental Protection Agency
NT	Near Threatened
NWSDB	National Water Supply and Drainage Board
O&M	Operation and Maintenance
OCC	Operation Control Centre
ODA	Official Development Assistance
O/L	Ordinary Level
PAA	Project Approving Agencies
PAP	Project Affected People
P&R	Park and Ride
PC	Pre-stressed Concrete
PHC	Pre-Tensioned Spun High Strength Concrete
PIWQS	Proposed Inland Water Quality Standards
PM10	Particulate Matter (10 micrometers or less in diameter)
PMU	Project Management Unit
PSD	Platform Screen Door
PP	Project Proponent
PPE	Personal Protective Equipment
PPHPD	Passenger Per Hour, Per Direction
PPP	Public-Private Partnership
RAP	Resettlement Action Plan
RBL	Rating background level
RC	Reinforced Concrete
RDA	Road Development Authority

ROW	Right of Way
RRI	Route Relay Interlocking System
RSS	Receiving Substation
RTS	Rapid Transit System
RTU	Remote Terminal Unit
SJKMC	Sri Jayawardhanapura Kotte Municipal Council
SLLRDC	Sri Lanka Land Reclamation and Development Corporation
SLR	Sri Lanka Railway
SLS	Sri Lankan Standard
SLT	Sri Lanka Telecom
SO_2	Sulphur Dioxide
SRM	Standard Reken Method
SSS	Service Substation
STEP	Special Term for Economic Partnership
TEC	Technical Evaluation Committee
TOD	Transit Oriented Development
TOR	Terms of Reference
TSS	Total Suspended Solids
TSS	Traction Substation
UDA	Urban Development Authority
UITP	International Organisation for Public Transport
VVVF	Variable Voltage Variable Frequency
VU	Vulnerable
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

Executive Summary

The Light Rail Transit (LRT) project is a project implemented by the Ministry of Megapolis and Western Development (MMWD) designed according to the proposed transport plan for the Western Region Megapolis area. The LRT is an electrically operated train which runs on and elevated platform which consists of concrete pillars and concrete/steel beams. The center pillars of LRT mostly follows the centerlines of the existing A and B Class roads of Road Development Authority (RDA) except at the places of curves, Denzil Kobbekaduwa Mawatha and Chandrika Bandaranayaka Kumaranathunga Mawatha as outlined below.

The objective of the project is to provide an efficient and reliable mode of transport in Colombo and Malabe corridor (especially the route between Malabe to Borella) which is a heavily traffic congested area. The proposed LRT route will serve the transport needs (especially office transport) of the adjacent areas such as Town hall area where the National Hospital is located, Colombo Fort World Trade Center area, Pettah Central Bus Stand area, Port City, Borella and Sethsiripaya, and Suhurupaya etc are located.

The LRT route starts near Fort Railway Station at W E Bastian Mawatha and ends at the depot site in the paddy area adjacent to Chandrika Bandaranayaka Kumaranathunga Mawatha, Malabe and enters Battaramulla, Pannipitiya Road. It passes through Gamin Hall Junction after crossing the Fort Maradana Rail Road,Ibbanwala Junction, Lipton Circus , Ward Place , Borella Junction, Parliament Road near Rajagirita McDonalds. It crosses Diyawanna Lake at Diyatha Uyana and crosses Batteramulla Junction after traversing behind Sethsiripaya, Palan Thuna Junction (via Denzil Kobbekaduwa Mawatha), Koswatte Junction, Talahena, Malabe Junction and enters the depot site, which is adjacent to Chandrika Bandaranayaka Kumaranathunga Mawatha. The basic LRT route is shown in Figure 0.1

The Project will be financed by the Government of Sri Lanka (GoSL) and Japan International Corporation Agency (JICA). MMWD will form a new company with majority shares of the GOSL for the operation and maintenance work of LRT. It is expected to complete detailed design and start construction in 2020 and complete the Construction in mid-2024.

The basic civil works of the LRT will be consisted of concrete box girders spanned on concrete piers founded on bored or steel screwed piled foundations depending on the road width. The LRT platform, on which rails for rolling stocks will be fixed, will be at a height of approximately 10m from the road level. The rail compartments will run, on the longitudinal rails in various combinations, depending on the passenger transport requirements. The 16km LRT route has a total of 16 stations. The expected total journey time from Malabe Depot Site to Colombo Fort will be about 30 minutes and in every 3-4 minutes a train will arrive at a station during rush hours and during other times it will arrive in approximately every 10minutes.

The existing environment of the LRT route is highly urbanized with an altered natural environment. The LRT traverses through main roads, crosses canals of Colombo Canal system, crosses Diyawanna Lake at Diyatha Uyana Batteramulla and crosses partially abandoned paddy areas adjacent to Chandrika Kumaranathunga Mawatha. The LRT route will not cross protected areas (e.g. Sri Jayawardenapura Kotte Bird Sanctuary and Talangama Environmental Protection Area) and archaeologically important structures.

The proposed LRT will give rise to adverse construction impacts and negative and positive operational impacts to the environment. The main construction impacts identified include;

1) There will be noise nuisance from the construction activity of LRT structure as well as simultaneously pile driving operations for the Depot Site.

2) There will be reduction in traffic capacity, where the LRT construction takes place. Traffic congestion will occur at construction sites along the LRT route and its connecting routes.

3) There will be risks to community and occupational health and safety risks to workers involved at various stages of the project, particularly when there is heavy construction.

4) Livelihood of people will get affected by construction work. Livelihood of about 455 employees hired by around 100 businesses will be partially or fully affected by the Project. Among these, 108 employees belong to Car-Mart (Peugeot and Mazda). Together with Ishara Traders, these big businesses are in Ibbanwala Junction. There will be 66 structures which will be partially or fully affected by the Project (30 totally affected, and 36 structures partially affected). One residence will be fully affected and the residents may have to be resettled at the proposed IT Park Station. Also, forty-one (41) paddy land owners and 5 tenant farmers at the depot site will be affected.
5) Utility relocation (electricity, water, sewerage and telecommunication) will cause temporary public inconvenience.
6) Temporary hindrances to the drainage of limited number flood plains (Malabe Depot area) and canals (e.g. Beria Lake Canal, St. Sebastian Canal), lakes (Diyawanna Lake at Diyatha Uyana) and low-lying areas,
7) Wastewater and sewage from construction sites may contaminate surface water and groundwater
8) Pruning and excising branches of Bo Trees which have religious value. There are 14 Bo Trees found along the LRT Route but extent of impact will be determined at the detailed design phase.

The main operational negative impacts are;

1) Risks to occupational health and safety
2) Public inconvenience created by noise and vibration
3) Crack development possibilities in adjacent buildings owing to vibration.
4) Occurrence of unexpected events such as accidents, fire.
5) Wetland degradation and surface water quality degradation at Depot Site by wastewater and sludge release and solid waste (scheduled Waste) from the Depot Area and stations which would pollute surface and ground water quality and impacts bio diversity.

The only positive construction impact is the creation of a significant amount of employment opportunities.

The main positive operational impacts are;

6) Travel time saving by the reduction of traffic congestion by discouraging the use of private vehicles; Provision of a comfortable, safe and reliable public transportation mode to the people. Increased connectivity of different transport modes and accessibility of strategic locations
7) Generation of jobs and improvement of local and regional economy
8) Air quality improvement by the reduced use of fossil fuel powered vehicles. Saving of fossil fuels and reduction of greenhouse gas emissions to the atmosphere as the LRT runs purely on electricity;

The proposed mitigation measures for the negative construction impacts are;

9) Limiting piling work to day time. Provide noise reduction devices for the piling hammer, provision of noise barriers as necessary and informing the nearby residents about the ongoing piling activities and use well serviced low noise generation equipment, avoid noise generating night time work.
10) Undertake traffic management plans for critical road intersections with the help of Local Authorities and Traffic Police, create temporary alternative access, provide traffic signage.
11) Adoption of all standard safety measures and monitoring.
12) Monitor all vulnerable buildings, conduct crack surveys, control piling impulses in pile driving equipment.

13) Provision of compensation through adoption of the Land Acquisition and Resettlement Committee (LARC) system and provision of livelihood support programmes
14) Study the utility plans, liaise with the relevant line agencies, restoration of damaged utilities, provision of temporary services until utility damage is restored or utility relocation is complete
15) Avoid temporary blockage of the whole canal sections, flood plains, carry out emergency breaches in coffer dams, use rigs to minimize waterway blockage, remove temporary obstructions during floods, provide culverts and control height of the pilot road adjacent to Chandrika Bandaranayaka Kumaranathunga Mawatha
16) Provide standard sanitary toilets with septic tanks or mobile toilets for worksites.
17) Carry out necessary religious rituals with the blessings of the devotees and chief incumbents of temples if a Bo Tree belongs to a temple is to be cut or pruned.

The main mitigation measures for the operational impacts are

1) Noise monitoring and provision of permanent noise barriers to noise sensitive receptors based on the international noise standards (Railway noise standards of Japan and Australia)
2) Monitor the condition of adjacent buildings taking the pre-construction crack survey (dilapidation survey) as the baseline.
3) Provision of a wastewater treatment plant to the Depot site and connecting the sewer output the proposed Sri Jayawardenapura sewerage network

The summary of the major impacts and mitigation measures are given in Table 0.1 and Table 0.2 .

The responsibility of environmental impact mitigation will be borne by the Project Proponent while the implementation of such mitigation measures will be carried out by the Contractor (through contractual arrangements) under the supervision of PMU and CEA's monitoring mechanisms.

The main responsibility of monitoring the project activities will lie with the Project Proponent (MMWD) assisted by the Project Management Unit (PMU) of LRT Project, under the appointed "Engineer" – Resident Engineer (or Resident Project Manager) and the Environmental Manager working under the above setup. LRT Project PMU will facilitate the contractors in carrying out the required work.

The construction and operational stages of the LRT will be monitored through an appointed Inter Agency Monitoring Committee which consists of the line agencies Urban Development Authority (UDA), Road Development Authority (RDA), Sri Lanka Land Reclamation and Development Corporation (SLLRDC), Department of Agrarian Development, Irrigation Department, National Water Supply and Drainage Board (NWS&DB), Colombo Municipal Council (CMC), Kotte Municipal Council and Kaduwela Municipal Council. CEA will undertake independent monitoring. The EMMP will be further refined after the contract award, based on the "Method Statement" of the Contractor considering the specific contract execution methods and the details of the Detailed Design.

It could be concluded that the project will have some mitgable negative impacts during construction and during the operational stage. The number of houses and commercial establishments to be relocated due to the proposed project is relatively low, since a major portion of the LRT route traverses in the middle of existing road networks. The LRT is a low-emission solution by itself compared to even a usual fossil fuel driven train.

The Extended Cost Benefit Analysis of the project indicated that the proposed LRT project for Malabe traffic corridor can be considered as an economically viable project suitable for implementation as according to the ECBA, The Benefit Cost Ration BCR is 2.15, the Environmental Internal Rate of Return (EIIR) is 20.2% and the Environmental Net Present Value (ENPV) Rs. 169billion.

It is recommended that the proposed LRT project from Colombo Fort to Malabe is implemented as a solution to the traffic congestion of Borella Malabe corridor, to provide passengers with a safe, efficient, reliable and comfortable quick mode of environmentally friendly mode of transport. The EIA report's mitigation measures and EMP shall be made part and parcel of the tender/bid documents and shall be included within the construction contract.

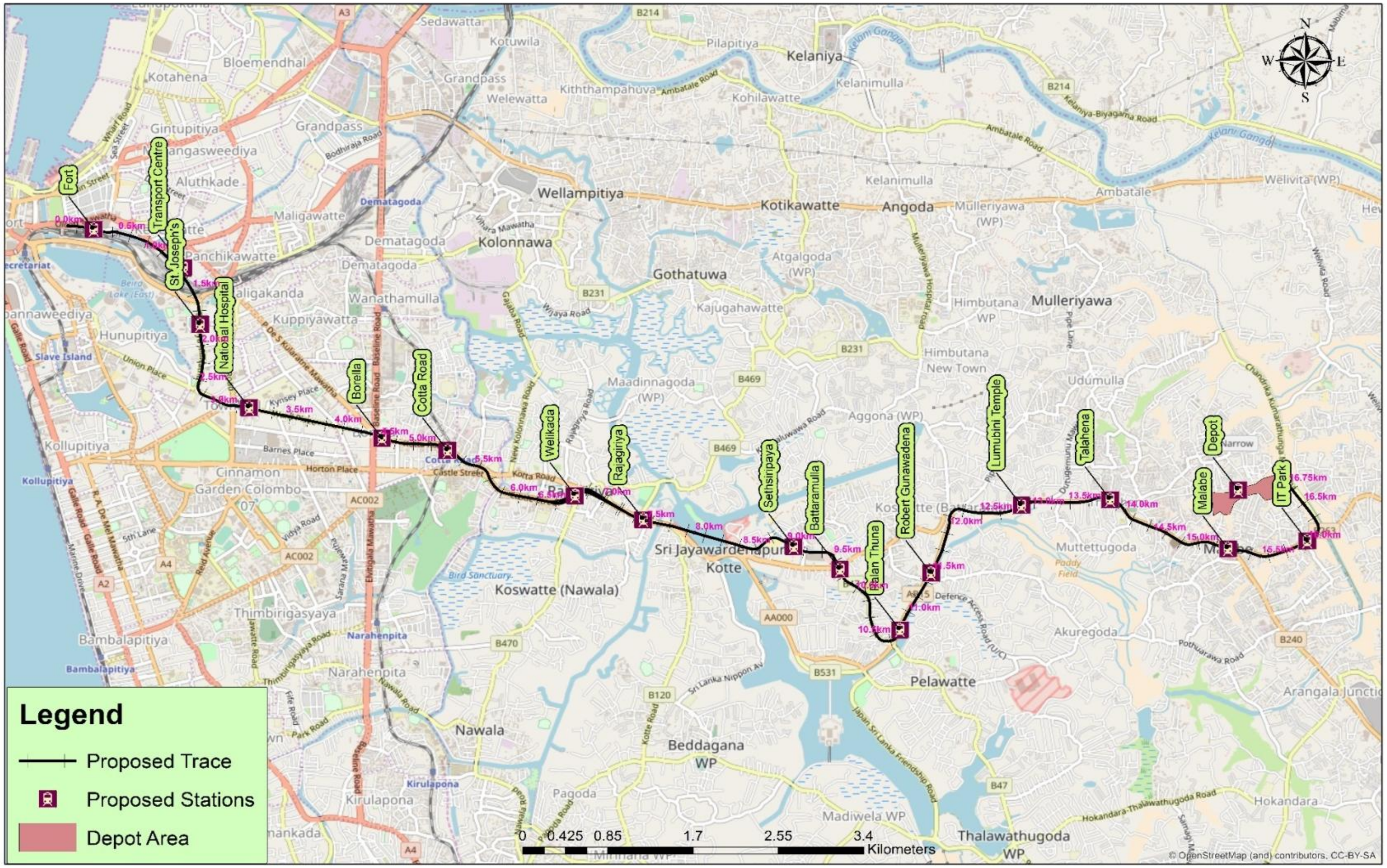


Figure 0.1 Proposed LRT Route and Stations

Table 0.1: Summary of expected impact and mitigation measure (Construction Phase)

IMPACT THEME	POTENTIAL IMPACT	PROPOSED MANAGEMENT MEASURE
NOISE	Increased noise levels in the vicinity of the construction site • The expected average noise level of 61 dB (Laeq) at 10m distance (nearest resident) is below CEA standard for construction activity at daytime (75dB (A)). • Projected maximum noise level (Lamax) at 10m distance (nearest resident) is 84dB. There is no limit stipulated for Lamax in Sri Lanka.	For general construction site (LRT route) • Fitting of exhaust baffles, maintaining vehicles and machinery in a high operable condition, • Use the, low-noise type machine and/or vehicles, • Construction site is separated with corrugated sheets or other suitable material especially at locations near noise sensitive receptors, particularly at National Hospital and school zone. • Scheduling of construction work that cause high noise and vibration to ensure least inconvenience to the public, • Avoid construction work on Poya days and days of other religious and/ or cultural importance, • Avoid high noise construction activities during the night time. • Establishing a complaint handling mechanism • Advance notification to the surrounding community For Depot • Conduct a test piling activity and check the noise level generated from the piling activity at Depot area. • Consider changing the height of hammer drop or weight of hammer to be used, depending on the result of test piling • Install a noise reduction equipment with piling hammer
VIBRATION	Increased vibration levels in the vicinity of the construction site • Vibration levels at a distance of 10m from the vibration source is estimated at 5-7 mm/s • Simultaneous piling activities will not have significant impacts on Type 1 and 2 structures that are located within 10m from the piling activities. • These activities may affect Type 3 and 4 structures located within the 10m boundary.	• Identification of type of building structure (Type 3 and Type 4). For Type 4 structure, the consultation with Department of Archaeology is required. • Carry out a property condition survey (crack survey) of nearby structures and record the present condition of the structure, to accurately assess any damage to these structures during the construction stage. • Vibration monitoring at selected area around the construction activities. • Regularly communicate with surrounding communities to inform the construction schedule. • Use of lower vibration generating device/machinery. • Scheduling of construction work that cause high vibration must be within authorized construction embodiment times, • Minimisation of piling energy (e.g. reduced hammer drop distance) as necessary depending on receptor distance. • Establishing a complaint handling mechanism and implementing a procedure to effectively deal with any issue raised by the community. • Provision of vibration cut-off trenches at locations required
TRAFFIC IMPACT	Road link capacity reduction • Reduction of traffic capacity up to 30% - 50% due to the construction activity. • Wider road network would be impacted due to congestion at road intersections.	• Preparation of traffic management plan for each construction stage such as diversion, lane control, safety measures. The traffic management plan will also take into consideration mobility and safety of vulnerable groups (e.g. school children, elderly). • Carry out traffic simulation for above traffic management plan • Road Intersection wise traffic analysis for the key road intersections affected by the study (See Section 1.4 of the Traffic Impact Assessment Report in Annex C for the

		affected intersections) • A stakeholder committee with the participation of project consultants, Colombo Municipal Council and the other relevant local government bodies, Road Development Authority and Traffic Police, will be appointed to give guidance on the developed traffic management plan • Monitoring of traffic flow during construction stage • Ensuring the safety during the construction period using standard safety measures. • Adherence to the workzone management guidelines formulated by RDA. • Provide minimum 3m lane width for bus routes • Maintain walkable paths for pedestrian movement especially where high density pedestrian traffic flows exist (e.g. Malabe, Rajagiriya Road, Olcott Mawatha, Justice Akbar Mawatha and Malay Street, access roads in depot area) • Retain access roads in depot area (slightly diverted) and ensure that design and construction of depot civil structures will not hamper movement of people and vehicles in the area.
LANDSCAPE	Impact on special values associated with aesthetics (e.g. nature, views of heritage structures), such as • Rajagiriya junction, • Ward place, • Ceremonial approach (Sri Jayawardenapura Road), • Densil Kobbakaduwa Mawatha.	• The major sensitive areas will be thoroughly studied in terms of landscape impact during detailed design stage through the consultation with concerned agencies. After detailed assessment of landscape impact, if it is found that alternative route is suitable, it will be a subject for supplementary EIA. • Micro level detailing, structures, colours, lighting, planting, trains designs and colours, stations, interactions will be part of the overall design depending on each section. • In order to realise the overall objectives, in the design team in addition to the design and structural engineers it will include; Tow Planners, Urban Designers, Architects, Landscape Architects, and Lighting Experts.
HEALTH AND SAFETY	Risks to occupational health and safety (e.g. accidents, health hazards to workers)	• Submission of an Occupational Health and Safety Management Plan (Construction Stage) prior to commencement of work. • Adoption of standard worker safety methods • Provision of personal protective equipment (PPE) • Provision of trainings and awareness programs to employees • Conducting hazard analysis and plan/provide adequate mitigation measures for such hazards identified, prior to carrying out major construction activities
	Risks to community health and safety • Increase of stress levels for affected residents and commuters • Risk to respiratory diseases due to dust • Hazards of communicable and infectious diseases	• The project site will be fenced and access points will not be available for the public. • Appropriate sanitary facilities will be provided at all construction sites. • Environmental pollution control measures, including watering proper maintenance of machinery shall be implemented. • Arrange construction activity and schedule to minimize the impact on surrounding community (e.g. prohibit high noise generating activity on night time)
SOCIO-ECONOMIC IMPACTS	Impact on livelihood and economic activities • Inability to park vehicles • Temporary loss or	• Provision of compensation to the Project Affected Parties (PAPs) using the compensation package decided for LRT Project based on LARC stipulations on assessing the financial and other losses of PAPs.

	impedance of access to business premises • Livelihood of about 455 employees hired by around 100 businesses will be partially and fully affected by the Project. 108 employees belong to Carmart (Peugeot and Mazda) and 75 employees belong to Lal and Nihal. • Impact on 41 paddy land owners and 5 tenant farmers	• Provision of alternative access to their premises as far as possible outside the construction sites to carry out their usual business activities and other domestic or related employment activities. • Develop a Livelihood Restoration Plan • Continual liaising with the Project Affected Parties (PAPs) will be undertaken to decide on the site-specific mitigation measures. • Consultation with people whose livelihood depend on modes of transportation that may be affected by the Project (e.g. 3-wheelers and bus operators). They will be included in the development of the traffic management plan.
BIOLOGICAL ENVIRONMENT	• No direct impact on protected areas as they were avoided by the design	• Monitoring of bird species will be conducted.
	• Trimming of some trees) 652 trees belonging to 82 species are located along LRT route. • 89 trees planted along Denzil Kobbekaduwua Mawattha, will need to be removed. • Two trees of one nationally endangered tree *Diospyros ebenum* which are planted which will not to be directly impacted. • Negligible impact on terrestrial and aquatic habitat • No impact on habitat fragmentation or disruption of movement patterns of species	• Offset trees of 10 times of that is cut down by the project • Enhancement of biodiversity through creation of various type of habitat such as wetland, forest zone and open area. • Use the native species which will enhance the value of ecosystem in the area • Creation of green buffer zone around the Depot by selection of tree species which grows high to mitigate the landscape impact
	LRT route will pass through these wetlands • left of the Madiwela East Diversion Canal (mostly abandoned paddy fields) • lower end of the command area of the Thalangama tank • Diyatha Uyana, which is an open water type habitat	• Minimize removal or pruning of trees • Introduce a wastewater treatment plant and • Collect scheduled waste for the “Ecocycle” process.
IMPACT ON UTILITIES	Underground Utilities: electricity cables, telecommunication lines, sewerage pipes, storm water conduits, water supply lines Overhead utilities: electricity lines, telecommunication lines.	• Close coordination with and provision of support to utility agencies, including CEB and NWSDB. • Adopt schedules for the shifting and temporary termination of infrastructure service supply • Make the public aware of schedules in advance to prevent ad hoc activities • Make timely payments as agreed • Assist in shifting of facilities

		• Obtain information from other on-going projects
LAND ACQUISITION & RESETTLEMENT	Impact on private properties (land and built structures) There will be 66 built structures which will be partially and fully affected by the Project. One residential house may be fully affected at the proposed IT Park Station.	• Develop and implement a Resettlement Action Plan (RAP) and Livelihood Restoration Plan • Carry out consultations with project affected persons (PAPs)
	Impact on government institutions and properties: • Existing roads (RDA) • Diyatha Uyana, Floating Market (UDA), Diyawanna Lake, SLLRDC • Maradana Railway Line (SLR)	• Consult relevant agencies (e.g. RDA, UDA, SLR) • Provide necessary assistance, such as relocation of affected properties.
SOLID WASTE	Erosion of excavated materials, spoil and other waste construction materials etc.	• Prevent stocking of loose earth by the road side • Cover temporary stockpile with polythene sheet and place weights • Manage sand stockpiles by compaction/haunching. • Provide temporary drainage around the sand stockpiles.
	Nuisance to pedestrians and other road users caused by construction wastes Impact on the aesthetics of the city (temporary)	• Careful planning of temporary storage and disposal • Segregate wastes properly. Recyclable materials will be handed to registered recyclers. • Scheduled wastes (e.g. oil) will be collected and carefully stored. Treatment and disposal of these wastes will be contracted out to a registered industrial waste company.
SURFACE WATER & GROUNDWATER	Impact on water quality of Diyawanna Lake	• Monitor water quality in the lake during construction period
	Impact on groundwater quality due to construction of foundation structures	• Monitor groundwater quality
CULTURAL HERITAGE	There are total 14 Bo trees along LRT route, with and without shrines. No uprooting of Bo tree is expected. Some branches of Bo tree overarching the LRT route may be cut downed/trimmed.	• Consult relevant stakeholders • Carry out religious rituals and communicate with relevant stakeholders (Monks and devotee) before the commencement of construction activities.
	Hindrance access to religious and culturally important sites	• A traffic management plan will be developed considering alternative access roads to religious and culturally important sites.
WASTEWATER	No workers camp at site is required, but limited construction workers may be accommodated at Depot site.	• Provide cylindrical septic tank or portable toilets at the construction areas; • Adequate facility such as sanitary latrines will be provided for temporal accommodation at Depot site.
	Spillage, leak and accidental discharge of oil from construction vehicles	• Proper use and maintenance of construction machines and heavy vehicles • Install Oil and grease traps in the drainage system • Establish and implement emergency and contingency plan in case of spills
WATER COURSE	LRT route will traverse Diyawanna Lake	• Use a two-dimensional flood model with a possible tentative blocking arrangement for construction rigs within the Diyawanna. • Conduct lake blocking part by part. • Limit construction of the foundation of LRT structure within the lake during dry season; avoid critical monsoon periods such as April- June and September to November. • Carry out temporary blocking of the lake section according to the instructions of SLLRDC; Re-run the model depending on the site-specific construction arrangements. • Prepare a suitable pumping arrangement in case of flood

		• If in the opinion of the Engineer that flooding is aggravated because of temporary construction blocks such blocks will be temporarily removed until the flood subsides. • Encourage the contractor to use less invasive designs such as balanced double cantilever bridge to cross the lake
	Construction activities may cause pocket flooding	• Opening of drainage paths over the road • Creation of temporary drainage path from the construction sites to the nearest drain, as necessary. • Removal of construction equipment from site if inundation occurs.
	Construction activities may cause backwater on flood plains.	<u>Depot Area</u> • Provide a 3m wide canal right round the fill area • Conduct of construction works in parts. • Control of height of fill; Allow water overtopping over the fill • Propose to improve the existing drainage canals in the low-lying paddy by desilting them. • Establish direct drainage connection between these canals and main canal. • Open culvert gates, in case of flood • Avoid blocking of existing drainages • Refining of the flood modeling; Lower part of the sub catchment will be made as a hydro dynamic model to represent the existing drainages and internal road culverts. • Breach fillings at strategic locations in case of flood <u>Pilot Road in the Low-Lying Areas Adjacent to Chandrika Bandaranayaka Kumaranathunga Mawatha</u> • Minimize height and width of the pilot road to a height of 0.6m. • Provide temporary culverts to all drainage paths and at places of the flood plain crossing the pilot road. • Breach filling at strategic locations in case of flood • Test pilot road using the flood model of SLLRDC
AIR QUALITY	Generation of dust Emissions from construction machineries and vehicles	• Wetting and water spraying • Covering of transport vehicles • Careful stockpiling of construction materials • Monitoring of dust levels • Proper maintenance of construction machineries and vehicles • Careful selection of location of construction yard • Limiting of vehicle speed • Proper planning and siting of construction activities • Set up dust barriers
UNUSUAL EVENTS	Impacts of unexpected events such as accidents and natural hazards	• Develop an Emergency Response Plan • Compliance with applicable performance specification, design standards and codes, health and safety regulations • Provision of firefighting system

Table 0.2: Summary of expected impact and mitigation measure (Operation stage)

IMPACT	POTENTIAL IMPACT	PROPOSED MANAGEMENT MEASURE
NOISE	Noise level will satisfy noise standard for both Peak noise level (LAmax) and Equivalent noise level (LAeq) awarding to Japanese and Australian Noise standards of LRT. However, there might be a disturbance especially around noise sensitive receptors.	• Consider noise mitigation measures (e.g. noise barrier), especially for sensitive areas. • Carry out noise monitoring along LRT route • Standard maintenance of trains, structure and tracks • Establish a grievance mechanism
VIBRATION	Vibration impact is expected, but the impact is not considered significant.	• Conduct monitoring of vibration at selected points along the route • Standard maintenance of trains, structure and tracks • Establish a grievance mechanism • Proper maintenance of train structure, tracks and rolling stocks
HEALTH AND SAFETY	Risks on occupational health and safety • Accident due to the maintenance of LRT structure and rolling stocks	• Develop Health and Safety Management Plan for operational stage • Provide of PPE • Deploy security guards • Develop an Emergency Response Plan • Adoption of standard worker safety methods, • Develop and implement an Occupational Health and Safety Management Plan (Operation Stage) • Provision of PPEs, • Putting up of warning signs, • Training of employees
SOCIO-ECONOMIC IMPACTS	Impact on livelihood and economic activities • Continuing livelihood restoration of PAPs • Conflict of interest with existing modes of transportation (e.g. buses, 3-wheeler drivers)	• Monitoring of the Livelihood Restoration Plan for the affected PAPs • Consultation with relevant stakeholders to seek optimum solutions for transport operators (e.g. buses, 3-wheelers) • Provisions to make new bus routes and shuttle services to connect stations to main towns • Propose developing terminals for 3-wheelers close to the trains stations.
SOLID WASTE	Waste from depot • Wastes generated at Depot will include Lubricant oil, sludge, Break shoe, metal scraps/particles, rubber tube and batteries.	• Segregate wastes. • Recyclable materials will be handed to registered recyclers. • Non-hazardous wastes will be disposed in accordance with relevant local regulations. • Regular collection and disposal of wastes • Scheduled wastes (e.g. oil) will be collected and carefully stored. Treatment and disposal of these wastes will be contracted out to a registered industrial waste company
	Waste from stations • Litter such as papers, waste as biodegradable waste (food waste, garden waste etc.), plastics, glass and paper empty plastic bottles will be generated at each stations	• Waste generated from stations will be collected according to the type of waste by registered waste contractor and treated through a registered waste disposal facility
WASTEWATER	There might be spillage, leak and accidental discharge of oil/contaminated water at Depot area	• Secondary containers will be placed in storage areas for hazardous substances(e.g. oil) • Spill kits will be provided • Provide drainage from chemical storage areas to oil separator (depot area)
	Wastewater will be generated from washing of rolling stocks as well as sanitary wastewater from	• Wastewater treatment system with sufficient treatment capacity will be installed in the depot area. Wastewater will be discharged to the public sewage system. • Periodical maintenance of Wastewater treatment system will be conducted.

IMPACT	POTENTIAL IMPACT	PROPOSED MANAGEMENT MEASURE
	administration building will be generated from the depot.	
	Wastewater generated from the stations is mainly sewage from the toilet facility.	• Sewage will be sent to public sewage system • Periodical maintenance of sewage system at station will be conducted.
BIOLOGICAL ENVIRONMENT (FLORA & FAUNA)	No direct impact on protected areas	• Monitoring of bird species will be conducted.
	Loss of green areas (e.g. agricultural land)	• Maintenance of restored zone under restoration program
URBANISATION	Conversion of green areas and paddy fields for the development/ expansion of train stations	• Coordinate with relevant agencies regarding possible alternatives
UNUSUAL EVENTS	Impacts of unexpected events such as accidents and natural hazards • Failure of rail component and structure • Failure due to extreme heat, equipment failure and accident • Flooding	• Develop an Emergency Response Plan

CHAPTER 1 Introduction

1.1 Background of the Project

Introduction of the Light Rail Transit (LRT) system is a proposed project, to be implemented by the Ministry of Megapolis and Western Development (MMWD). The LRT Project (hereinafter also referred to as "the Project") is an elevated electrically operated railway system that connects strategic locations and transport hubs from Fort to Malabe (e.g. Borella, Battaramulla). The proposed Project uses an elevated platform made of concrete pillars and concrete/steel beams. The center pillars of LRT mostly follow the centerlines of the existing roads. Besides the LRT route and 16 train stations, a depot area will be built in Malabe West for the maintenance and storage of trains (rolling stocks). A conceptual image of the LRT is shown in Figure 1.1. The detailed Project description is provided in Chapter 2. The Proposed route of the LRT is given in Figure 2.2.

Figure 1.1 Conceptual Image of the LRT

1.1.1 Background of the Project

Since the establishment of the current government of Sri Lanka (GoSL) in January 2015, the Ministry of Megapolis and Western Development (hereinafter referred to as "MMWD") which is responsible for planning the urban development in Colombo Metropolitan Area[1] has set out the "Western Region Master Plan - 2030". A priority concern of this master plan is to solve traffic congestion in Colombo Metropolitan Area by introducing an alternative public transport system.

According to the Urban Transport System Development Project for Colombo Metropolitan Region and Suburbs (CoMTrans), among seven major corridors towards the city center, Malabe Corridor is observed to have the highest density of private cars and the lowest travel speed at peak hours. Based on the results of ComTrans and the Megapolis Transport Master Plan, the Rapid Transit System (RTS) has been identified as an option to improve public transportation.

The Megapolis Transport Master Plan lays out an RTS network, composed of seven lines, that stretches out to Colombo's suburban areas (see Figure 1.2). This network was formulated based on several factors such as the country's economic development, population growth, and projected transport conditions (e.g. traffic volume in major corridors, modal share, and connectivity with other public transport mode).

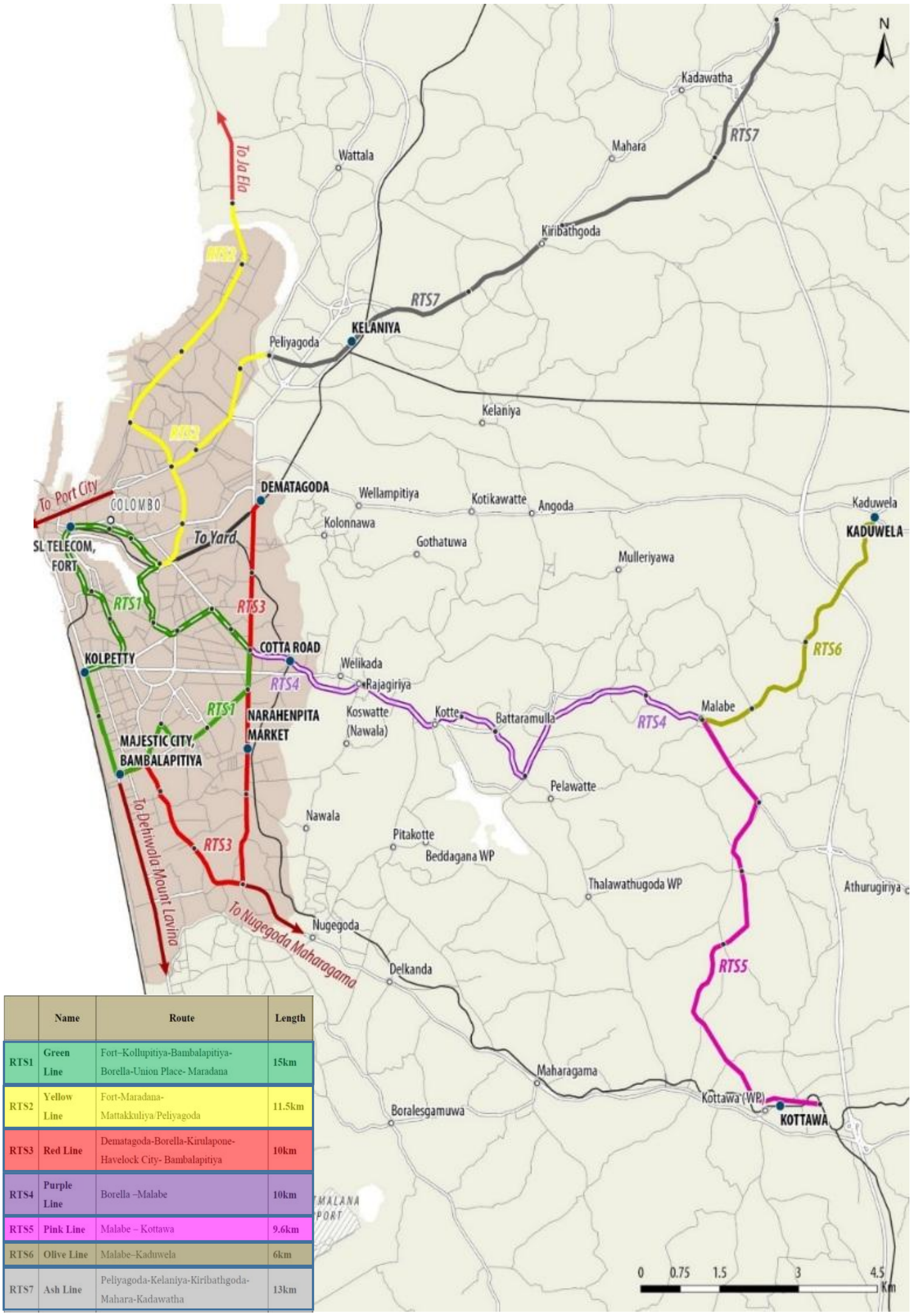
Within the RTS network, the GoSL made an official request for an ODA loan to the government of Japan to fund the section covering the Northern part of the circular line of RTS-1 and RTS-4, which run along Malabe Corridor. The proposed Colombo Light Rail Transit (LRT) system which constitutes part of RTS-1 and RTS-4, will be under the Special Term for Economic Partnership (STEP) between the two governments. This LRT is the subject matter of this EIA Report.

1.1.2 Current Status

The LRT project is in the Feasibility Stage. The Feasibility Study aims to conduct preparatory surveys for target routes in order to examine the necessity and feasibility of the Project for establishing the New Light Rail Transit System under the Western Region Megapolis Development. It also aims to prepare the necessary documents for the project appraisal as a candidate for Japanese ODA Loan.

1.1.3 Implementing Agency

The Project Management Unit established under the Ministry of Megapolis and Western Development (MMWD) is responsible for the implementation of the proposed LRT project. The organizational chart and operational mechanism is described in Chapter 2.



	Name	Route	Length
RTS1	Green Line	Fort–Kollupitiya-Bambalapitiya-Borella-Union Place- Maradana	15km
RTS2	Yellow Line	Fort-Maradana-Mattakkuliya/Peliyagoda	11.5km
RTS3	Red Line	Dematagoda-Borella-Kirulapone-Havelock City- Bambalapitiya	10km
RTS4	Purple Line	Borella –Malabe	10km
RTS5	Pink Line	Malabe – Kottawa	9.6km
RTS6	Olive Line	Malabe–Kaduwela	6km
RTS7	Ash Line	Peliyagoda-Kelaniya-Kiribathgoda-Mahara-Kadawatha	13km

Source: Transport Master Plan (MMWD)

Figure 1.2 Proposed RTS Network

1.2 Objectives of the LRT Project (Project Justification)

1.2.1 Project Justification

In Sri Lanka, over 90% of people and cargo transport depends on road networks. Around 42% of GDP and 29% of the population are concentrated in the capital Colombo, especially in the Western provinces which has achieved solid economic growth since the end of civil war.

The number of traffic modes utilizing road networks such as automobiles, buses and motorcycles has been rapidly increasing. About 1 million people are entering into the center of Colombo every day, resulting in severe traffic congestion in Colombo and its surroundings. During morning and evening time, travel speed is observed less than 20 km/h, which is defined as traffic congestion. There are roads with less than 10 km/h travel speed which means that the current urban transport network may be reaching its limits. Malabe corridor is one of the most congested corridors in Colombo. Images of Malabe Corridor (facing towards Colombo) during peak hours in the morning and night time are shown in Figure 1.3 below.

a) Malabe Corridor (daytime) b) Malabe Corridor (night time)

Figure 1.3 Photos of Malabe Corridor during peak hours

Moreover, based on the results of CoMTrans, travel time between Fort Lake House Junction and Battaramulla Junction can reach up to 40-50 minutes during peak hours, when it would only take about 15 minutes to travel the same distance during off peak hours (refer to **4**). It means travel time increase by about 2-3 times. Such decline in traffic mobility will adversely affect the economic activity of the Colombo Metropolitan Area and it would create negative impact on the national economy.

The approach to develop roads cannot solve the traffic issue alone. Based on the current dense traffic condition at major roads in Colombo City, and from the efficiency of public transportation over private vehicles (in terms of transporting more people in a period of time), introduction of a new mode of public transportation system is urgently necessary. In particular, a railway based public transportation system is desired.

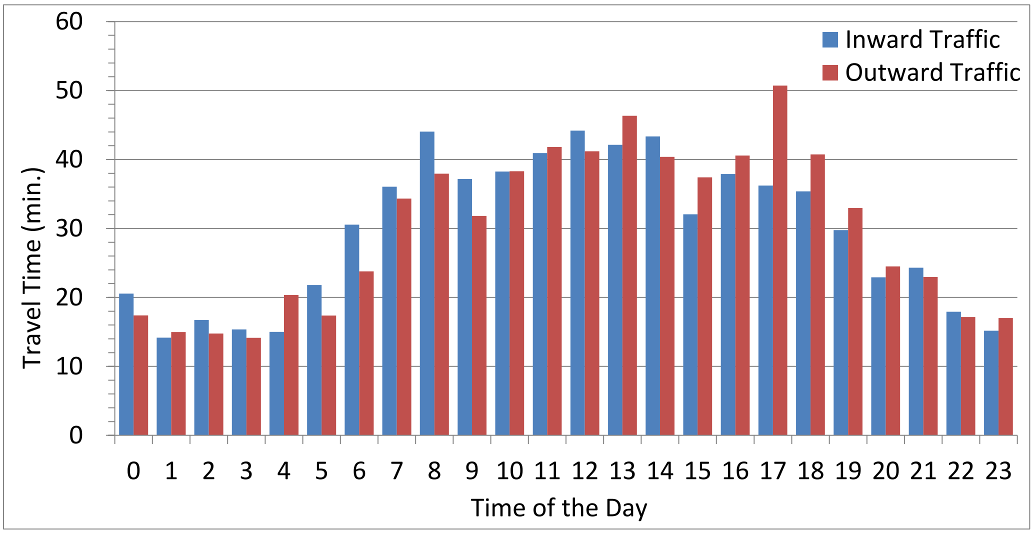


Figure 1.4 Travel time between Fort Lake House Junction to Battaramulla Junction

1.2.2 Objectives of the proposed Project

The main objective of the Project is to improve traffic conditions in Colombo metropolitan area by providing a comfortable, safe and reliable mode of public transportation. The proposed LRT route particularly targets to connect strategic locations and transportation hubs such as Fort, Town Hall/National Hospital, Borella, Sethsiripaya/Battaramulla, and Malabe (refer to Figure 1.5). Access to business centers, schools, hospitals and government offices (e.g. NIC, passport office) will be easier and transfer to other modes of transportation (e.g. provincial buses and railway) will also be convenient.

With the LRT project, travel time from Malabe to Fort will be cut to approximately 30 minutes. The reliability of travel time (not affected by road traffic) and ease of commute can enable commuters to travel comfortably. The proposed LRT system will serve the transport needs of people, particularly those who travel to and from Colombo via Malabe Corridor.

In addition, with the adoption of the LRT Project, traffic condition along the route will be reduced. Private vehicle users may be converted into using this alternative public transportation. This can lead to improved air quality and reduce economic losses due to traffic (e.g. gasoline consumption, maintenance of vehicles).

In a nutshell, the Project is aimed at:

- Easing traffic congestion in Colombo and its surrounding areas;
- Reducing travel time of passengers and commuters;
- Having improved connectivity of strategic locations and transport hubs;
- Increasing accessibility of places along the route;
- Providing a comfortable, reliable and safe alternative mode of public transportation; and
- Enhancing air quality by reducing greenhouse gas emissions from the transport sector

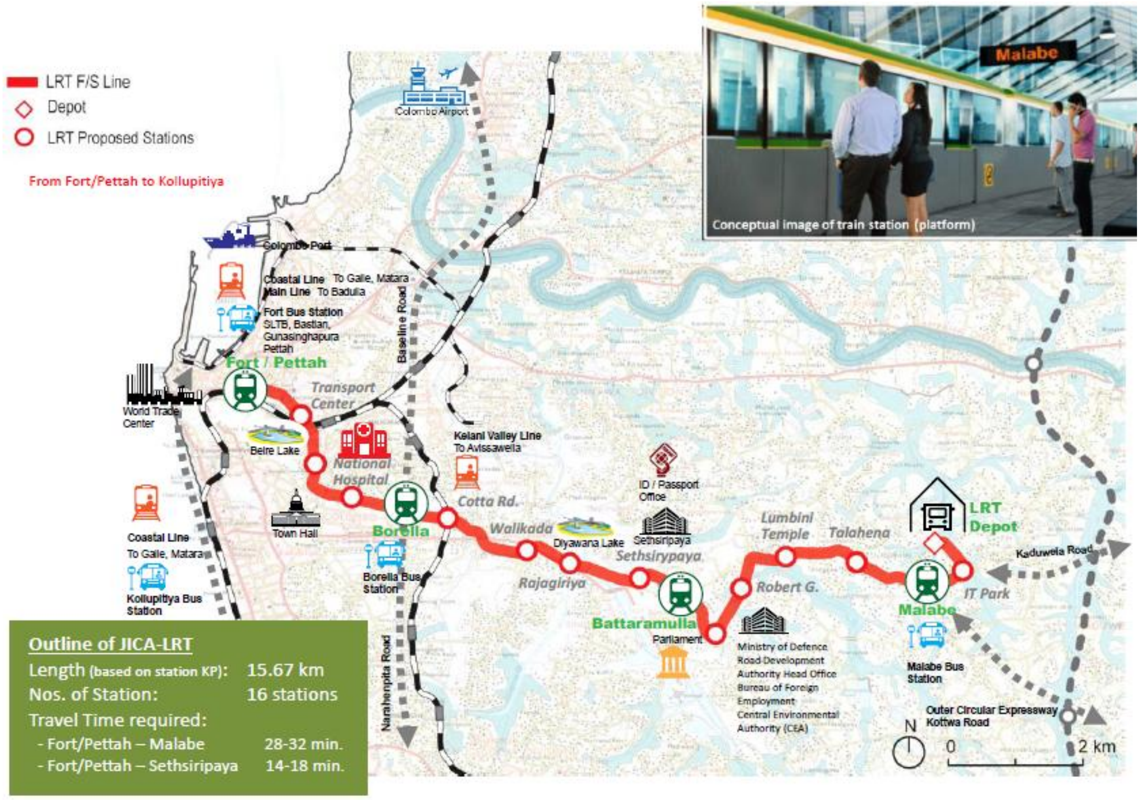


Figure 1.5 LRT Connectivity Map

1.3 Project Scope

The LRT Project will cover the 16 train stations, elevated structure, railway tracks, rolling stocks, depot, signaling and telecommunication system, and electrical and mechanical equipment. The Project will not cover the development of multi-modal transportation hubs/centers and parking facilities but these are considered in future planning.

1.4 Objectives of the EIA Report

The objectives of the EIA report are as follows:

- To study the existing environment of the proposed LRT corridor
- To ensure that alternatives to the proposed project have been studied and to determine whether the justification for the selection of the proposed project option is acceptable.
- To evaluate the potential adverse environmental impacts namely physical, physiochemical, social and ecological impacts of the project on the environment
- To propose suitable mitigation measures for the negative impacts. To assess the positive impacts of the proposed project.
- To meet requirements set by the CEA as stated in the Project's Terms of Reference.

The main objective of the EIA Report is to design a more environmentally and socially acceptable project with minimum social and environmental impacts. The EIA report and its recommendations will also enable the Project to comply with Sri Lankan National Environmental standards through the adoption of feasible and cost-effective mitigation measures. The EIA study consists of the following activities:

- Carrying out baseline studies on noise, ambient air quality, surface and ground water quality as well as sociology along the project route.
- Have stakeholder and line agency consultations through official meetings, public meetings, focus group discussions, social interviews using structured questionnaires.
- Correctly identify the fully affected and partly affected stakeholder belongings such as residential houses, high rise buildings and public buildings.
- Assess the potential environmental and social impacts from the project and determine the major impacts which require mitigation, to ensure that the project causes minimum social and environmental impacts.
- Develop an environmental Management and Monitoring plan for the project, to ensure sustainable implementation of the project.

Scoping and Impact Assessment study according with JICA TOR was conducted separately and is attached in Annex M.

1.5 Methodologies and Technologies Employed for the EIA Study

The EIA was carried out on par with the ToR, covering the major Environmental components such as Physical, Physio-chemical, Biological, Social environs that are likely to get impacted during the project interventions.

1.5.1 Literature Survey, Data Collection

The relevant and available literature related to the EIA study was reviewed (refer to References) and pertinent data were collected through desk studies. The main source of data related to the feasibility aspects were extracted from the recent “Preparatory Study on The Project for Establishment of New Light Rail Transit System in Colombo”, prepared by the Japan International Cooperation Agency (JICA) Study Team.

Reconnaissance visits and social surveys were conducted with the relevant key agencies to collect published and non-published data related to the project area. The data and the satellite images available for the maps were obtained from Survey Department and other relevant line agencies to develop necessary maps for the study area and its environmental settings. GIS data pertinent to Talangama Environmental Protection Zone was collected from CEA and that for Diyawanna Oya Sanctuary was collected from the Department of Wildlife Conservation.

1.5.2 Impact Assessment

In the analysis of impacts, the following impacts were studied:

- Impacts on hydrology (drainage network) due to bridge crossing across Diyawanna Lake and temporary land filling activities for the proposed depot was determined using flood models available at SLLRDC for Metro Colombo Environmental Improvement Project.
- Impacts on water quality (especially on the deport area) were determined using the measurements, and laboratory analysis.
- Impacts on ecology (flora and fauna) – Was studied through site knowledge based on the project activities and using information obtained from the site. Ecological information was also obtained from Colombo Wetland Development Project.

- Social impacts were assessed through site reconnaissance and social consultations through official meetings, public meetings, focus group discussions and through structured questionnaire surveys.
- Impacts on buildings and other social infrastructure were assessed in general by going through the construction methods, structure of nearby buildings etc. on the use of a services of a structural engineer.
- Impacts on the visual aspects of the landscape was studied by the use of the vertical profiles of the road against the existing landscape.

1.6 Conformity with Government policies and plans

Following applicable laws, regulations and policies will be complied by the proposed LRT project.

1.6.1 National Environmental Act (NEA) No 47 of 1980, and its' amendment Acts No. 56 of 1988 and Act No. 53 of 2000

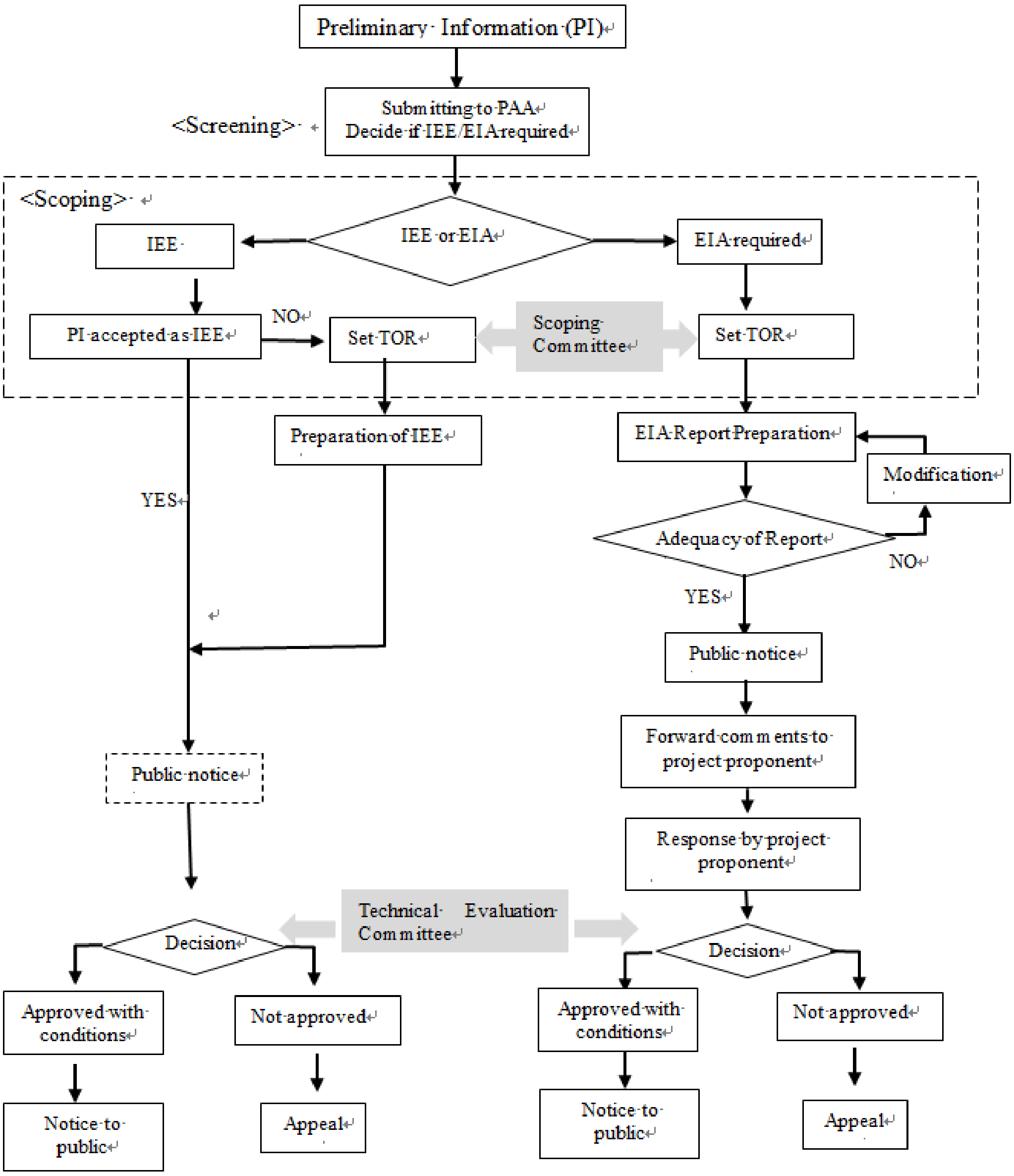
(1) Provisions

Under provisions of Part IV C of the NEA No. 47 of 1980 and subsequently stipulated in Gazette (Extra Ordinary) No. 772/22 dated June 24, 1993 the government of Sri Lanka (GoSL) made Environmental Assessment (EA) a legal requirement for a range of development projects. The list of projects requiring an EA in the form of Environmental Impact Assessment (EIA) or Initial Environmental Examination (IEE) is prescribed in the above Gazette notification.

In addition, the Gazette notification includes a list of line ministries and agencies that are designated as Project Approving Agencies (PAA). The PAA's are responsible for the administration of the EIA process under NEA. Prescribed projects requiring environmental assessments, listed in the same regulations relevant to the proposed project include;

- Construction of railway lines.
- Reclamation of land, wetland area exceeding 4 hectares;
- Mechanized mining and quarrying operations of aggregate, marble, limestone, silica, quartz, and decorative stone within 1 kilometre of any residential or commercial areas

There are 6 major steps in the IEE/EIA process; 1) Screening, 2) Scoping, 3) Preparation of the EIA/IEE, 4) Report review, 5) Approval with terms and conditions or rejection with reasons and 5) Post approval monitoring. The EIA process in Sri Lanka is shown in Figure **1.6**.



Source: CEA

Figure 1.6 EIA Process

(2) Applicability to the Project

The proposed LRT Project will require to undergo an Environmental Impact Assessment study as it falls under the category of projects which are listed in gazette no 772/ of (EIA Gazette).

There are also requirements for wastewater discharges, air emissions, noise and vibration which have been stipulated by the CEA under the provisions in the National Environmental Act. However, since this project does not fall under the category of industries, the noise level standards and air emission standards stipulated by the CEA under gazette notices (924/12 dated 23rd May 1996 and its amendment gazettes) will not be applicable to this project. Furthermore, the Light Rail Transit project does not result in any air emissions. However, there will be a certain amount of wastewater discharge from the depot and train stations. In addition to this there are Hazardous Waste Management Regulations under the NEA. These regulations will also have a bearing on this development project, as the project will be required to abide by the standards stipulated by the Central Environmental Authority for effluents discharged into inland surface water and Hazardous Waste Management Regulations as waste oil is considered as a hazardous waste.

1.6.2 Colombo District (Low Lying Areas) Reclamation and Development Board Act No. 15 of 1968

The Sri Lanka Land Reclamation and Development Corporation (SLLRDC) established under this act have power to declare low lying areas within the Colombo district as flood protection areas. The act was amended by Law No. 27 of 1976, Act No. 52 of 1982 and Act. No. 35 of 2006. - Since parts of the LRT route goes through low lying lands coming under the jurisdiction of SLLRDC their approval is required.

1.6.3 Crown lands Ordinance (Chapter 454)

This ordinance could be sited as "An ordinance to make provision for the grant and disposition of crown lands in Ceylon; for the management and control of such lands and the foreshore; for the regulation of the use of the water of lakes and public streams; and for other matters incidental to or connected with the matters aforesaid". This ordinance empowers the relevant minister to declare reservations for public streams and protect the source, course or bed of any public stream.

Since some parts of the land in the Light Rail route belongs to the Government, the provisions in this law will apply to this project.

1.6.4 Fauna and Flora Protection (Amend) Act (No. 49 of 1993)

The Fauna and Flora (Protection) Ordinance No. 2 of 1937, as amended by the Fauna and Flora (Amend) Act No. 49 of 1993 and Act No. 22 of 2009 provides regulations for the protection, conservation and preservation of the 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". Offenses relating to amphibians and fish included in Schedules III and IV of the Act. Part IV (sects. 42 to 48) concerns the protection of flora. The provisions in this law will apply to this project, as the project may have impacts on both terrestrial fauna and flora.

1.6.5 Urban Development Authority Law No 41 of 1978

The Act grants authority to the Urban Development Authority to declare areas as Urban Development Areas. Upon obtaining permission from the Minister, UDA can sell, lease, and purchase land owned by the Authority.

Since the proposed development lies within an area which is under the jurisdiction of (CMC) the Urban Development Authority, the UDA will require to be represented in the Technical Evaluation Committee for the EIA.

1.6.6 Flood Protection Ordinance (Chapter 449)

Under this ordinance the relevant minister is empowered to declare any area in Sri Lanka to be a flood area. While such order remains in force, the area indicated shall form a flood area and be subjected to the provisions of this ordinance. According to the guidelines of this ordinance the Director of the Irrigation Department or any other person designated by the relevant minister shall prepare and carry out a scheme for the efficient protection of such area against floods.

1.6.7 Colombo District (Low Lying Areas) Reclamation and Development Board Act No. 15 of 1968

The Land Reclamation and Development Corporation (SLLRDC) established under this Act has the power to declare low lying areas within the Colombo district as flood protection areas. The Act was amended by Law No. 27 of 1976, Act No. 52 of 1982 and Act No. 35 of 2006.

1.6.8 Thalangama Environmental Protection Area: Government Notification under the National Environmental Act, No.47 of 1980, Order under Section 24C and Section D.

Thalangama Environmental Protection Area was designated as a protected area by the Central Environment Authority (Gazette Notification 2007 1st March、No.1,489/10). According to the Gazette Notification, permitted uses and activities within the area include the following:

- Cultivation of paddy field
- Fishing
- Nature trails
- Construction of towers for the bird watching
- Environmental educational information centre and a sales outlet
- Construction of a security post

Prior approval from the CEA is required when developing any infrastructure within the protected area.

1.6.9 Declaration of Sri Jayawardenepura Bird Sanctuary

The Sri Jayawardenepura Bird Sanctuary in Kotte was designated as a Sanctuary by the Department of Wildlife Conservation (No. 331/8 Wednesday January 9, 1985). Unlike National Parks, development in Sanctuaries may be allowed with the approval of the Department of Wildlife Conservation.

1.6.10 Municipal Council Ordinance No 29 of 1947

This ordinance will be applicable to the project within the Colombo Municipal Council Area limits. The said act is relevant to the drainage system, underground utilities such as the storm water system, sewerage system and buildings and roads coming within the jurisdiction of CMC.

1.6.11 Agrarian Development Act (No. 46 of 2000)

This act is applicable to the paddy field areas of the proposed Depot area and to the abandoned paddy field areas close to Talangama Environmental Protection Zone.

1.6.12 Road Development Authority Act (No. 73 of 1981)

This act is applicable as a major part of the proposed LRT system runs in the middle of A Class and B Class roads which comes under the jurisdiction of RDA.

1.6.13 National Thoroughfares Act No. 40 of 2008

This action is applicable to all roads of Sri Lanka and as LRT system runs on national roads and impacts even adjoining national roads outside the LRT route.

1.6.14 Sri Lanka Railways Authority Act (No. 60 of 1993)

The Act cited above is applicable to the proposed LRT system as it crosses railway lines at Maradana.

1.6.15 Antiquities Ordinance, No. 9 of 1940

This ordinance is applicable to the project as there could be roadside archeological monuments covered by this act.

1.7 Required Preliminary Approvals and Conditions Laid Down by State Agencies

1.7.1 Required Approvals

The approvals and consents required for the project are summarized in the Table below.

Table 1.1 Required Approval/Consent

Agency/Organization	Purpose
Road Development Authority (RDA)	To utilize existing roads and regarding the Right of Way
Urban Development Authority (UDA)	Approval to use their land
Sri Lanka Land Reclamation and Development Corporation (SLLRDC)	Approval for development of the site for the depot and construction of the Light Rail route through flood retention areas such as the deport area.
Department of Archeology	Clearance that archeological sites will not be affected
Local Authority	Concurrence approval (Relevant local authorities will be represented in the TEC (Technical Evaluation Committee for EIA approval)
Ceylon Electricity Board	Consent to relocate/ adjust electrical utilities (if any to give way to LRT structures)
National Water Supply and Drainage Board	Consent to relocate/ adjust underground water supply lines (if any to give way to LRT structures)
Sri Lanka Telecom	consent to relocate/ adjust underground and overhead telecommunication lines (if any to give way to LRT structures)
Wildlife Department	Clearance that the project is outside the boundaries of Sri Jayawardenepura Bird Sanctuary
Department of Agrarian Development (Kaduwela DS)	Approval for the use of Paddy Lands for depot area
Colombo Municipal Council	Consent to relocate/adjust existing sewer and storm water line (if any to give way to LRT structures)
Sri Jayawardenapura Kotte Municipal Council	Consent to relocate/adjust existing sewer and storm water line (if any to give way to LRT structures)
Kaduwela Municipal Council	Consent to relocate/adjust existing sewer and storm water line (if any to give way to LRT structures)

1.7.2 Conditions Laid Down by State Agencies

Conditions Laid Down by RDA

After LRT Construction To widen some of the road segments extra land acquisition will be needed. RDA has indicated their concerns as follows;

1. Widen the center median (present width 1.2m) of the road to match with the LRT column width.
2. Traffic management plan for the construction period to be addressed and RDA approval should be obtained
3. Number of lanes, and width of the traffic lane, width of the walkways and center median should be according to the drawing
4. RDA will undertake additional land acquisition required for road widening.
5. Funding for additional land acquisition should be provided by RDA

CHAPTER 2 Project Description

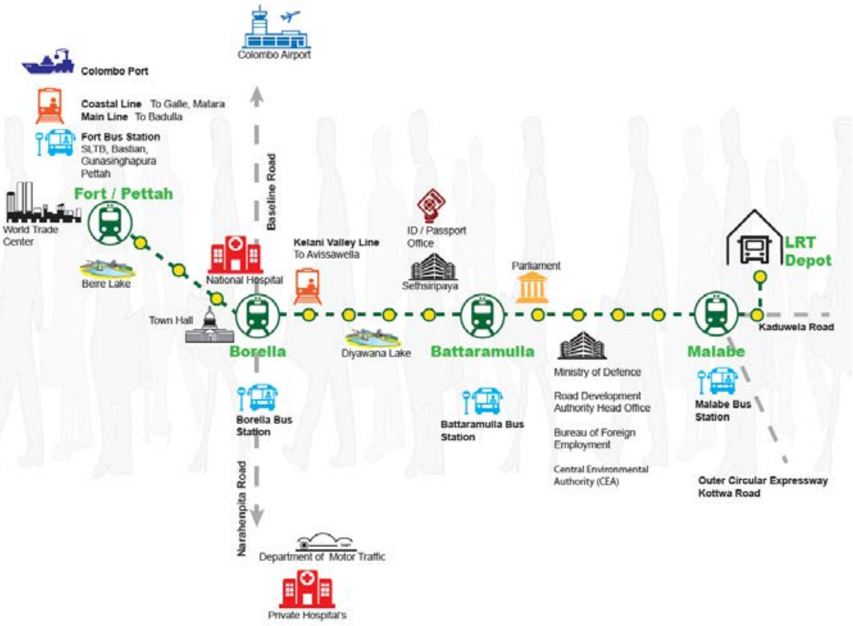
2.1 Description of the proposed project

2.1.1 Location of the Project

The LRT System will connect strategic locations and transport hubs from Malabe to Colombo. It will connect Malabe, Battaramulla, Borella and Fort/ Pettah. A simplified version of the route with key locations is shown in Figure 2.1. The proposed LRT is located within Colombo District. The location of the proposed LRT route is shown in Figure 2.2 below.

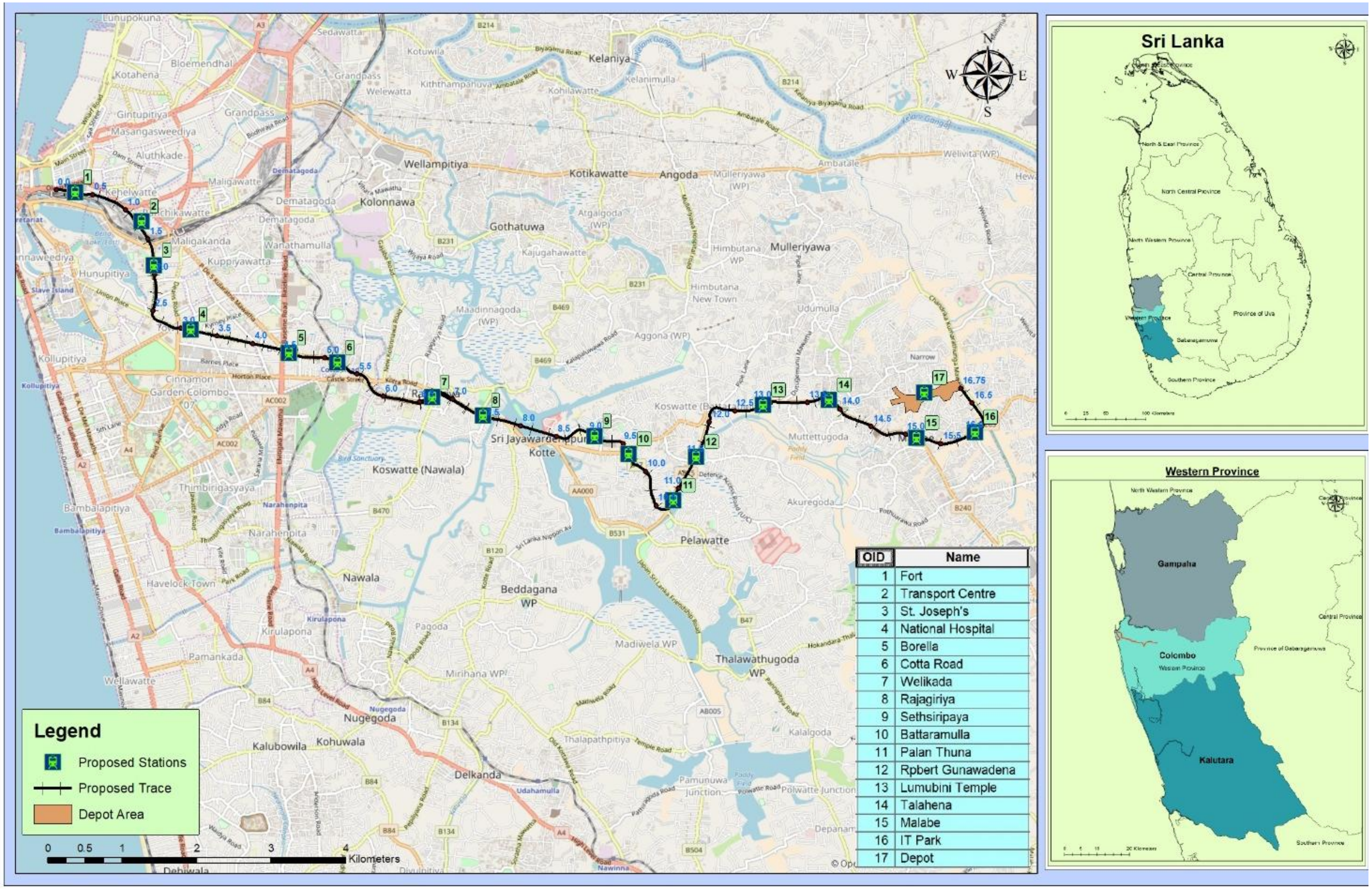
The LRT route starts from Fort station and enters the Railway Yard and Railway, T B Jayamawatha-D R Wijewardena Mawatha Junction (Gamini Hall) , T B Jayamawatha, takes a left turn at Ibbanwala Junction and enters Dr. Colvin R De Silva Mawatha, Lipton Circus, Ward Place , Borella Junction, Dr N M Perera Mawatha(Cotta Road) , takes a right turn and enters Sri Jayawardenapura Mawatha, crosses Diyawanna Lake (Diyatha Uyana) , takes a left turn at Polduwa Road , takes a right turn and enters the rear area of Sethsiripaya ,takes a left turn and enters Batteramulla Junction, Pannipitiya Road , Palan Thuna Junction, Denzil Kobbekaduwa Mawatha, Kaduwela Malabe Road , Low lying area on the Left side of Chandrika Kumaranathunga Mawatha and the depot site on the Left side of Madewela East Diversion Canal. The LRT includes 16 stations and 1 Depot.

Location map indicating the DS division and GN division are presented in **Figure 2.3** and **Figure 2.4**.



Source: JICA Study Team

Figure 2.1 LRT Connectivity Map



OID	Name
1	Fort
2	Transport Centre
3	St. Joseph's
4	National Hospital
5	Borella
6	Cotta Road
7	Welikada
8	Rajagiriya
9	Sethsiripaya
10	Battaramulla
11	Palan Thuna
12	Rpbert Gunawadena
13	Lumubini Temple
14	Talahena
15	Malabe
16	IT Park
17	Depot

Figure 2.2 Location map of the LRT Project

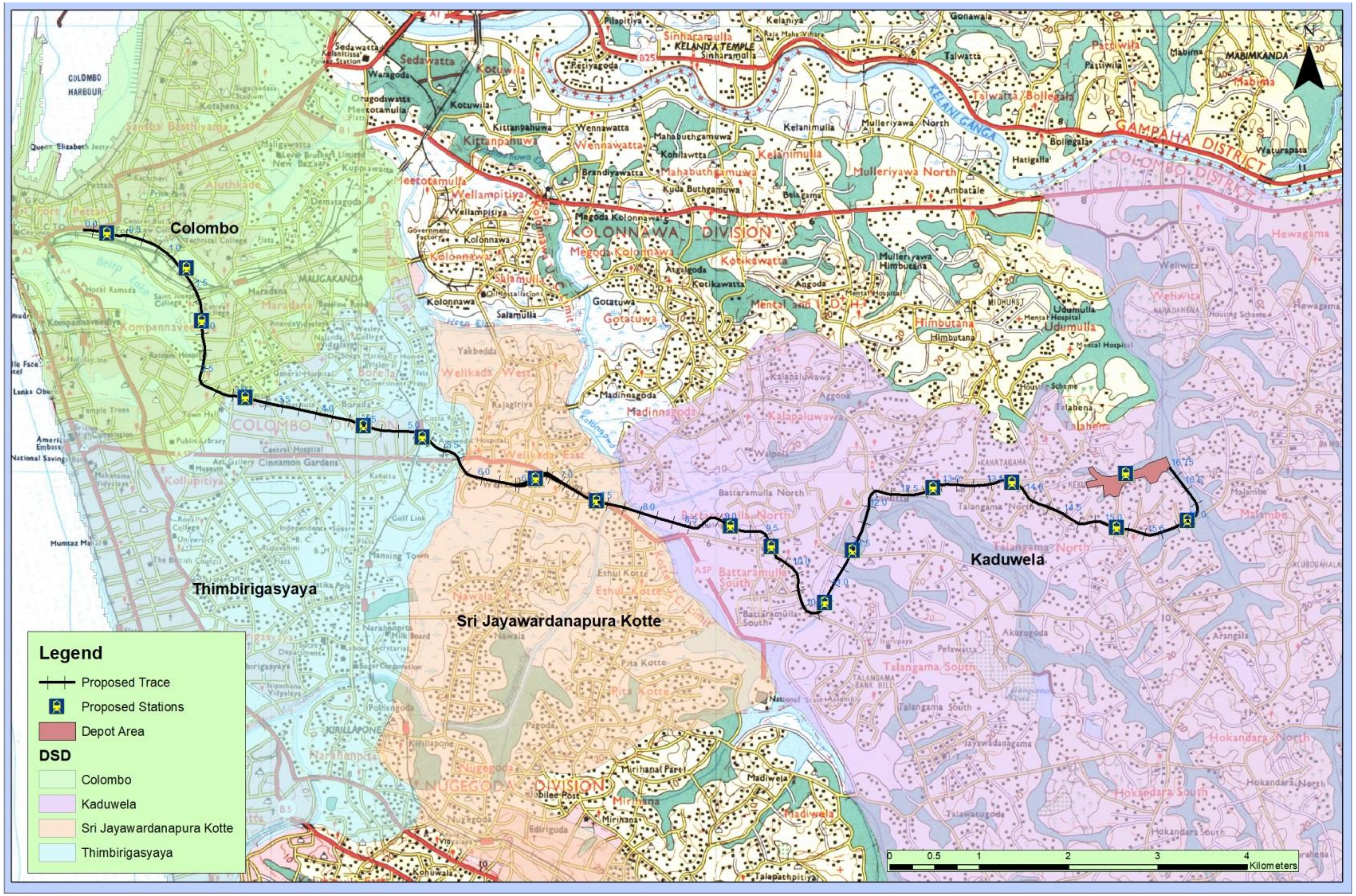


Figure 2.3 Affected DS Divisions

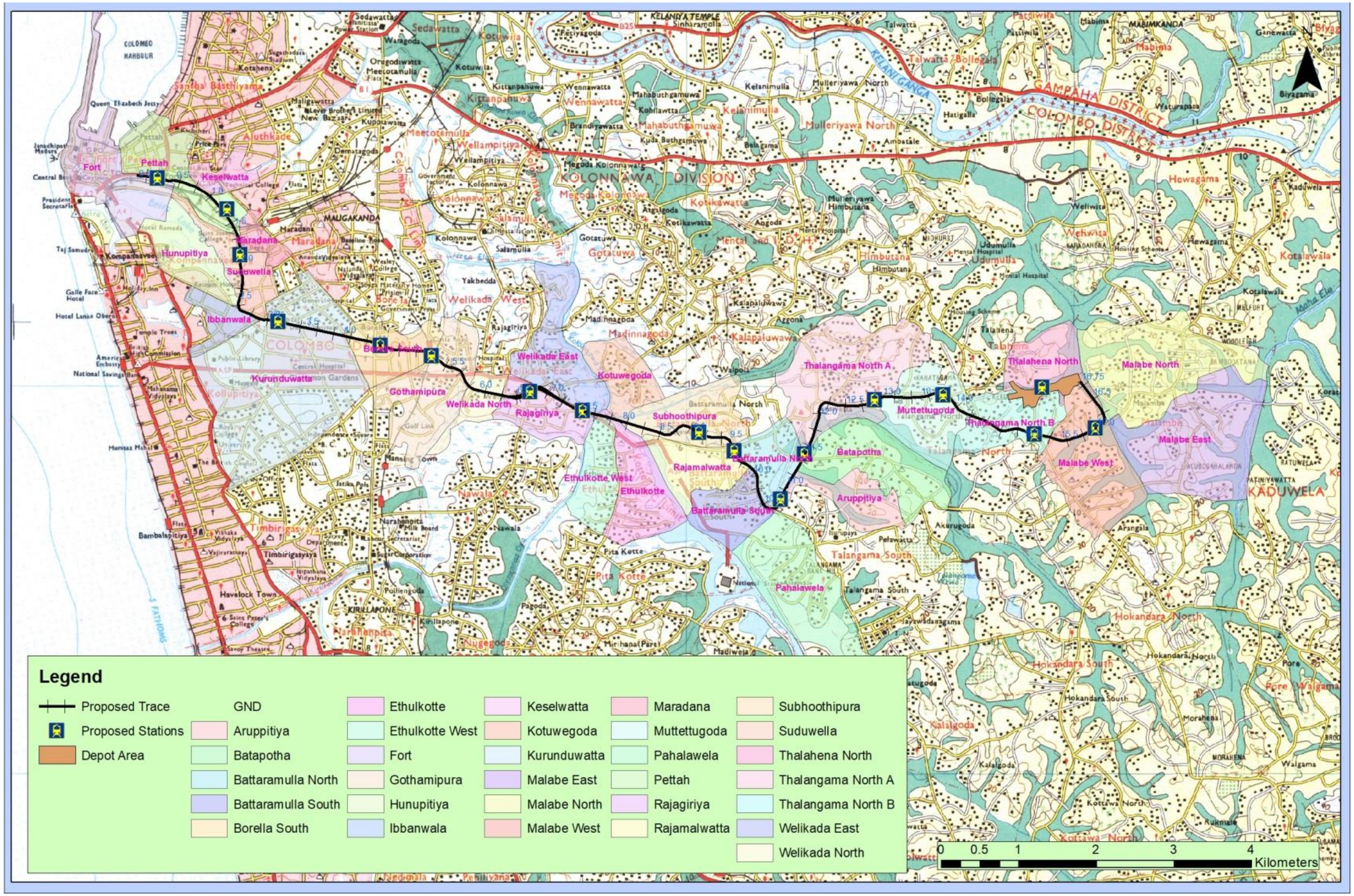


Figure 2.4 Affected Grama Niladhari Divisions

2.1.2 Ownership of the Project Site

The proposed LRT route is mainly located on national roads which belong to the Government of Sri Lanka. Most of these roads are A and B class Roads owned by RDA. Few segments of C Class roads also will be used (e.g. Polduwa Road at Diyatha Uyana) owned by the local authorities. There are other land strips which belong to Sri Lanka Railway (Railway Yard Pettah) and UDA (Diyawanna Lake and the rear are of Sethsiripaya).

The PMU is still in the process of obtaining the required consent from relevant agencies. Correspondence letters are attached in **Annex B**.

2.1.3 Project Components

The proposed LRT system is composed of the following: railway track, rolling stock, train stations, depot (parking and maintenance for rolling stock), signaling and telecommunications system, and electrical and mechanical facilities. Components of the project are described below in detail.

(1) LRT Structure

The LRT structure consists of three structural components – the girder (super structure that supports the railway track), the pier (sub-structure), and the foundation. An image of these components is shown in **Figure 2.5.**

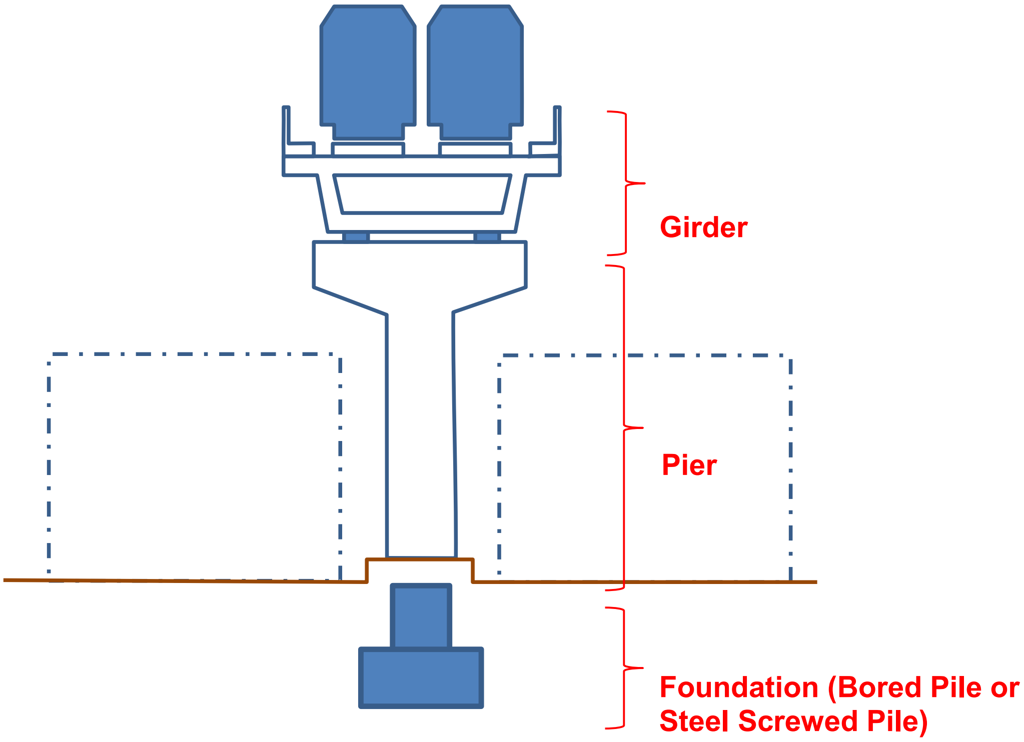
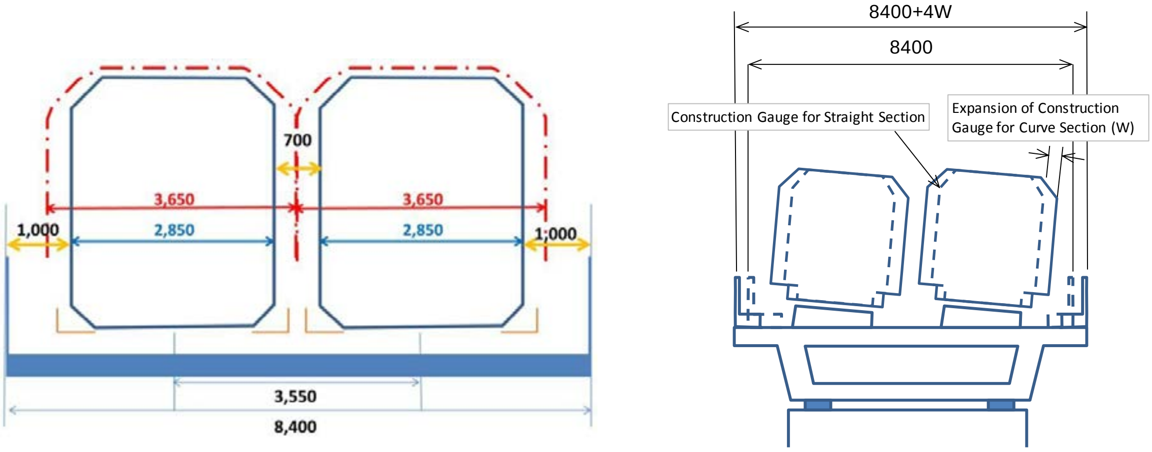


Figure 2.5 Components of the LRT Structure

The proposed 16km LRT structure will be built primarily on existing roads. The cross-section of the railway track on the girder is shown in **Figure 2.6**. It can be observed that the total width of the girder is approximately 8.4m (refer to **Figure 2.6**(a)). This width can accommodate two trains heading to opposite directions. The width of the rolling stock is approximately 2.85m and an inspection walkway at the outer sides of the rolling stocks has an allowance of approximately 1m.

It is important to note that the dimensions discussed above are for a straight section. In case of a curved section, more space is required for the railway track width. The required additional space is computed using the formula shown in **Figure 2.6** (b).



(a) Straight Section

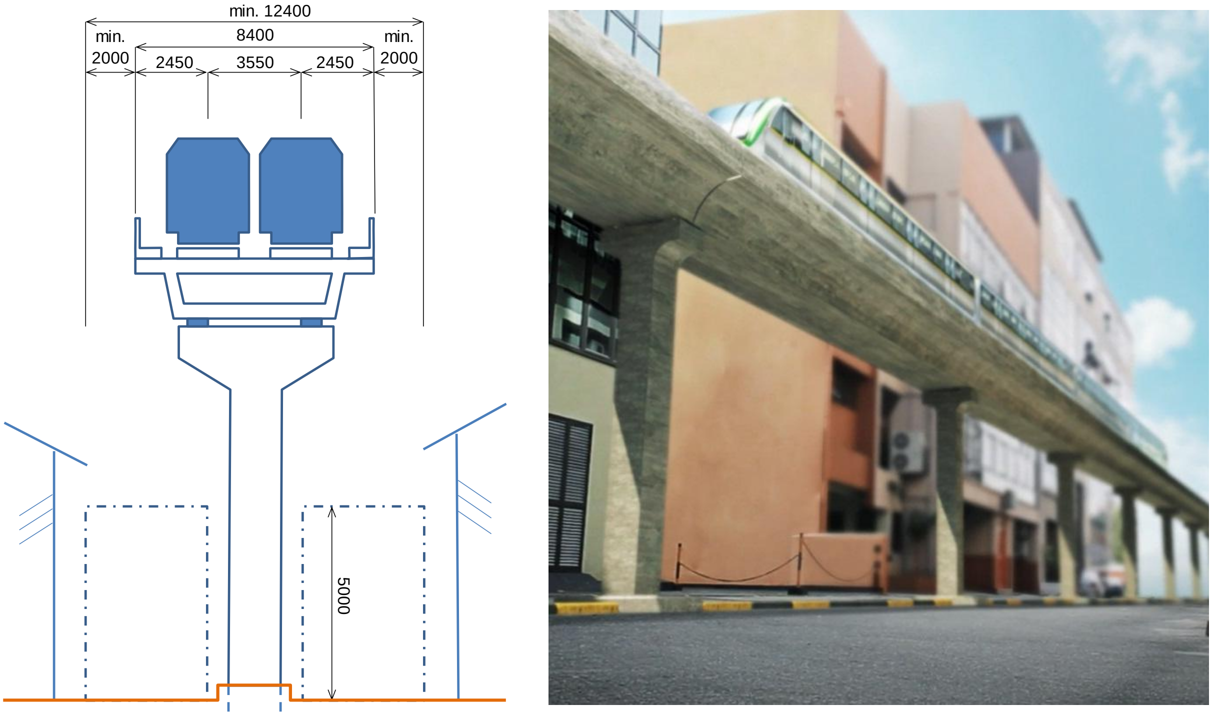
(b) Curved Section

Note: Dimensions in mm

Figure 2.6 Image of a Girder

The pillar of the elevated structure is approximately 1.5m x 1.5m. The average height is set at 10m with a minimum height of 5m, depending on the characteristics of certain locations (see **Figure 2.7**). An image of the railway track is also shown in the same Figure.

The Right of Way (ROW) of approximately 2m has been added at both sides of the railway track. This space is allocated as construction space for substructure and viaduct; and evacuation space in times of emergency (e.g. for access to buildings during fire). This width can be negotiable if the local conditions allows during detailed design stage.



(a) Cross-section of elevated railway track
Note: Dimensions in mm

(b) Conceptual image of elevated railway track

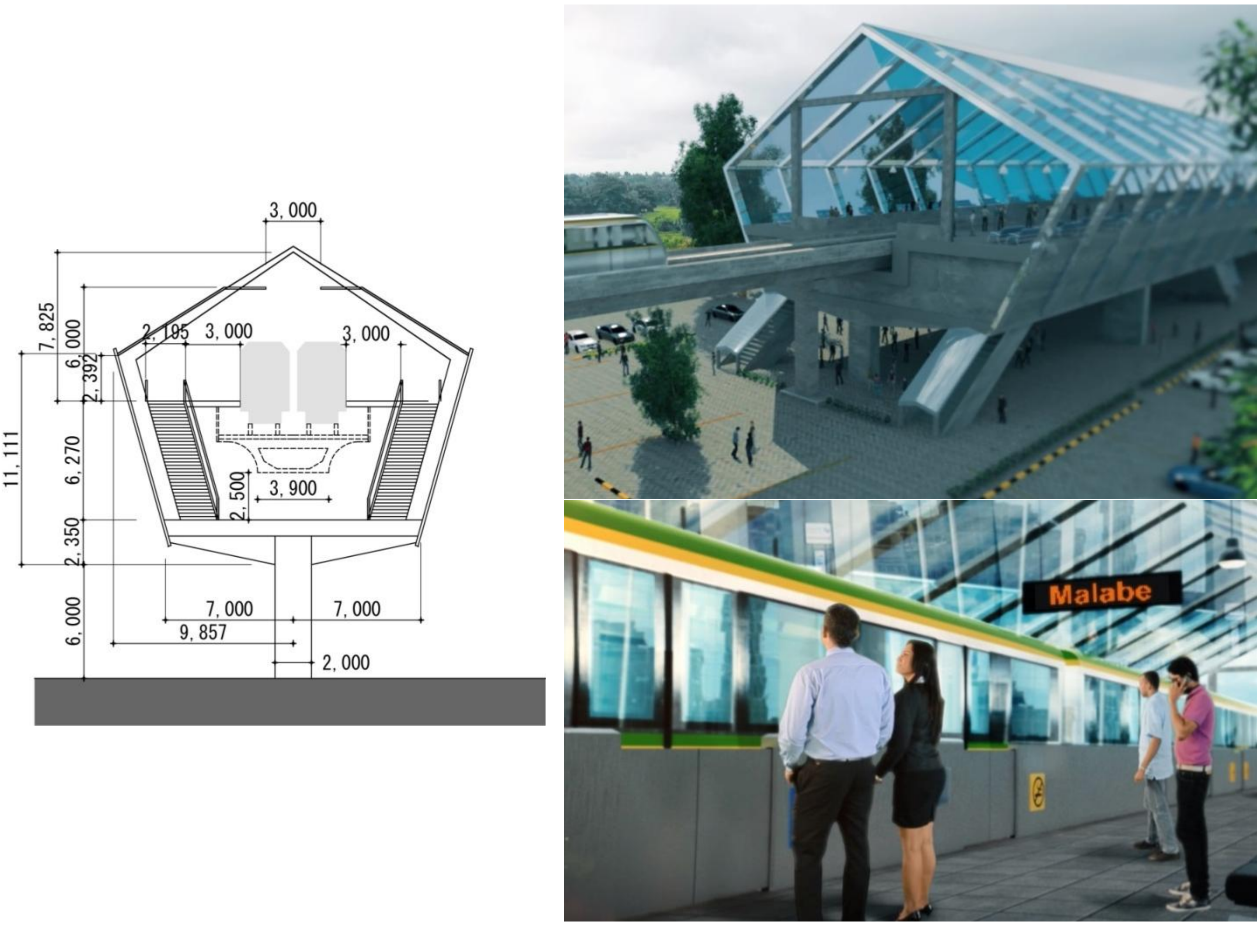
Figure 2.7 Image of a Pier

(2) Train Stations

The proposed LRT System is composed of 16 train stations from Fort to Malabe. The location of the stations is shown in Figure 2.2.

The cross-section image of the elevated train station is shown in **Figure 2.8**. The width of the platform is approximately 4m and the required width for the train station structure is approximately 14.65m. These dimensions include the space for ticket booth, ticket gates and stairs to the concourse. The minimum height of the station is also set at 5m.

The conceptual exterior and interior images of the proposed LRT train station are also shown in **Figure 2.8**.



(a) Cross-section of the train station

Note: Dimensions in mm

(b) Conceptual images of the train station

Figure 2.8 Image of a Train Station

(3) Rolling Stock

For the LRT system, 25 trains will be used. Each train is composed of 4 up to 6 cars (rolling stocks), depending on the time of operation. An image of the proposed train for the project is shown in **Figure 2.9**.

Figure 2.9 Image of LRT Rolling Stock

The selection of the right type of rolling stock depends on the following items:

- Maximum speed
- Gauge size
- Traction power supply
- Train formation
- Standard Passenger Capacity
- Capacity of a train
- Major dimension (length, width)
- Weight per train
- Body Materials
- Saloon design (door, seat type)
- Special facilities
- Traffic performance acceleration/deceleration)
- Propulsion system
- Brake control system
- Others (bogies, signal system, etc.)

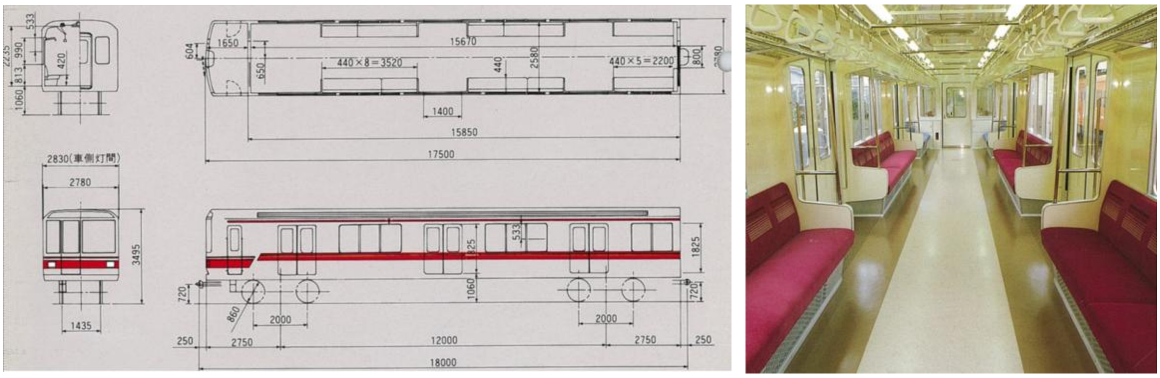
The proposed specifications for the LRT's rolling stocks are summarized in **Table 2.1**.

Table 2.1 Recommended specifications for the LRT

Technical Parameters		**Specification**	
Maximum Speed		80km/h	
Gauge		1,435mm (Standard gauge)	
Traction Power Supply		Third Rail System	
Train Formation *Tc: Trailer Car with driver's cab,* *M: Motor car*		2M2T (Tc+M+M+Tc)	
Passenger Capacity			
Standard Passenger Capacity	Seated	Standing (3.3 persons/m^2)	Total
Lead Car	42	86	128
Intermediate Car	52	84	136
Capacity of a Train (4 car-sets)	Per Car	Nos. of cars	Total
Lead Car	128	2	256
Intermediate Car	136	2	272
Total Passengers (3.3 persons/m^2) Including Seated passenger			528 (seated: 188)
Total Passengers in different AW (Added Weight due to standing passenger)			
AW-4: stand (4persons/m^2) + seat		600	
AW-6: stand (6persons/m^2) + seat		806	
Physical Characteristics			
Leading Car Length		18,000mm	
Intermediate Car Length		18,000mm	
Body Width		2,650~2,850mm	
Weight per Train (tare)		120t	
Body Materials		Light weight stainless steel or Aluminium	
Saloon Design			
Door Ways		3 doorways each side of car	
Door Type		Double slide doors 1,300 ~ 1,400mm width	
Seat type		Longitudinal seat type	
Special Facilities			
Wheel Chair Space		Equipped	
Baggage Space		Not Equipped	
Toilet		Not Equipped	
Traffic Performance			
Acceleration		3.2 km/h/s (0~30km/h)	
Deceleration		Service 4.0 km/h/s Emergency 5.0 km/h/s	
Propulsion System			
Power Collection System		DC 750 V, Collector shoe, (2set / 1 Bogie)	
Control System		VVVF inverter with IGBT, (1 unit/ M car)	
Brake Control System		All electric command electro-pneumatic brake	
Bogies		Bolster-less type (air suspension)	
Auxiliary Systems and Equipment			
Air Conditioning Equipment		Roof top type	
Auxiliary Power Supply Equipment		SIV: 3-phase inverter with IGBT	
Inter communication system		Communication system between front and rear cabin	
Passenger Information System		Public address system via loudspeaker Visual information system via LCD screens	
Security camera		Several security cameras are installed in each Rolling Stock.	
Signal System		ATP, CTC, Automatic Train Operation (ATO) CBTC or Track Circuit System	

Source: JICA Study Team

The exterior and interior images of the proposed rolling stock, which is currently in operation, are shown in **Figure 2.10**. Basically, it is equipped with a longitude type seat, handrails, interior security camera and digital signage.



Source: JICA Study Team

Figure 2.10 Proposed Rolling Stock (External & Internal Images)

In the case of bogies, simple and easy maintenance type is recommended as shown in below.

Source: JICA Study Team

Figure 2.11 Sample of Bolsterless Bogie with 3rd Rail Collector

(4) Depot

Depot is an indispensable facility to maintain the quality of train operation. Its main purpose is to serve as a parking lot for the rolling stocks and as a maintenance area to inspect, repair and prepare rolling stocks for operation. Its specific functions include:

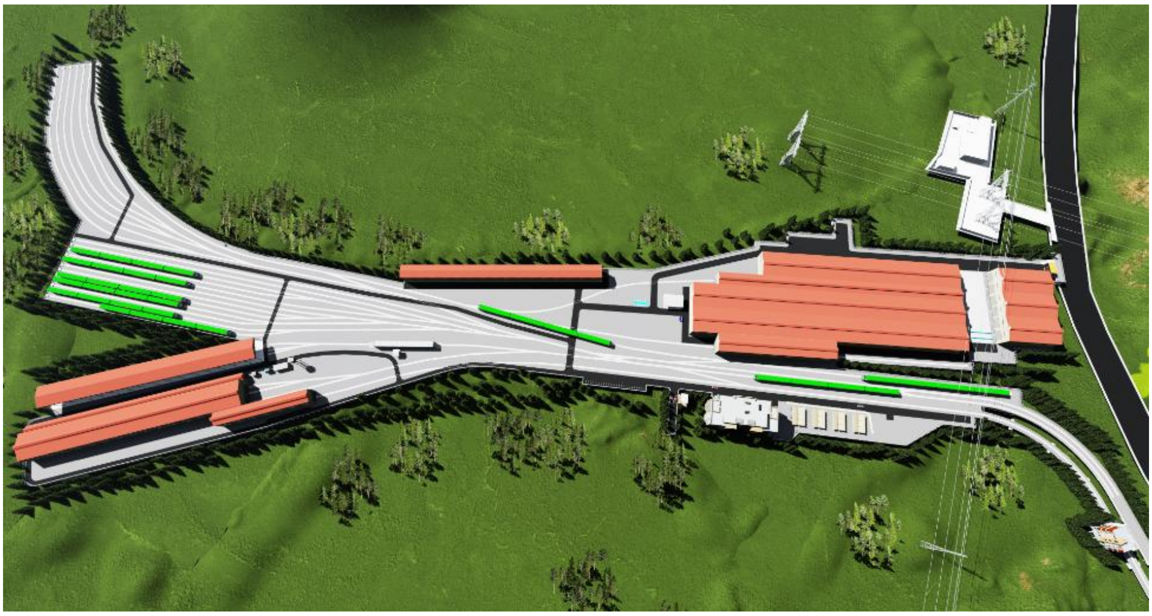
- to park trains,
- to conduct inspections and preparations for the operation,
- to repair the failure on the train set, and,
- to overhaul rolling stock.

The proposed depot site is located in Malabe area. The site, approximately 15 ha of land, mainly consists of paddy land and abandoned land. Since the area is a water catchment area, the depot will be built on an elevated structure supported by pillars. Conceptual images of the planned depot platform are shown in Figure 2.12. A photo of an existing elevated depot area is also shown below.

The distance between pillars will be 4-5 meters and the height of the pillar would depend on the topography of the area. However, the height of the bottom of the platform will be 1-2m from the level of an extreme flood event that happens once in 100 years (based on simulation).

The proposed location and layout for the depot area are shown in Figure 2.13. It consists of parking spaces for trains (stabling tracks), sheds for heavy and light maintenance, wastewater treatment system, power station, and administrative building.

A detailed description of the maintenance activities in the depot area is presented in Methodology of Operation (Chapter 2.1.8).



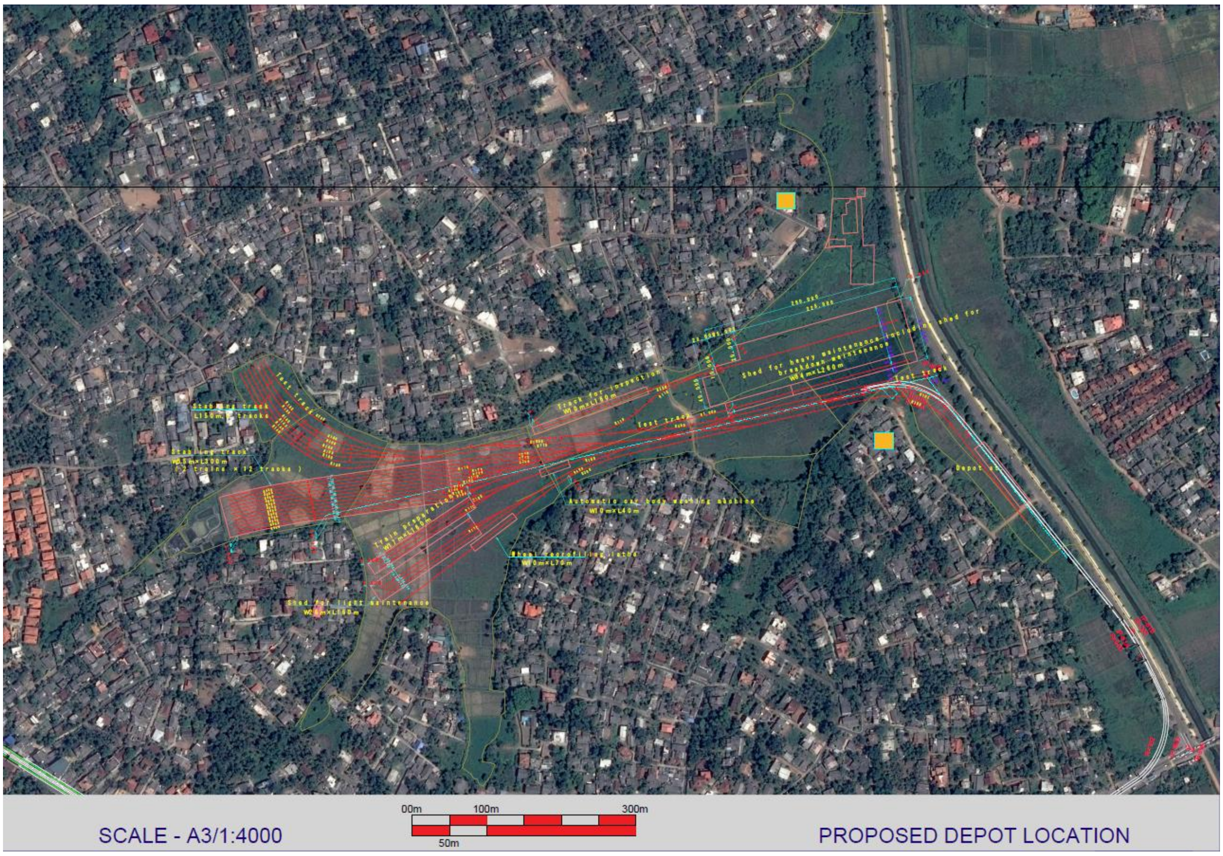
(a) Top View of Depot Area

C

(b) Side View of Depot Area

Figure 2.12 Conceptual Images of the Depot Area

Image of an elevated railway depot area (Source: Bhavesh Swami[1])



Source: JICA Study Team

Figure 2.13 Proposed Layout for the Depot Area

(5) Signaling and Telecommunications

The Signaling and Telecommunications are both important in order to control and operate the trains. S&T ensure safety and performance of running trains. It is also necessary for the provision of satisfactory service to passengers and response to special/unanticipated events. The life cycle of S & T equipment ranges from 15 years up to 20 years.

S&T consist of four systems, namely:

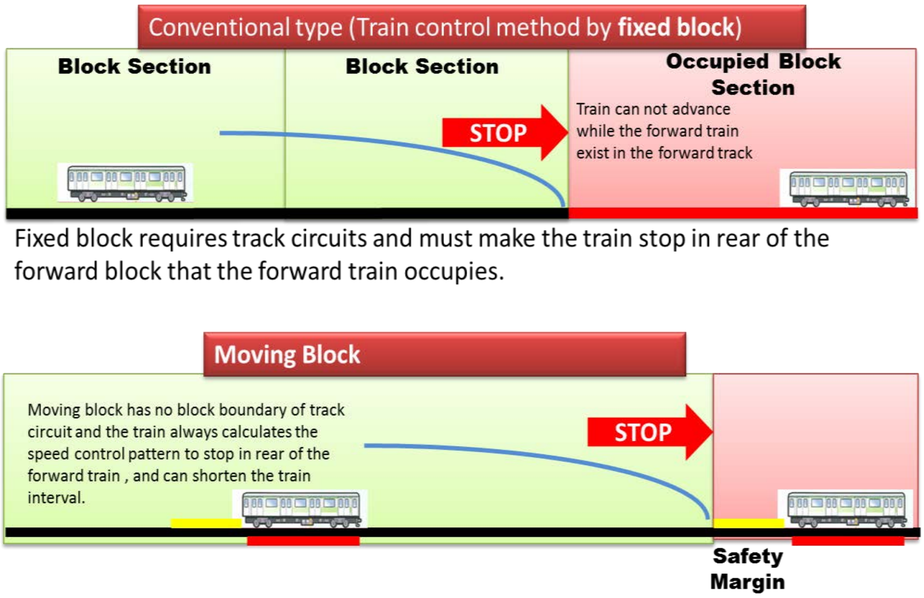
- ATP (Automatic Train Protection)
- ATO (Automatic Train Operation)
- ATS (Automatic Train Supervision)
- CIS (Centralized Interlocking System) to park trains,

For the planning on Telecommunications, the selecting the types of transmission means as well as collecting & monitoring the types of events and information will be described in the following sections.

1) ATP (Automatic Train Protection)

The automatic train protection system prevents train collisions by controlling mutual train interval and it limits the speed on the basis of route and temporary work conditions.

In order to accomplish automatic train protection system, there exist two types of methods based on different train detection system for its location, “Fixed Block System with Track circuits” and “Moving Block with CBTC (Communications-Based Train Control)”. The description of these two types is shown in **Figure 2.14**.



Source: JICA Study Team

Figure 2.14 Image of ATP

2) ATO (Automatic Train Operation)

For the LRT, a semi-automatic train operation (Grade of Automation 2) will may be employed. According to the International Association of Public Transport (UITP), this grade of automation is characterized by automatic starting and stopping of trains, but a driver operates the doors, drives the train if needed and handles emergencies.

3) ATS (Automatic Train Supervision)

Train operation control system has the basic function of ensuring smooth operation of train groups, including train diagram control, operation record management, operation control and monitoring, route control, guidance display control, and information broadcasting for all trains on the main track and on the entry and exit sections to car depots.

4) CIS (Computerized Interlocking System)

The computerized interlocking system (CIS) and/or the RRI (Route Relay Interlocking System) will be installed on the main track at each of station and in the car depot to secure the safety of the route setting.

5) Telecommunications

Telecommunication system is used to ensure a smooth and efficient execution of the train operation and maintenance work. This system also functions as a medium of communication to the passengers, drivers and dispatchers in case of recovery of train operation after abnormality, special events and emergencies. Its compositions and functions are shown in **Table 2.2**.

Table 2.2 Telecommunications Equipment

Classification	Component
Train radio equipment	Train radio, maintenance radio, emergency warning, Train information (Delay, train information in other lines, Transfer)
Cable equipment	Dispatcher telephone, exchange telephone
Closed Circuit Television (CCTV)	Video monitoring
Optical transmission equipment, etc.	Optical fibre transmission, power supply
Passenger information display equipment, station announcement equipment	Train Operation guidance display (Train Delay Platform No. Departure time), guidance announcement (Train approach, Door closing, Abnormal event information)

Source: JICA Study Team

- Communication means between OCC and moving trains

  The train radio equipment establishes communications between the dispatching centers, trains on the main track, and vehicles inside the car depot. This enhances train operational safety and facilitates the performance of duties. The emergency alarm equipment has emergency warning and emergency train stop functions which can be used as emergency measures.

- Optical transmission equipment

  The optical transmission equipment will be required to install among OCC and stations independently, securing a high degree of transmission quality and transmission speed.

  The optical transmission equipment is a transmission circuit used to ensure efficient and high-quality information on the communication between the central dispatching centre and field organizations and on the remote monitoring and control from the centre for a period of train operation and maintenance, even when there is a possibility of interference caused by lightning or electrical magnetic noise.

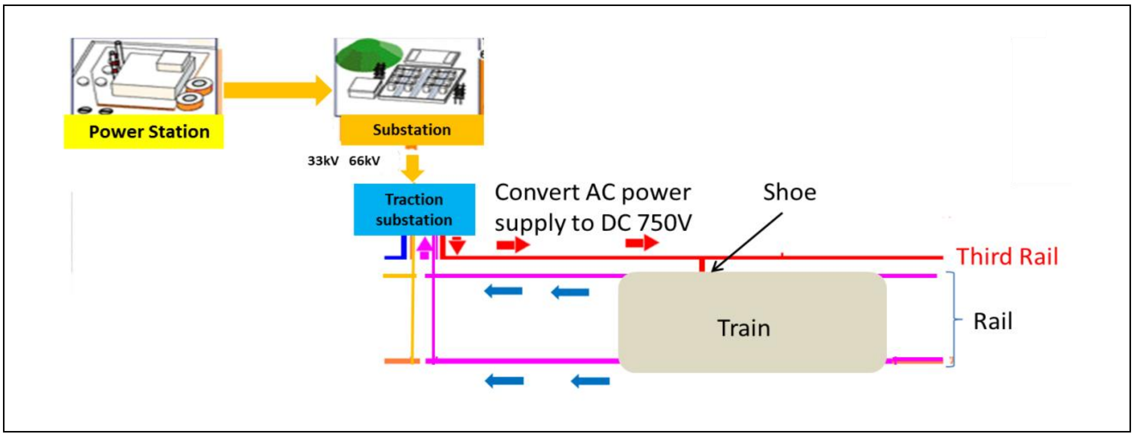
- CCTV (Closed Circuit Television) equipment

  The CCTV equipment has CCTV cameras in the platforms and concourse of each station, which enables monitoring passengers getting on/off trains at the train cabin.

(6) Electrical and Mechanical

1) Electricity / Power Supply

Electricity will power the LRT System. A third-rail power supply system will be employed for the LRT. **Figure 2.15** shows the image of electricity flow for power supply to LRT train. The AC power is distributed from the power station to Receiving Substation (RSS) for LRT system via CEB's grid lines, and then RSS sends AC to Traction Substation (TSS) which converts to DC from AC. TSS supplies DC 750V on the third rail to motor in LRT vehicle for traction.



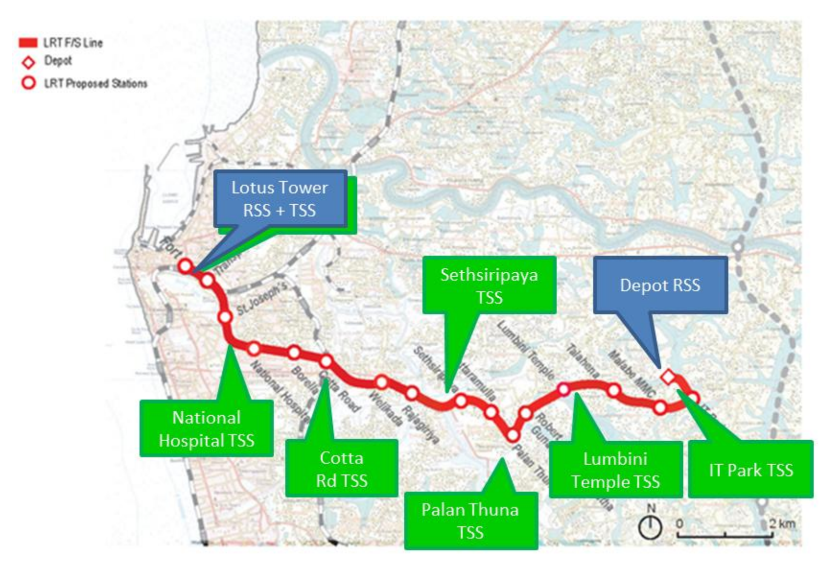
Source: JICA Study Team

Figure 2.15 Image of Electricity Flow for LRT System

Location of RSS and TSS

The candidates of location for RSS, where the 132 kV power can be received, are shown in **Figure 2.16**. Ceylon Electricity Board (CEB) confirmed enough existing capacity and lines.

On the other hand, TSS should be installed at every 2 to 3km when the feeding voltage is DC 750V. Seven TSS are planned to be installed. **Figure 2.16** shows the candidate locations for TSS, which satisfies land area requirements and space for intervals.



Source: JICA Study Team

Figure 2.16 Proposed Location of RSS and TSS

Other Electric Provision Facilities

Service Substation (SSS) provides electricity to electrical equipment in station. Therefore, it should be installed inside of station or nearest place in case of there is not enough space inside station.

Traction Electric Room is a room that supplies electricity to track lines in Depot and has only the main switch for each line is arranged. The equipment is installed at the "Depot RSS". The main switches for each line are listed as Entry Track, Outgoing Track, Maintenance, Heavy Repair, Test Track, Stabling Tracks and Other Tracks.

OCC Electric Room provides electricity for the operation control centre, which is installed at the ground floor of the OCC building at where OCC and Power SCADA are prepared. It equips two 33kV feeder lines transmitted from RSS and an emergency generator.

Electric Capacity for RSS/TSS/SSS

The required capacity for electricity based on the preliminary operation plan is presented in **Table 2.3**. Note that the figures will change when the train operation and alignment are changed.

Table 2.3 Required Capacity for Substation

No.	RSS Name	TSS Name	Required Capacity				
			Rectifier (kW)	**Converting Rectifier Capacity to AC (kVA)**	**SSS (kVA)**	**TSS (kVA)**	**RSS (kVA)**
1-1	Lotus Tower	Lotus Tower	3,516	3,710	770	4,480	16,830
1-2		National Hospital	2,104	2,240	630	2,870	
1-3		Cotta Road	3,752	3,960	630	4,590	
2-1	Depot	Sethsiripaya	3,851	4,080	910	4,990	16,250
2-2		Palan Thuna	2,673	2,820	--	2,820	
2-3		Lumbini Temple	2,813	2,980	639	3,610	
2-4		Depot	2.982	2,980	980	4,130	
2-5		OCC	--	--	700	700	

Source: JICA StSource: Source: Study Team

Note: In this table, the apparent power (kVA) uses a scalar sum as it is (In the event of the power factor exceeding 0.9, no large error occurs between the vector sum and scalar sum.). The rectifier adopts 12 pulse rectifier, since any standards in harmonic waves in Sri Lanka were not found, 12 pulse is selected according to Japanese standards that specify not to produce problems (Since the occurrence of harmonics is a physical phenomenon, there is no difference in occurrence by country.).

Countermeasures for Unexpected Events

For example, in case of shutdown of the Lotus Tower RSS, electricity cannot be transmitted to 2 TSS such as Fort and National Hospital. This will cause the train to stop. Even if a train stops between stations due to a power failure, it is not recommended that the operator let passengers walk on the elevated track. The LRT structure is fully elevated and has a third rail along the rail. When passengers walk on the deck, the third rail may be pressed and this may generate electric shock which can cause serious injury/ accident.

In order to prevent this situation and ensure uninterrupted operation even with the shutdown of one RSS, all RSS will require 40MVA capacity. If CEB cannot supply 40MVA for each RSS, train operation becomes limited (reduced number of services), when one RSS shuts down.

Regenerative Power Absorbing Device

With installation of the platform screen door (PSD), train should stop at fixed point. With this, a regenerative power absorbing device is required for fixed stopping. A battery system will be employed and these devices will be installed at the Fort TSS and the Lumbini TSS. It is important to note that detailed specifications will be determined during the detailed design stage.

Power SCADA

Power SCADA is a software responsible for monitoring and control of substations and electrical rooms, and placed in OCC. A terminal of Power SCADA is installed in each substation and electric room, and it monitors and I/O (input and output) for controlling. This terminal device is named as Remote Terminal Unit (RTU). Power SCADA and RTU are connected by double looped optical cable.

Third Rail

The third rail supplies power to trains along the track as shown in **Figure 2.17**. It is supported by insulator and touch with shoe of train.

Source: JICA Study Team

Figure 2.17 Image of Third Rail

2) Mechanical System

Mechanical equipment, which will be installed in the station facilities, will be decided during detailed design. Components of the mechanical system to be considered are listed in **Table 2.4**.

Table 2.4 Components of the Mechanical System

Item.	Facilities
1) Air conditioning equipment	• Air conditioning equipment, (including attached piping construction) • Exhaust fans • Duct (including outlet, inlet, intake, exhaust)
2) Water supply and drainage facilities	• Water tank and accessories • Feed water pump • Sanitation equipment • Piping
3) Fire protection equipment	• Fire alarm equipment • Fire water tank • Fire protection water pump • Fire hydrant related • Fire-fighting piping • Inert gas injection facility • Portable fire extinguisher
4) Electrical equipment	• Power supply equipment (equivalent to electric SSS) • Power distribution equipment • Uninterruptible power system • Interior lamp and outlet • Ground fault facility • Building related automatic equipment
5) Elevator Escalator	• Elevator • Escalator
6) Platform screen door (PSD)	• Half height PSD • Controllers • Power Supply System with UPS
7) AFC (Auto Fare Collection)	• Ticket Vending Machine • Passenger Gate • Fare Adjustment Machine • Money Management Facilities • Station Server • Contactless IC Card • Card Initializing System

Source: JICA Study Team

2.1.4 Layout plans

As discussed in Chapter 2.1.3, 12.4m of ROW will be secured for LRT route. As LRT will mostly traverse on existing road, there will be limited reservation required. Some reservation is required at areas around train stations, the low-lying area adjacent to Chandrika Kumaranatunge Mawatha, and the area for the proposed Depot. Detailed layout plans for LRT system are being prepared carrying out fine adjustments to minimize building damage and land acquisition. Layout of LRT system and Depot is given in Chapter 2.1.3.

2.1.5 Future Expansion

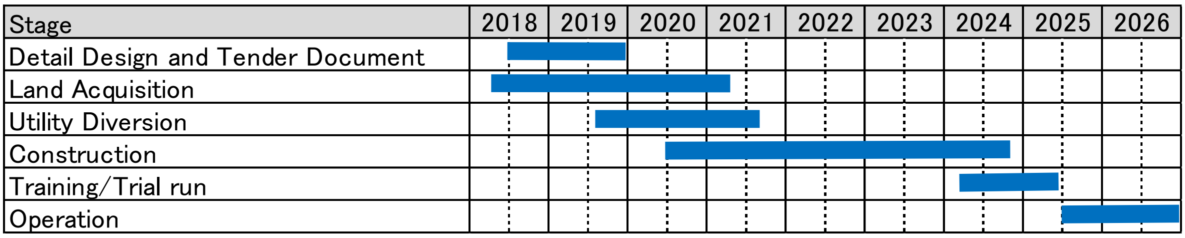
As discussed in Chapter 1.1.1, The Megapolis Transport Master Plan lays out an RTS network, composed of seven lines, that stretches out to Colombo's suburban areas. This LRT project will be part of the network (Part of RTS-1 and RTS-4) and extend to formulate LRT network according to the master plan.

A multimodal transportation hub (MmTH) is planned to be developed at Fort station. Therefore, LRT system will be integrated with MmTH in future.

2.1.6 Pre-Construction and Construction Activities

(1) Phased Implementation Schedule

The tentative implementation schedule for the Project is shown in the figure below. It is aimed to start the construction by middle of 2020 and to start the operation by 2025.



Source: JICA Study Team

Figure 2.18 Project Timeline

(2) Pre-construction activities

Planning and design of the LRT system is the main pre-construction activity. The EIA study which was done in parallel with the said feasibility studies is also a major pre-construction activity. Other pre-construction activities will be site surveys, geotechnical investigations, studying the underground or overhead utility plans carrying out the Resettlement Action Plan (RAP) through social consultations, preparation of detailed cost estimates and the contract document and the contract award.

Prior to the commencement of construction of the LRT structures, relocation of utilities interfering in the LRT structure construction such as high voltage lines and pylons, under- and above ground electric power lines and telephone cables, underground water and sewer pipes, etc. is necessary. In addition, some of the trees and branches affecting the LRT structure construction need to be felled, and existing structures within the Right of Way are required to be demolished or shifted. These pre-construction works will take approximately two years.

(3) Construction Activities

The construction activities of the LRT system include the following: trench excavation, mid pier construction, utility removal and relocation, temporary earth filling in low lying areas (in the depot area of the paddy fields near Chandrika Kumaranathunga Mawatha), installation of steel platforms in Diyawanna Oya Lake for the construction of piers, piling, standard concrete work, pier construction, pre-casting and launching of girders, underwater concrete work, sheet piling for shoring, use of heavy machinery, disposal of construction waste, installation of rails and the rolling stock along with other LRT furniture such as signaling equipment etc.

2.1.7 Construction Methods

The construction of this LRT project will require careful planning and organization, given the magnitude of the works, time constraints and the location of the works on busy national and arterial roads within Colombo Metropolitan Area.

There are different types of construction methodologies depending on the area and the type of structure which will be built. This section discusses construction methodologies for the following:

- Construction of elevated structure (viaduct) on existing roads
- Construction of elevated structure (viaduct) on surface water
- Construction of elevated train station
- Construction of depot civil structures

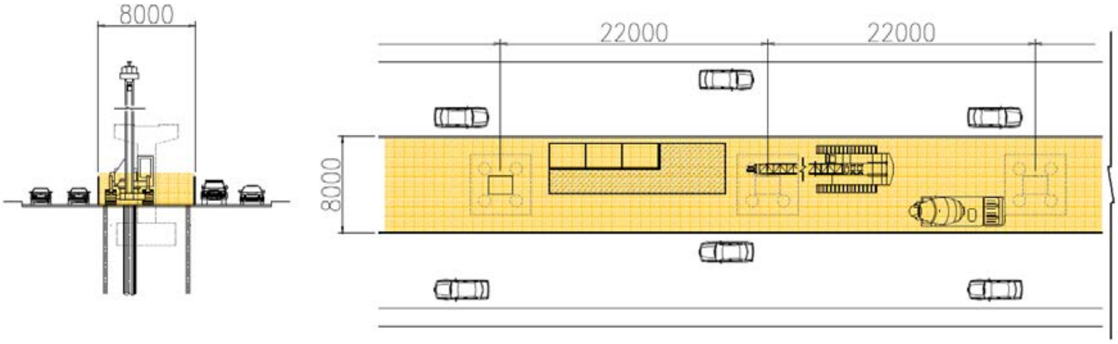
(1) Construction of Elevated Structure (Viaduct) on Existing Roads

Construction methodologies of the three parts of the elevated structure (foundation, pier and girder) are described below.

(1) Foundation

The viaduct foundations consist of conventional bored cast in-situ RC (reinforced concrete) piles and pile caps. The bored piles will be constructed using high torque powered rotary drilling rigs mounted on crawler cranes and using various buckets, augers and chisels.

To secure sufficient space for the construction of the pier pile caps and to accommodate the construction equipment, a minimum width of 10m will typically be required as a working space on the center of the affected roads. A typical section of the construction work space arrangement is given in Figure 2.19



Source: JICA Study Team

Figure 2.19 Typical Section of the Construction Work Space Arrangement

For reducing the width of the working space on the center of the roads, screwed steel piles may be introduced, which can narrower the width of the working space down to 8m and make construction period shorter.

(2) Construction of Pier / Sub-structure

Conventional reinforced concrete pier columns will be used for the viaduct substructures of the LRT viaduct. It is considered that the columns would be constructed using standardized steel forms to promote a good quality of finish and reduce construction cycle times. For shortening the construction period, steel pier columns can be an alternative. Typical construction sequences and daily schedules are shown in the **Table 2.5** below. Images of construction of pier are shown in **Figure 2.20**

Table 2.5 Typical Construction Sequence and Daily Schedule for Substructure

No.	Work	Reinforced Concrete Structure		Steel Structure	
		Contents	Days	Contents	Days
1	Preparation	Securing working space, mobilization	10	Securing working space, mobilization	5
2	Piling	Cast in-situ RC piles construction (3 days for 1 pile)	12	Screwed steel piles (1 day for 1 pile)	4
3	Excavation	Sheet piling, excavation, leveling concrete	7	Sheet piling, excavation, leveling concrete	3
4	Pile Head Treatment	Chipping	1	Re-bar welding	1
5	Footing	Re-bar arrangement, formwork, concrete casting	7	Re-bar arrangement, formwork, concrete casting	7
6	Pier	Scaffolding, falsework, re-bar arrangement, formwork, concrete casting, curing, formwork dismantling (20 days for pier, 10 days for pier head)	30	Scaffolding, installation, shop welding, painting	10
Total (working days)			67		30

Source: JICA Study Team

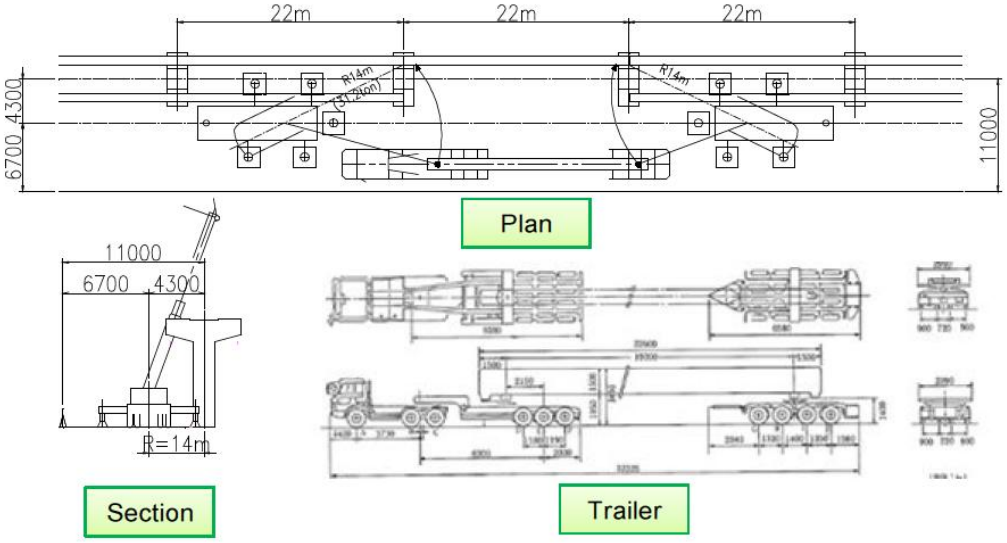
Source: JICA Study Team

Figure 2.20 Pier Construction (Manila)

(3) Construction of Girder / Superstructure

A pre-cast concrete method will be applied to the manufacturing of prestressed concrete (PC) girders. **Figure 2.21** shows an example of a pre-cast plant of the PC girders. Candidate area locations of the manufacturing yards along or close to the LRT planned route are under consideration and will be confirmed in a later stage. PC girders will be transported by a trailer from the manufacturing yard to each construction site.

The PC girders will be erected at once using a crane where construction space can be secured. Meanwhile, an erection girder will be used in city areas where a construction yard can hardly be kept, and in erecting PC box girders. **Figure 2.21** shows a schematic drawing for the PC girder erection using cranes.



Source: JICA Study Team

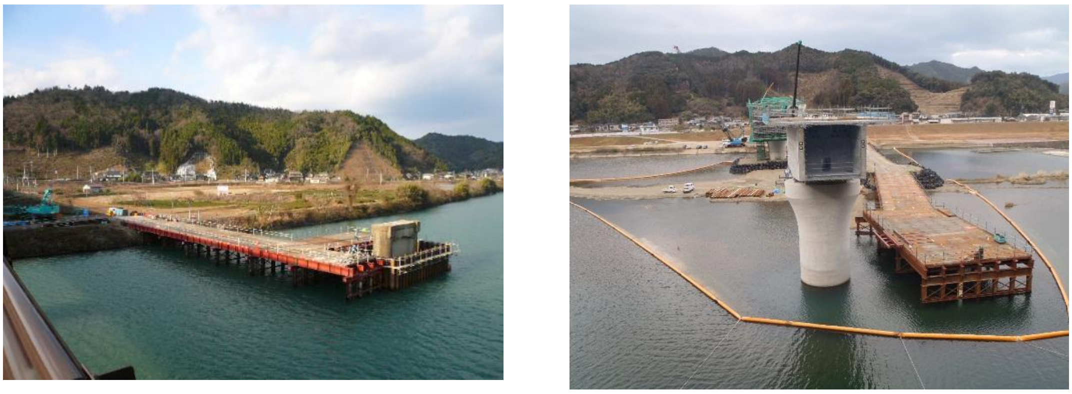
Figure 2.21 Track Crane Girder Erection Method

For sections where construction has to be completed in a short period or a girder is erected for a long span, steel material may be selected.

When installing girders at stretches with sharp bends, segmental pre-casting and launching may be required

(4) Construction of Viaducts (Bridge) on the Surface Water (Diyawanna Lake)

Structure types of the viaducts to be constructed on the surface water are basically the same as those to be constructed on the ground. However, construction methods are different. Installation of a temporary jetty (stage) parallel to the LRT alignment and an access to the jetty is required. Steel members are to be used for the jetty and width of the stage will be 10 to 12m. In addition, cofferdams to be built using steel sheet piles are necessary for the piling work and substructure construction. The cofferdam is to make a dry area inside and enable construction works.



Source: Internet Sites

Figure 2.22 Sample Photos of Temporary Jetty and Cofferdam

Superstructure works also utilizes the jetty. Girders and/or segments will be transported on to the stage and erected using cranes or an erection girder. After completion of the viaducts construction, the temporary jetty will be totally dismantled and removed.

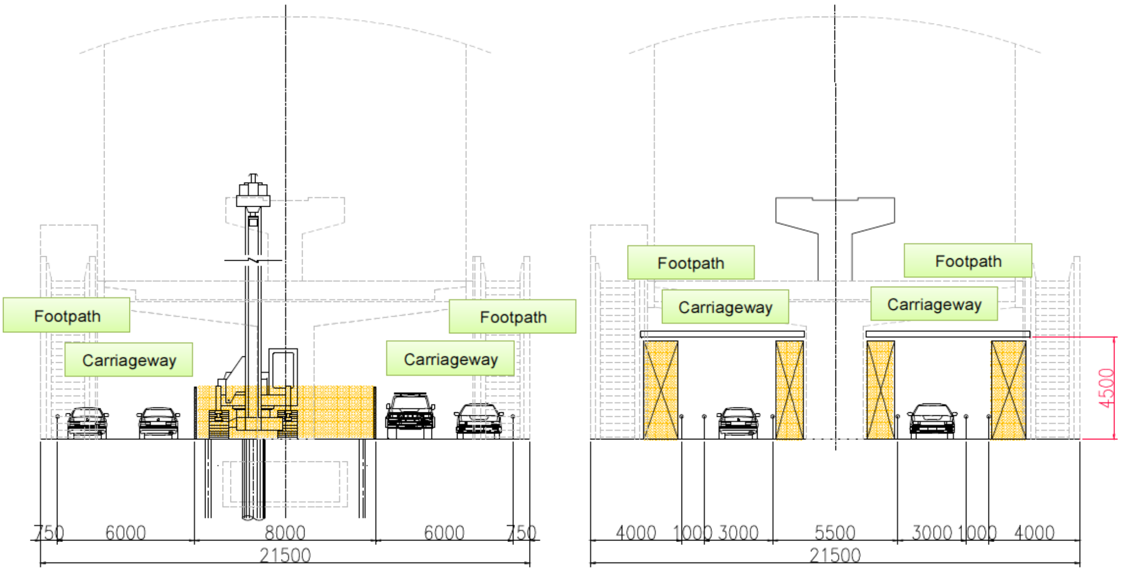
During the detailed design stage, an option to construct the superstructure section over the lake with balanced double cantilever design may be considered.

The period of the LRT viaducts construction works in the Diyawanna Lake will be approximately one year.

(5) Construction of Elevated Station

The station structure is supported entirely by centrally located piers with cantilever pier heads. The critical phase in terms of impact on traffic is during the construction of the cantilever pier heads. At the stage of the cantilever pier heads construction, central construction area will occupy a width of approximately 18m along the road to allow false work support to the cantilever ends of the pier head. The contractor will need to occupy at least two lanes in each direction along the road during the construction of the cantilever piers. The occupation of traffic lanes at each station is projected for approximately 6 months before station construction progresses sufficiently to allow full road access to the traffic.

Typical work space layout during station pier and cantilever pier head construction and concourse level supporting beams and floor placing is shown in **Figure 2.23**.



Source: JICA Study Team

Figure 2.23 Typical Work Space Layout for Station Pier Construction

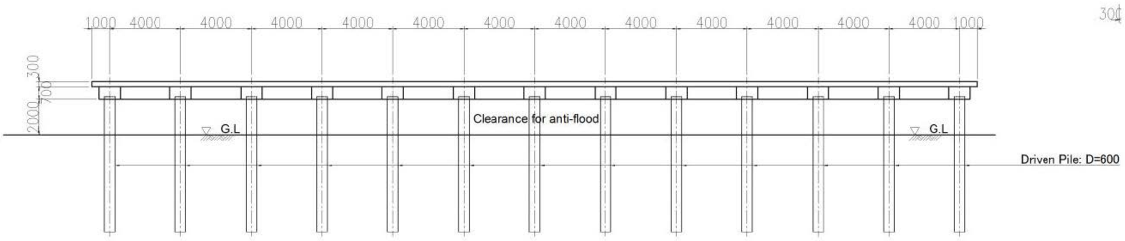
The projected construction period for the elevated station substructures and frames (civil and architectural) excluding pier construction and girder installation is around eight months and that for electro-mechanical installations (E&M) is approximately another ten months, which is eighteen months in total for each station.

(6) Construction of Depot Civil Structures

The depot, which is planned to be located north of Malabe Station, will be constructed on elevated RC platform since the planned area has seasonal flooding. The elevated platform consists of pre-tensioned spun high strength concrete (PHC) pile foundations and RC slabs to create space over the existing ground for the flooding. Outline of the elevated platform is as follows:

- Pre-tensioned spun high strength concrete (PHC) piles of approximately 10.5m long (8.5m under the ground level) and 600mm diameter to be driven down to the supporting layer;
- Distance between the piles is 4m and 4.5m center to center;
- Reinforced concrete slab of 300mm thick with beams on the piles; and
- One unit of the elevated platform is 50m by 20m.

The planned elevated depot platform is shown in **Figure 2.24**.



Source: JICA Study Team

Figure 2.24 Planned Elevated Depot Platform

(7) Method of lowland filling and fill level

Temporary land filling will be required for the depot area and for the low-lying areas. See Figure for these areas and approximate extents for filling. Since construction stage is short term, fill levels for these places were determined using the 10-year flood levels, which is 4.8m MSL with a 3m wide peripheral canal. These flood levels were obtained from SLLRDC flood models formulated for Metro Colombo Environmental Improvement Project.

2.1.8 Resources for Construction

(1) Construction Material (Raw Material) Requirements

Construction materials to be used for the LRT project and the approximate quantities required are listed below.

- Cement: 45,000ton (900,000 50kg bags)
- Sand: 95,000ton (36,000m^3)
- Reinforcing bar: 13,000ton
- Steel: 19,000ton (2,500m^3)
- Rail: 92,000m

These materials will be sourced from the approved sources. River sand will be used for concrete construction. Metal will be obtained from licensed quarries. Cement and steel reinforcement and railings will be imported.

(2) Requirement and Availability of Workforce during Construction

Construction works will be awarded to major recognized construction contractors who will recruit necessary labor force from inside and outside of the country based on the stages of the project. It is not intended to construct temporary labor camps in construction sites. However, temporary construction yards will be designated. It is estimated that a maximum of 2,500 workers per day will be involved in construction activities at peak stage.

(3) Area Required for Landfill

Since the LRT mainly goes on built up area, no landfill will be required except for the Depot area and the segment from the start of Chandrika Kumaratunga Mawatha to the Depot. However, even for these areas, there will be no large-scale land fill activity, but minimum temporary access construction is expected, since the LRT and the Depot is constructed with piles and piers as described in the previous section.

2.1.9 Operation and Maintenance

(1) Operation of the LRT

Operation of the LRT involves the following tasks:

- Driving train
- Controlling train operation by Operation Control Centre (OCC)
- Providing service for passengers at stations (including selling tickets, giving information and supporting disabled passengers, security concerns activities, kiosk)
- Providing service for passengers in trains

- Taking appropriate measures when emergencies or abnormalities event.

During operation, it is estimated that 222 trains will run per day and 18 trains will run during peak hours. The travel time between Fort and Malabe will be approximately 30mins.

(2) Maintenance of the LRT

Maintenance of the LRT system involves the following tasks:

- Checking daily condition of rolling stock
- Inspection for rolling stock and facilities including track, power supply system, signaling and communication system and Automatic Fare Collection (AFC) system
- Overhauling rolling stock
- Repairing rolling stock and facilities.

1) Maintenance of Rolling Stock

Maintenance for rolling stock can be divided into 3 types – preventive maintenance, breakdown maintenance, and train preparation. An outline of these maintenance systems are outlined in **Table 2.6**.

Table 2.6 Maintenance System for Rolling Stock

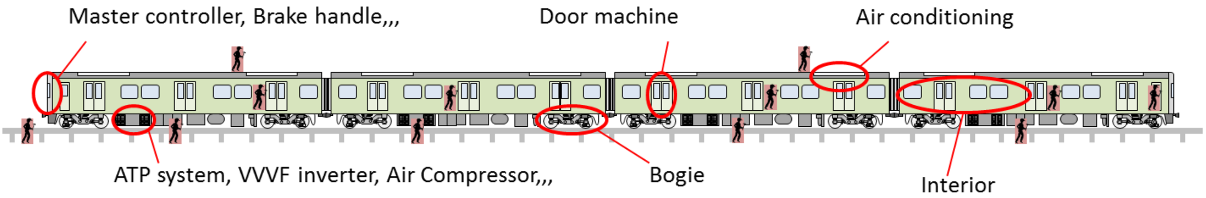
Category			Maintenance Main items	Period
Preventive Maintenance	Departure Inspection		Check Conditions and Functions to operate the train service.	Before Departure from Depot
	Light Maintenance	Daily Inspection	Check Consumables, Check Conditions and Functions, Check facilities for passengers.	Within 10days
		Monthly Inspection	Daily Inspection Items, Inspect Conditions and Functions.	Within 3 months
	Heavy Maintenance	Semi Overhaul	Monthly Inspection Items, Overhaul Significant Equipment.	Within 4 years or 600,000 km
		Overhaul	Semi-Overhaul Items Overhaul All Equipment	Within 8 years
	Wheel Re-profiling		Re-profile the wheel set.	(Depends on Route alignment & Operation plan)
Breakdown Maintenance			Check the conditions and Functions, Repair the failure on a train.	(The failure on a train occurs)
Train Preparation	Daily Cleaning		Pick up waste on a train, Clean interior of a train if dirty.	After operation
	Car-Body Cleaning		Wash car body by the machine.	Every 3 or 4 days
	General Cleaning		Clean interior, Wash car body.	Within 30 days

Source: JICA Study Team

Preventive Maintenance

- Light Maintenance

The main purpose of Light Maintenance is to check or inspect the condition and the function of a rolling stock in operating condition (**Figure 2.25**).

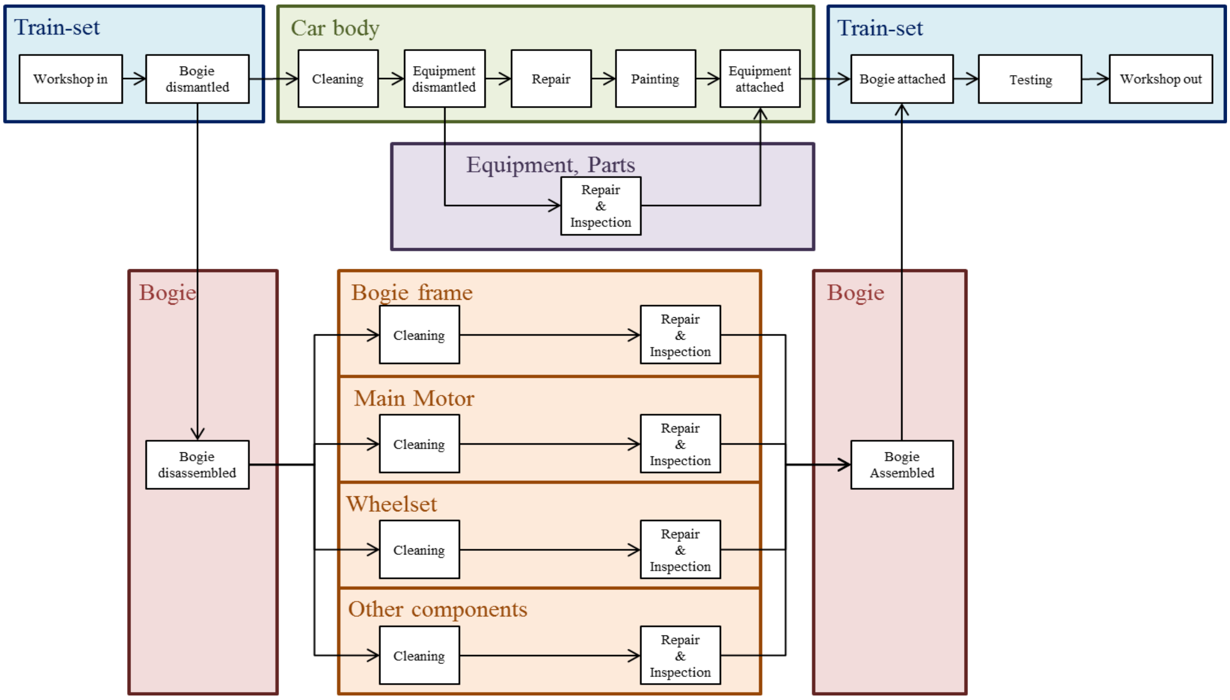


Source: JICA Study Team

Figure 2.25 Example image of Light Maintenance

- Heavy Maintenance

The main purpose of Heavy Maintenance is to overhaul the equipment. The work flow of Heavy Maintenance is shown in **Figure 2.26**.

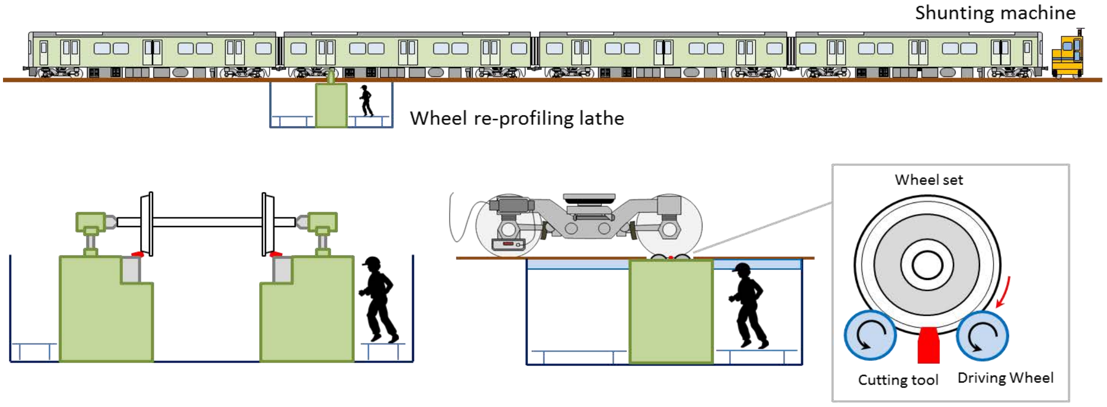


Source: JICA Study Team

Figure 2.26 Work flow of Heavy Maintenance

- Wheel re-profiling

The main purpose of Wheel re-profiling is to enhance shape of the wheel with a wheel re-profiling machine, to maintain riding comfort (**Figure 2.27**). The wheel re-profiling is conducted irregularly, depending on the condition of wheel tread.

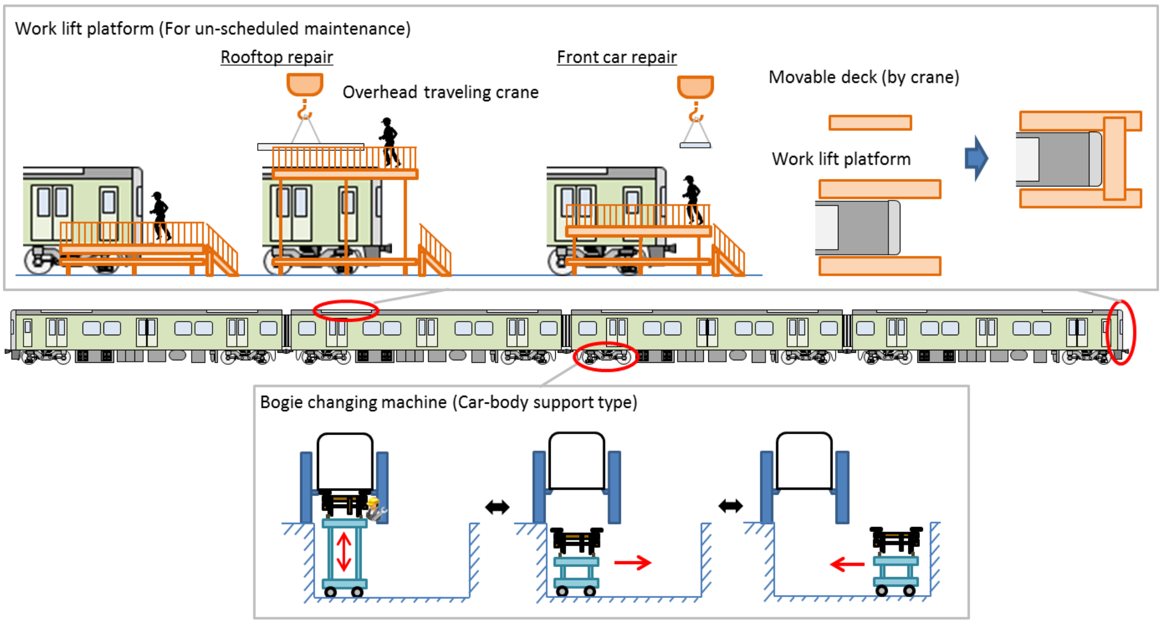


Source: JICA Study Team

Figure 2.27 Example image of Wheel re-profiling

Breakdown Maintenance

The main purpose of Breakdown Maintenance is to repair the failure on a train. The train has various kinds of equipment on the roof, under floor, in the car (**Figure 2.28**). In case of this study, it is assumed that exchanging of bogie is often conducted because the shape of wheel tread will be deformed due to route alignment (many curves).

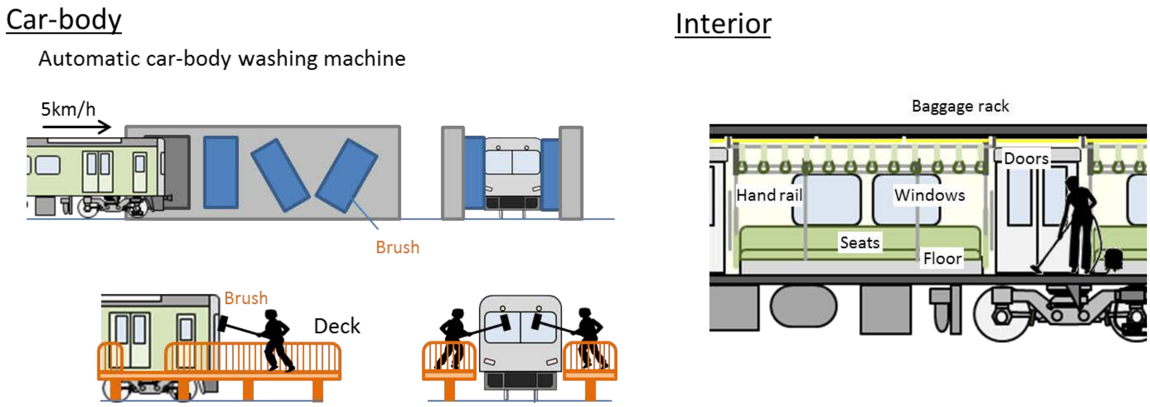


Source: JICA Study Team

Figure 2.28 Example image of Breakdown Maintenance

Train Preparation

The main purpose of train preparation is to wash and clean a train in order for passengers to feel comfortable when using the train. Train Preparation involves 3 activities – cleaning after operation every day; washing train cars every 3 or 4 days; and washing car bodies and cleaning all facilities such as lighting, seats, floor, windows etc. (see **Figure 2.29**).



Source: JICA Study Team

Figure 2.29 Example image of Train Preparation

(3) Institutional arrangements

In order to implement the project, there will be a Regulator and an Operator. The Regulator empowered with authority (a Commissioner) will be appointed by the Government through an Act of Parliament (e.g. "Sri Lanka Light Rail Transit System Act", which is in draft level). The Act will also stipulate the establishment of a government-owned O&M company which will be composed of a working group from different ministries.

The proposed organizational structure for the O&M Company is shown in **Figure 2.30**. Environmental and occupational health concerns (including related complaints and grievances) are handled by the Health, Safety, and Environment (HSE) Division. However, compliance and monitoring are under the responsibility of other relevant divisions.

Source: JICA Study Team

Figure 2.30 Proposed organizational structure for O&M Institution

2.1.10 Energy Requirement

The type of energy to be used for the operation is electrical energy which will be supplied by CEB. The details have been discussed in Section 2.1.3 (Electrical and Power Supply).

2.1.11 Wastewater Sources

(1) During Construction

Wetting activities and rainwater can generate wastewater at construction sites. Sewage will also be generated from portable toilets that will be installed for workers at construction sites. There will be no labor camps that will be built, within the site

Wastewater during construction will mainly be potentially contaminated rainwater and waste water from portable toilets at the Depot site.

Wastewater collection, treatment and final disposal during construction phase is discussed in the impact assessment part of this Report (Chapter 4).

(2) During Operations

During operation wastewater will be released from the stations and the depot site in which repair and maintenance work will be carried out. In addition, wastewater will be generated from administration building, such as from toilet and wash areas/sinks.

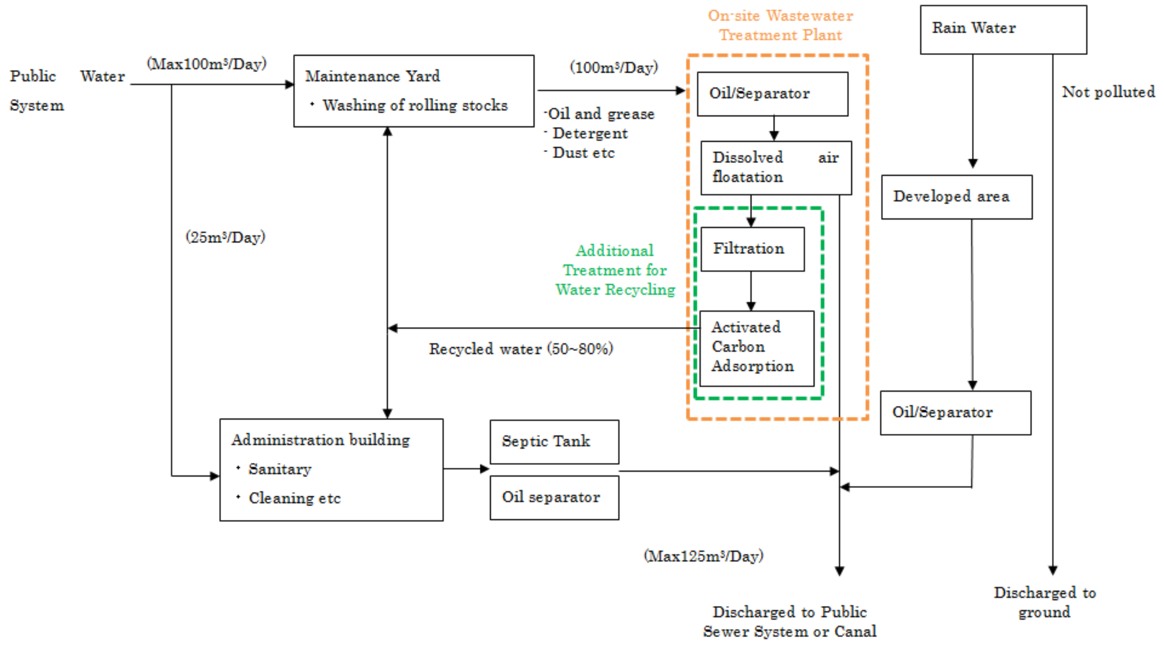
Wastewater from the depot area is generated from maintenance activities, such as carriage washing or parts cleaning. Approximately 100m3/day of wastewater is expected to be generated from these activities. Wastewater generated may contain oil and grease, detergent, dust (And possibly metal particles.

Wastewater collection, treatment and final disposal during operation phase is discussed in the impact assessment part of this Report (Chapter 4).

(3) Conceptual Layout of the Proposed Wastewater Plant

A wastewater treatment system will be installed in the Depot Area. Figure 2.31 shows the water flow and treatment methods to be used.

This system will mainly treat wastewater coming from the maintenance yard. It consists of an oil separator unit and a dissolved air flotation unit. Oil separators will be used to treat both wastewater from maintenance activities and potentially contaminated rainwater. In order to recycle some of the water and use as greywater for both maintenance yard and administrative building, additional units (filtration and adsorption) may also be included in the wastewater treatment system. The plan is to recycle 50 up to 80 percent of wastewater generated.



Source: JICA Study Team

Figure 2.31 Water Flow Diagram

(4) Sludge

Limited amount of sludge from the wastewater treatment system would be generated and this would depend on the amount of dirt, dust, oil/grease accumulated by the trains.

2.1.12 Other Wastes

(1) Construction Solid Waste

Wastes generated during construction stage will mainly comprise construction wastes (e.g. rubble, wood plants, metals), excavated soil, domestic wastes, and oil wastes. These wastes will be generated for the entire LRT route.

It is estimated that around 60,000m^3 of excavated soil and rubble will be generated when constructing the LRT route and stations and around 80,000m^3 will be generated from temporary fillings that need to be removed after constructing the depot. However, it should be noted that at this stage it is difficult to estimate the exact amount of waste that will be disposed offsite. This will depend on materials that cannot be reused or recycled.

(2) Solid Wastes During Operation

The depot area is the place where maintenance, washing and servicing of rolling stock are conducted. Typical solid wastes generated at the depot and workshop area are listed in Table 2.7. General solid wastes, which include domestic solid wastes, are generated at an approximate amount of 200kg per day.

It is important to note that the amount of wastes generated depends on operation conditions and may vary significantly. The estimated amounts are just indicative figures.

Table 2.7 Waste generated during operational stage

Waste	Source	Estimated amount generated
1. Lubricant oil	air compressor and gear box	7 liters/day
2. Sludge	wastewater treatment plant (when cleaning train and its parts);	200kg/day
3. Brake shoe (brake pad)	brake equipment	
4. Metal scraps/ particles	wheel re-profiling lathe, etc. (wheel reprofiling, and exchanging parts)	550kg/day (ave)
5. Rubber tube	brake system (need to exchange every 8 years depending on its specs)	
6. Batteries	Rolling stock	5000pcs/2yrs

Source: JICA Study Team

2.1.13 Other Infrastructure Facilities

(1) Energy including fossil fuel/electricity and sources

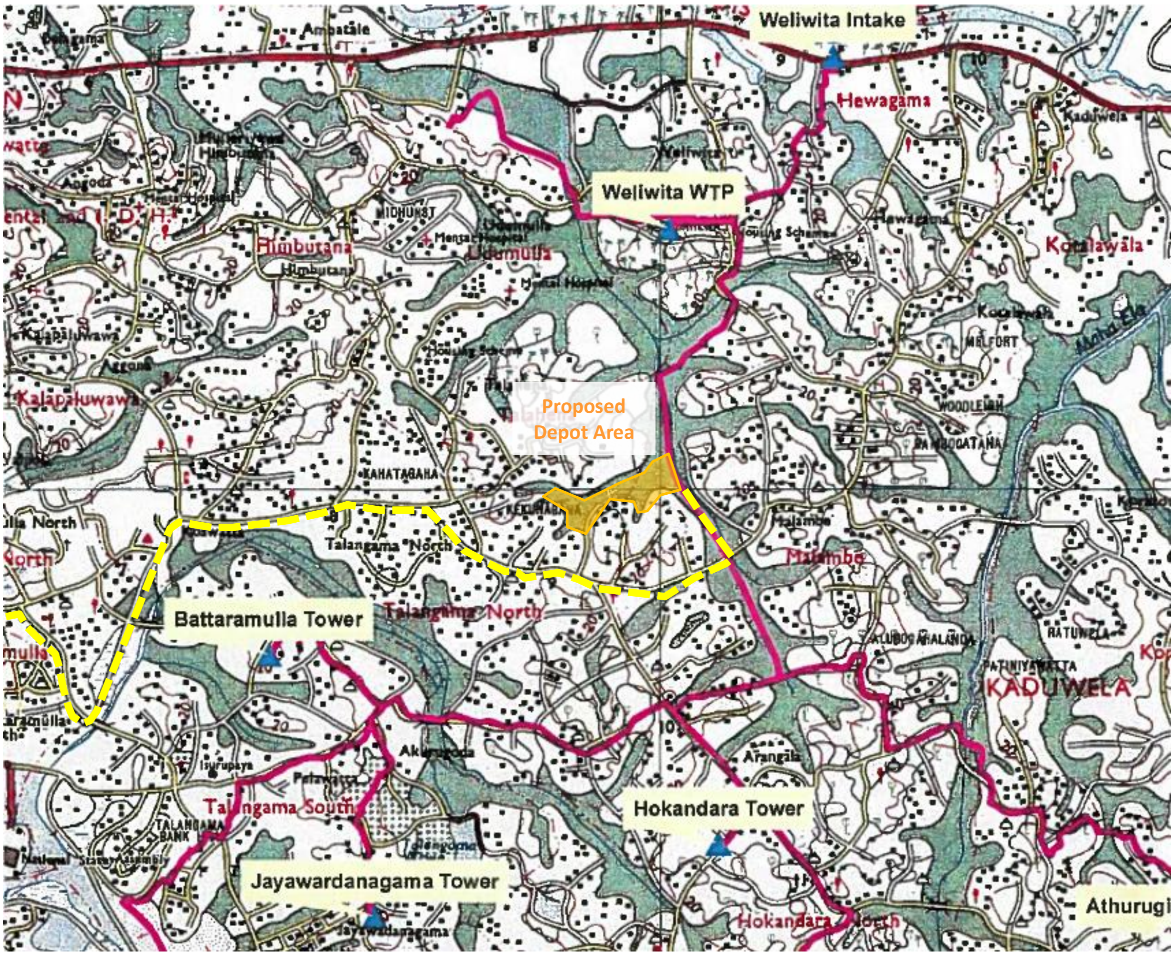
Electricity will be supplied by CEB from the existing electricity grid. For details, refer to Power Supply (Section 2.1.3)

(2) Water and sources

During Construction, water will be obtained from NWSDB mainly through temporary water connections.

During operation, water will be used for maintenance activities, washing purposes (office building and train stations), and emergency purposes (e.g. firefighting) Water will be supplied from a proposed Weliwita water treatment plant (WTP), which will have a water supply line adjacent to the proposed depot area (see Figure 2.32). Water will be withdrawn from the Kelani River and this will be supplied to the WTP, where it will be treated to the desired water quality specifications. The water will then be supplied to the network located south of the WTP. Approximately 180,000 m3/day of water can be supplied by the WTP. Operation of the Weliwita WTP is estimated to start by 2020.

As an alternative, in case the Weliwita WTP will have delays or problems with implementation, the LRT Project may opt to use groundwater resources in the area.



Source: National Water Supply and Drainaige Board

Figure 2.32 Potential Water Supply Source in Weliwita

(3) Access roads

The LRT trace traverses the existing roads, thus no extra access roads will be necessary. Access will be obtained from the existing road network itself. Access will be required for the depot area and for the low-lying paddy area adjacent to Koswatta Malabe Road. Access will be taken from the pilot road of the LRT.

Since most of the LRT route will be built on existing roads, space to keep construction materials and equipment is limited. During construction, temporary construction yards will be selected by the EPC contractor.

2.1.14 Project Investment and Funding Sources

The funding source of the project will be from the Government of Sri Lanka and Japan International Corporation Agency (JICA)

2.2 Alternatives Analysis

2.2.1 No Project Option

In Sri Lanka, under its stable economic growth, the number of traffic modes on the road network such as private car, buses, and moto-bicycles is projected to increase rapidly. Currently, about 1 million people are entering to the center of Colombo every day and this causes severe traffic congestion in the city center and surrounding road networks. It is predicted that existing road networks may not be able to handle future traffic demand.

Without having a rail-based public transport, especially, the LRT project on Malabe corridor, the following losses are predicted in future.

- Declining efficiency of economics activities due to large travel time loss by traffic congestion
- Increasing air pollution due to heavy vehicle transports
- Increasing noise pollution due to road transport
- Increasing road traffic accidents

Therefore, for both environmental and social aspects, it is undesirable not to implement the LRT.

2.2.2 Alternatives of Structural Options

In the official request for the LRT project, elevated structure (viaduct) is applied in the entire route. In order to compare with other structural options, namely underground and on street (existing road), 3 options were compared from the points of views described in the **Table 2.8**. Elevated option was considered as the most desirable option.

Table 2.8 Alternative of structural option

Items	Underground	On Street (Existing Roads)	Elevated(Viaduct)
Distance for Construction	Less than Elevated option	Almost same as elevated structure	As original
Construction cost	Highest of Civil Cost (approx. 3times or more than elevated option)	Civil structure itself is not expensive. However civil costs for intersections at SLR railway crossing and land acquisition costs will be higher than other options	As for civil cost: it is middle among the option As for total cost: it will be most economical option
Structural characteristics	With expensive “shield machine”, construction period can be reduced on ground, however, it is difficult for installation of its machine into underground and of construction of underground stations.	Structure can be simple; however, many flyover sections are required as complicated structures at SLR crossings and road intersections.	Numbers of piers on route is required.
Workability	Proper underground soil conditions and underground information for building is highly required. Highest difficulties exist in construction.	Easiest for construction on street but enough road space is required. It is not seen anywhere for applicable section in the route.	Construction of piers is installed at road median. It is necessary to grasp utility pipes at the installation point of piers. Traffic management during the construction is required.
Traffic Problem	Occur at the underground station area with large space.	Reduce existing road space and accelerate traffic congestion by car	Need traffic management (lane configuration, parking space) due to decrease width by piers
Natural condition	High risk of effect on groundwater and ground settlement	Noise and vibration affect residents living near roadside.	Noise and vibration are generated from the top of viaduct during
Land Acquisition, Resettlement	Need to confirm the rights of land in underground	Many land acquisitions are required.	Land acquisition is the limited among three options.
Landscape	Large structure happens at the entering of underground station,from/to undergroundnear deport.	New scenery by tram on street	Consideration about appearance of elevated structure is required.

Items	**Underground**	**On Street (Existing Roads)**	**Elevated(Viaduct)**
Safety	Consideration for evacuation at the time of flood or emergency stop	Consideration when crossing residents and cars at intersections	No crossing to residents and cars, relatively safe to operate
Noise and vibration	Although it is less than other options, vibration is transmitted to buildingsdepends on underground condition.	The largest noise and vibration affect residents living roadside compared to other options.	There are some noise and vibration to buildings with same height near the viaduct.
Total evaluation	Not recommended due to construction cost and technical familiarity	Not recommended since not enough space on ground and large land acquisition required	Most desirable option in this project

2.2.3 LRT Alternative Routes

For LRT Alternative Routes analysis, following 3 sections has been studied.

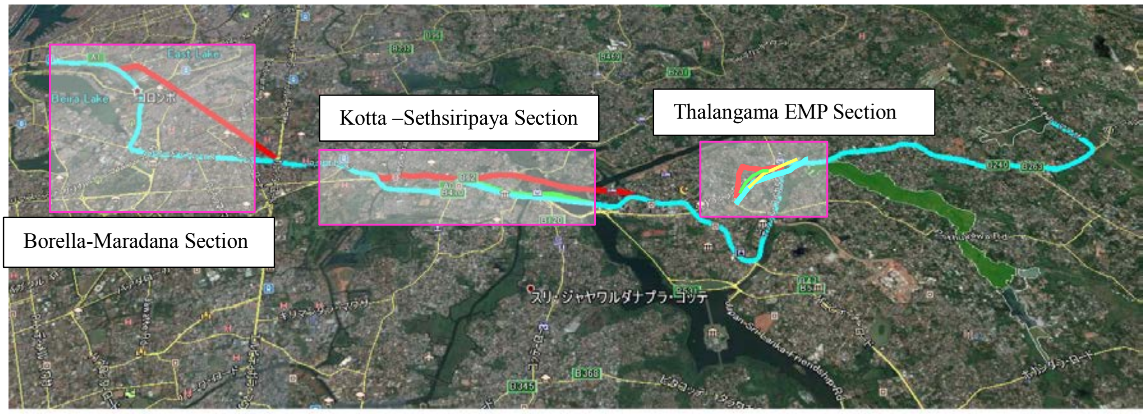


Figure 2.33 Sections of Alternative Route Analysis

(1) Borella – Maradana Route

For the section between Borella and Maradana, following 2 alternative routes were studied. The result of alternative analysis is shown in **Table 2.9**.

- **Alternative 1:** The route via National Hospital area. It serves the high employment area of the CBD, provides connection to commercial and city centre, and enables direct access to the National Hospital.
- **Alternative 2:** The route along P De S Kularatne Mawatha. It connects Residential and educational area.

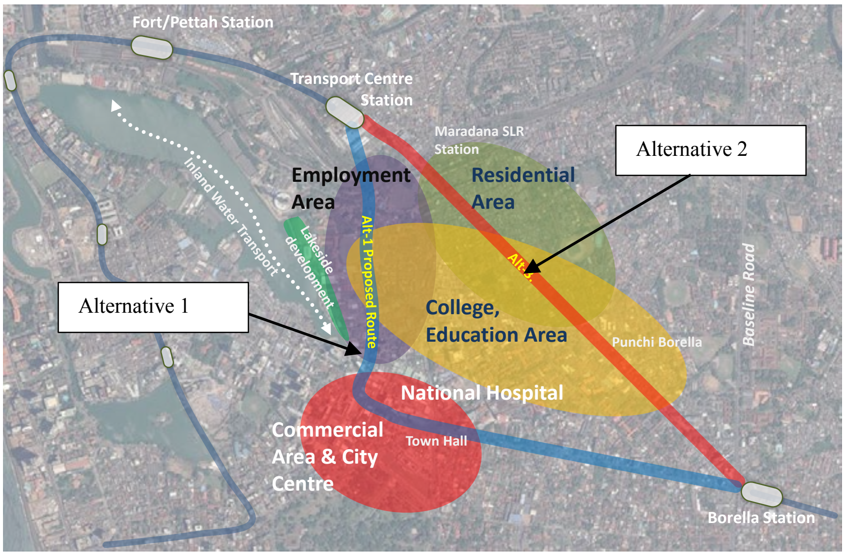


Figure 2.34 Two alternative routes between Borella and Maradana

Table 2.9 Alternatives analysis in Maradana-Borella Section

Item	Alternative 1 (Blue Route)	Alternative 2 (Red Route)
Description	The route via National Hospital area. It serves the high employment area of the central business district (CBD), provides connection to commercial and city centre, and enables direct access to the National Hospital	The route along P De S Kularatne Mawatha. It connects Residential and educational area
Length	• 400m longer than Alt 3.	• 400 m shorter than Alt 1.
Technical aspect	• More integrations are required with the future rehabilitation of Maradana road bridge due to electrification of SLR • More curve section required	• The line can be integrated with Maradana station. • Longer flyover is required to cross Sri Lanka Railway. • Straight line route
Transport catchment	• The route will cover public transport catchment widely including the center of the city (e.g. Town Hall area) (**Figure 2.35**)	• Public transport catchment is relatively small compared with Alt 1. (**Figure 2.35**)
Social aspect	• Several commercial shops are required to be acquired	• No significant issue
Aesthetic	• Adverse impact on Ward place road which is quiet residential zone with large street trees. • There are several heritage buildings.	• No significant issue
Hydrology	Not applicable	Not applicable
Ecological Environment	Greenery will be affected	No significant issue
Overall	Alternative 1 was recommended due to the overriding advantage of transport network	Alternative 2 was not recommended

Alternative Route 1 and Other RTS Routes

Alternative Route 3 and Other RTS Routes

Source: JICA Study Team, the base map from OpenStreetMap

Figure 2.35 Catchment area of LRT Stations of Alternative Route and Other RTS Lines

(2) Kotte - Sethsiripaya

For the section between Kotte and Sethsiripaya, following 2 alternative routes were studied. The result of alternative analysis is shown in **Table 2.10**.

- **Alternative 1**: The route via Sri Jayawardana Mawatha through Diyawanna lake.
  The proposed route is considered to be a Ceremonial approach into the Capital City of Sri Lanka under special planning regulations prepared by UDA in early 1980. Even though these regulations could not be fully implemented with undue influences and the envisaged Ceremonial Character has yet to be achieved, the UDA is now in the process of regaining such character by various means.
- **Alternative 2**: The route via Old Kotte Road and go behind Diyawanna Lake.
- **Alternative 3**: The route goes side road of Sri Jayawardana Mawatha to avoid LRT at centre of road.

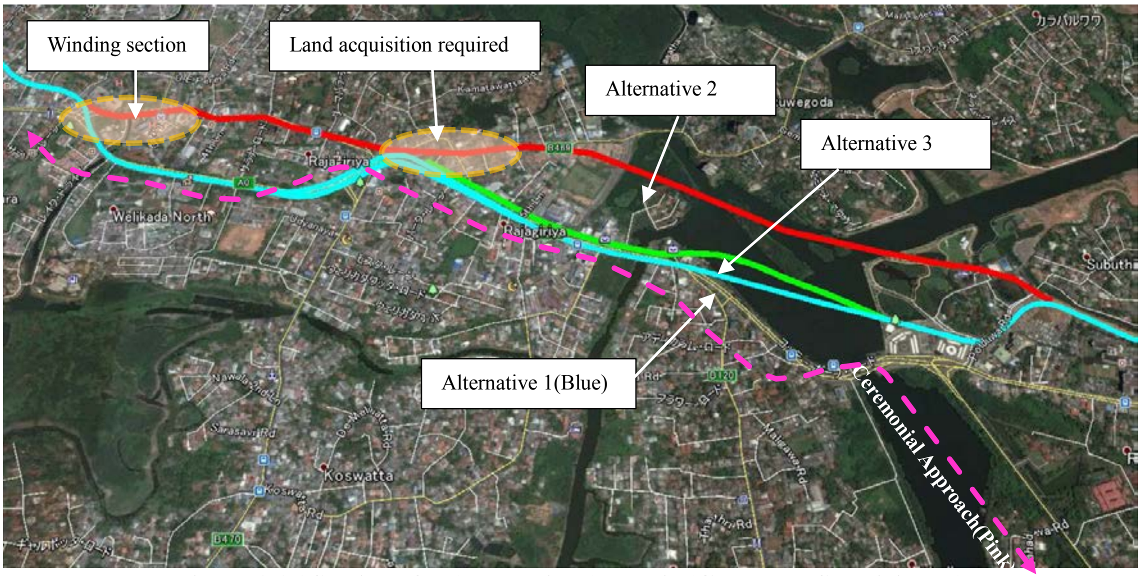


Figure 2.36 Sections for Alternative Analysis (Cotta and Sethsiripaya)

Table 2.10 Alternatives analysis in Kotte-Sethsiripaya Section

Item	Alternative 1 (Blue Route)	Alternative 2 (Red Route)	Alternative 3 (Green Route)
Description	The route via Sri Jayawardana Mawatha through Diyawanna lake See **Figure 2.37**.	The route via Old Kotte Road and go behind Diyawanna Lake	The route goes side road of Sri Jayawardana Mawatha to avoid LRT at centre of road. See **Figure 2.37** in detail.
Length	• Base	• 100m shorter than alternative 1	• Almost same as alternative 1
Technical aspect	• Although it is technical feasible to go along the sides of Rajagiriya fly over section, the cost is high. • Less sharp curve	• Going along Rajagriya fly over is not required • Old Kotta road has more sharp curves, requiring more land acquisition.	• Although it is technically feasible to go along the sides of Rajagiriya fly over section, the cost is high. • Less sharp curve
Transport catchment	Information not available	Information not available	Information not available
Social aspect	• Can be mostly managed with no land acquisition.	• Approximately 20 houses to be relocated	• 2~3 buildings and commercial property need to be acquired.
Aesthetic	• Disturb the concept of Ceremonial approach. However, area is already impacted with high raised buildings	• No significant impact	• Possible to mitigate the landscape impact on the concept of Ceremonial approach by having LRT route on the side of road
Hydrology	• Shortest Diyawanna Lake section	• Longest Diyawanna Lake section	• Second shortest Diyawanna Lake section
Ecological Environment	• No significant issue	• Island with mangrove in Diyawanna lake which is habitat of birds will be affected	• No significant issue
Overall	Alternative 1 is selected due to less land acquisition involved.	Alternative 2 is not preferred option due to the land acquisition issue, which can be studied further.	Alternative 3 can still be examined further during the detail design stage considering land availability along the road.

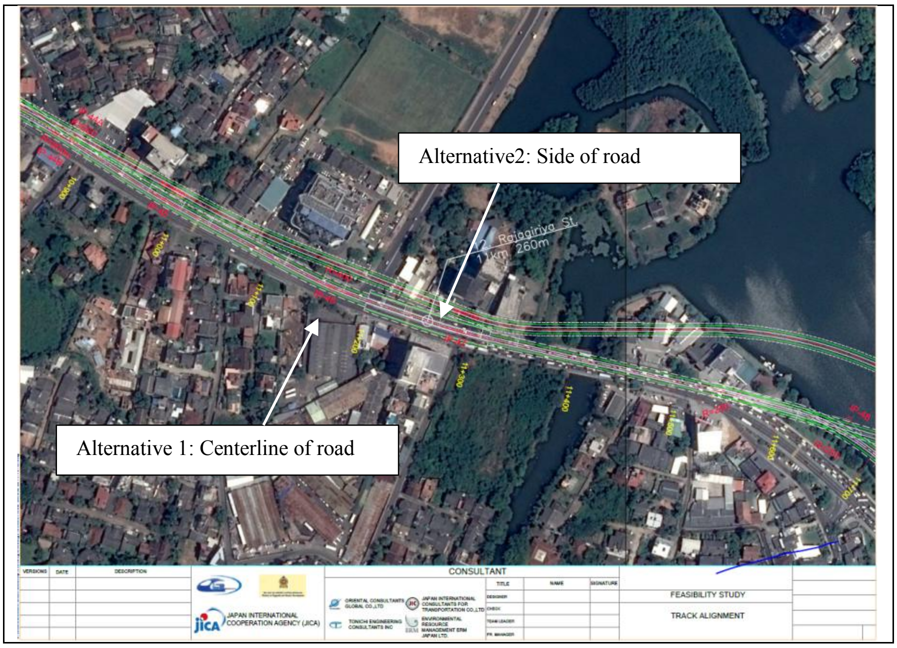


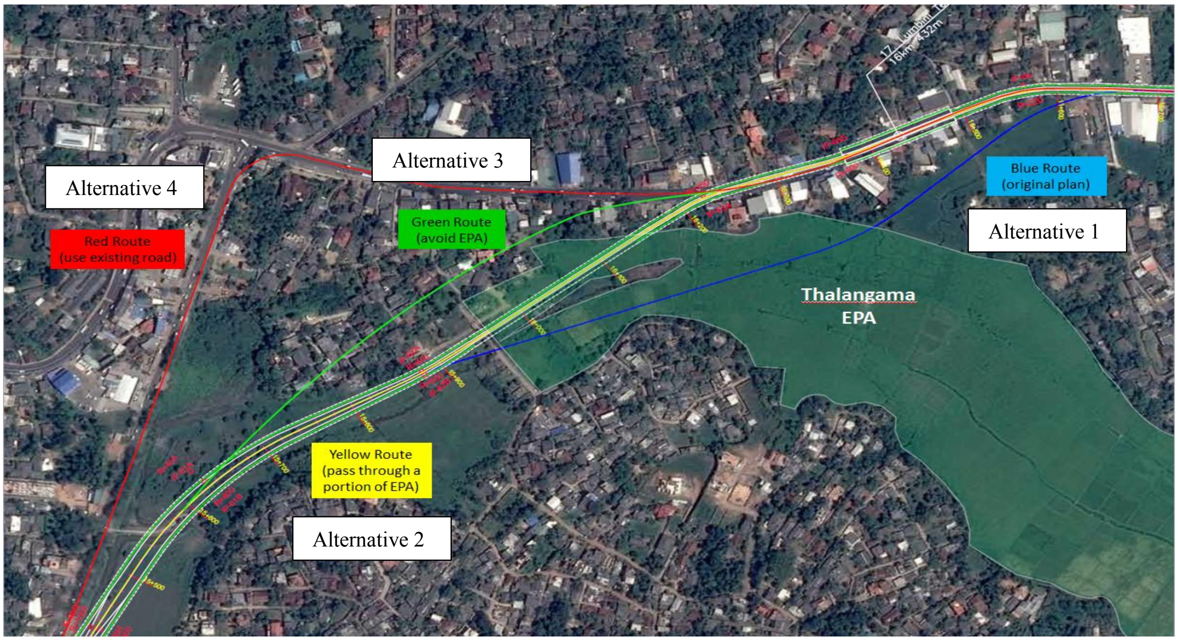
Figure 2.37 Two alternative routes on Ceremonial approach section

(3) Thalangama EPA Route

For the section between Denzil Kobbekaduwa Mawatha and B240 (Malabe road), 4 alternative alignment was studied. The best alignment in terms of technical and practical point of the view (low curvature, no obstructions (houses), shortness) was considered to be the alignment which passes through Thalangama Environmental Protection Area (EPA) shown as blue route in **Figure 2.38**. Thalangama EPA was designated as EPA by CEA and only limited activities are allowed in EPA. Therefore, following alternative alignments were studied further and the comparison of potential impact is summarized in **Table 2.11**.

- **Alternative 1**: Passing through Thalangama EPA (400m) and shortest route:
- **Alternative 2**: Passing through Thalangama EPA with minimum distance (200m)
- **Alternative 3**: Passing outside of EPA boundary (buildings will be affected)
- **Alternative 4**: Passing on existing route

Considering the importance of Thalangama EPA as well as the social impact (land acquisition), the Red route (passing on existing route was considered to be preferred route.



Source: Study Team

Figure 2.38 Alternative analysis in Thalangama EPA

Table 2.11 Alternatives analysis in Thalangama Area

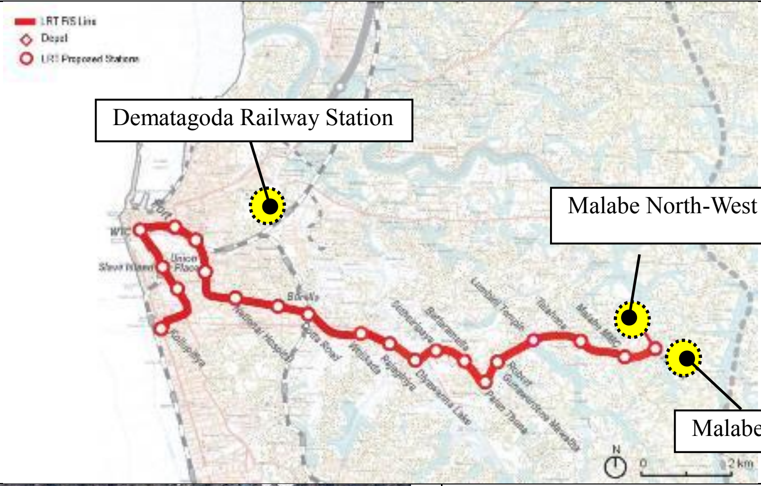
Item	Alternative 1 (Blue Route)	Alternative 2 (Yellow Route)	Alternative 3 (Green Route)	Alternative 4 (Red Route)
Description	• The shortest route passing through Thalangama EPA	• The shortest and less curve route crossing a portion of Thalangama EPA	• The route that goes outside of Thalangama EPA boundary.	• The route goes on existing road.
Length	• Shortest	• Second shortest	• Second longest	• longest
Technical aspect	• No significant issue	• No significant issue	• No significant issue	• Sharp curve at the corner • Increase in travel
Transport catchment	Approximately same for all routes			
Social aspect	• Less impact	• Less impact	• Approximately 20 houses to be relocated	• One commercial building and 3-4 houses might be relocated.
Aesthetic	• Most significant due to the disturbance of EPA	• Less significant compared with Alt.1	• Less significant compared with Alt1 and 2.	• Not significant issue

Item	Alternative 1 (Blue Route)	Alternative 2 (Yellow Route)	Alternative 3 (Green Route)	Alternative 4 (Red Route)
Hydrology	• Minor impact due to disturbance of flooding plain	• Minor impact due to disturbance of flooding plain	• Minor impact due to disturbance of flooding plain	• No significant issues
Ecological Environment	• The route runs through the northern edge of Thalangama EPA.	• The route runs through the northern edge of Thalangama EPA.	• No significant issue	• No significant issues
Overall	Not recommended due to legal restriction of EPA	Not recommended due to legal restriction of EPA	Not recommended due to land acquisition issue	Selected as recommended route since there is no legal restriction and significant land acquisition issue

(4) Depot site

Alternative analysis for the depot site has been conducted as shown in below **Table 2.12**. Three potential sites have been identified, which include: 1) Dematagoda Railway Station site, 2) Malabe South-East and 3) Malabe North-West. Based on the alternative analysis, Dematagoda Railway Station site and Malabe South-East site are not considered as feasible options. The required area for depot is approximately 15ha.

Table 2.12 Alternative analysis for Depot



	1) Dematagoda Railway Station site This site is an existing railway depot with an area of approximately 7ha. The site needs to be leased from the Railway Department. Since the site is located 1.5km away from proposed LRT route, it is difficult to make a connection.
	2) Malabe South-East There is an agricultural land available near the proposed LRT route. However unoccupied land is only about 3.5ha. The land can be used as part of the depot, but resettlement is required in order to secure sufficient area for Depot.
	3) Malabe North-West There is agricultural land available near the proposed LRT route with an area of approximately 10~15ha. Although sufficient land can be secured for Depot, agricultural land needs to be acquired. It is to be noted that the site is considered as a flood retention area.

Source: Study Team

CHAPTER 3 Description of the Existing Environment

3.1 Description of the Study Area

The study area was defined as 500m buffer from the project components, taking account of the nature of the impact as shown in Figure 3.1. The study area falls under four divisional secretariat (DS) divisions namely; Colombo, Thibirigasyaya, Sri Jayawardanapura kotte and Kaduwela. Map with relevant DS boundary is shown in Figure 2-3.

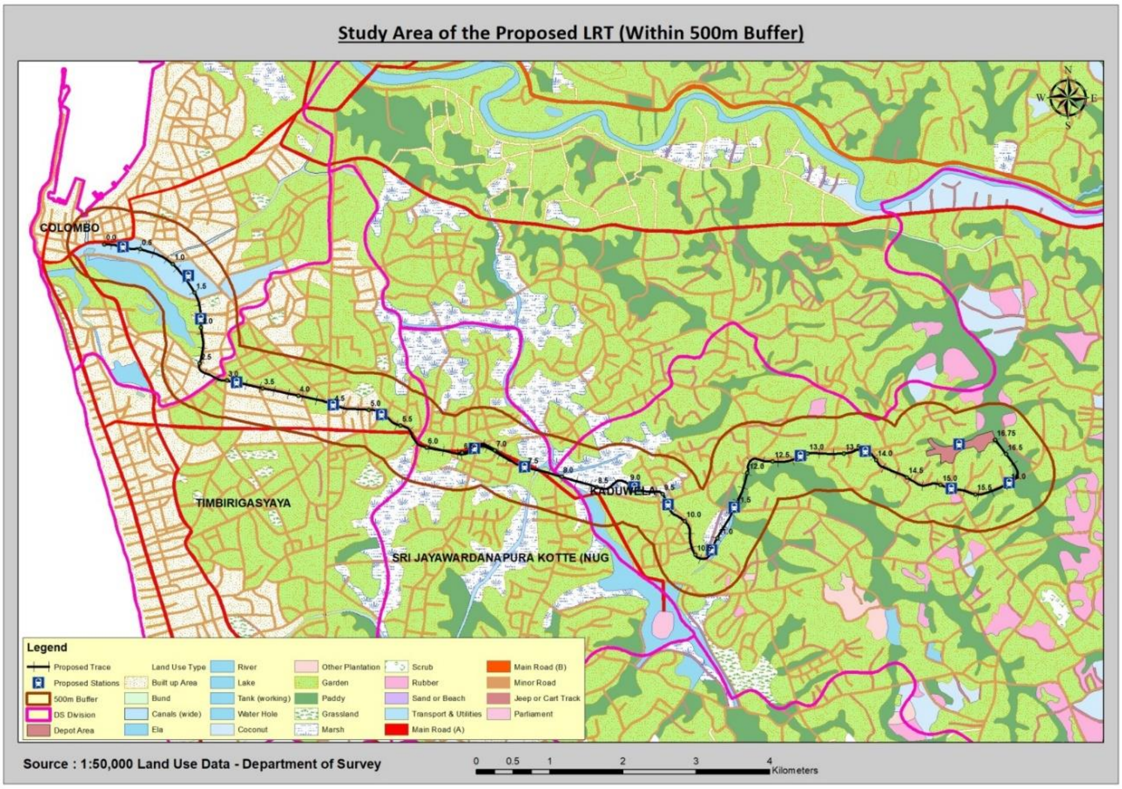


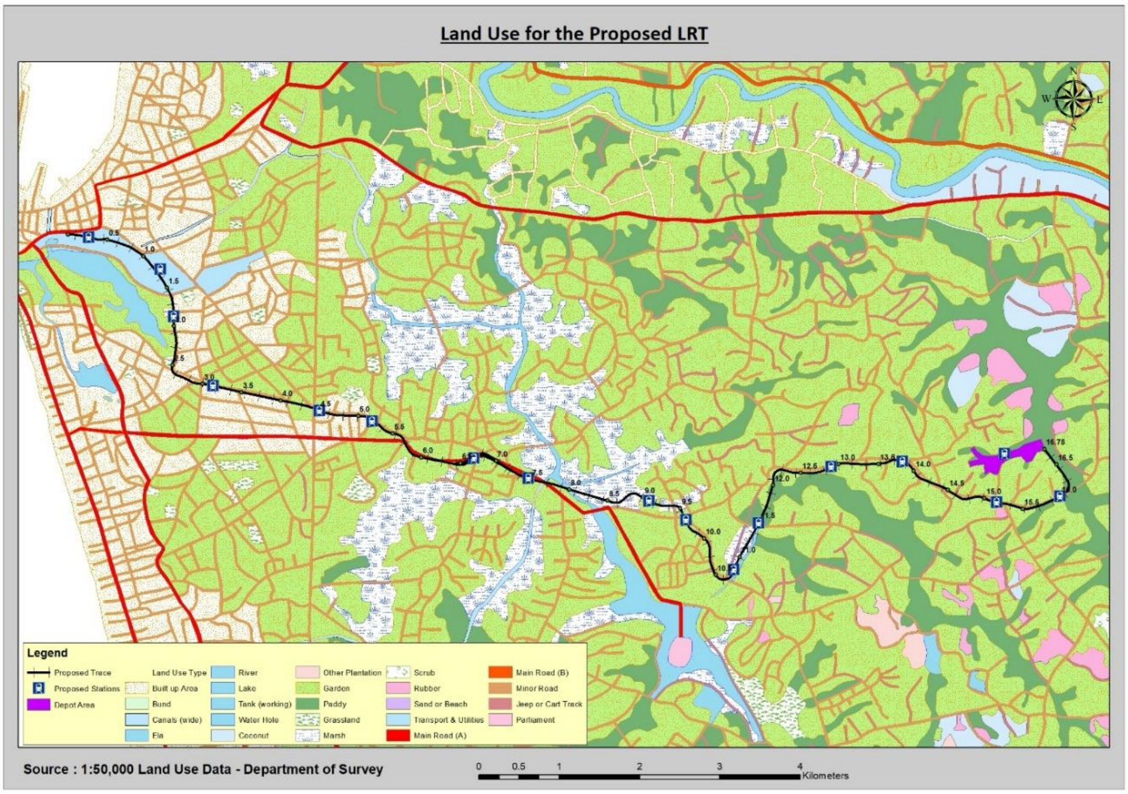
Figure 3.1 Study area of the project

3.2 Physical Environment

3.2.1 Existing Land Use

The Light Rail will be constructed primarily on existing roads. The land use along the LRT route is shown in Figure 3.2. The Figure shows that the land use changes from a highly dense built-up area to a more semi-urban landscape as the LRT goes from Fort Station to the depot area (Malabe town towards Chandrika Bandaranayaka Kumaranathunga Mawatha). Along the planned route, there are commercial facilities such as, office buildings, shopping malls and administrative buildings and public facilities including hospitals and stations (Fort and Maradana, etc). There are residential buildings around Ward Place. In addition, Beira Lake and Diyawanna Lake are the major water bodies along the route. Diyawanna Lake serves as a key leisure zone.

In general, Western side of the project area, including business capital of Fort area is more business-oriented zone, while eastern area toward Malabe becomes semi-urban area with open green spaces. The photos of project areas are shown below.



Source: Department of Survey

Figure 3.2 Land Use of LRT's Surrounding Areas


View at around Fort station


View at Lipton Circle.


View at Pelawatta Road


View at near Robert Gunawardena Mawatha

3.2.2 Topography

The terrain of the LRT is generally flat since it follows the existing roads. The terrain adjacent to Chandrika Bandaranayake Kumaratunga Mawatha is a low-lying flood plain.

3.2.3 Climate

(1) Temperature and Rainfall

Colombo has a tropical monsoon climate. It is fairly temperate all throughout the year. From March to April, the average high temperature is around 33°C. The monsoon seasons are from May to August and October to January. During these months, Colombo experiences heavy rain with thunder and strong wind every year.

Table 3-1 shows recorded average temperature and rainfall in Colombo in a year. The city sees little relative diurnal range of temperature, wherein the average temperature ranges from 25°C up to 31°C. Rainfall in the city averages around 200mm a year.

Table 3-1 Average Temperature and Rainfall

Month	Mean Temperature (°C)		Max. Rainfall (mm)
	Min	Max	
Jan	24.2	32.4	65.3
Feb	24.9	32.5	106.7
Mar	26.0	32.9	91.3
Apr	26.5	33.3	185.9
May	25.8	31.6	752.4
Jun	26.8	31.1	132.3
Jul	26.3	30.7	49.2
Aug	27.1	31.0	1.1
Sep	26.5	30.6	29.0
Oct	25.7	31.1	374.0
Nov	24.3	30.7	404.8
Dec	24.2	31.4	165.1

Source: Department of Meteorology

3.2.4 Ambient Air Quality

As updated ambient air quality data in project area are not readily available, the ambient air quality monitoring conducted for the other development projects in Colombo (New Kelani Bridge Project in Colombo) was referred to. Since the location of the project is geographically close to the proposed project, and no additional air major emission source (such as power plant or other industrial facilities) have been implemented recently in these areas, it is considered that data can be used to represent the air quality in the project area.

Table 3-2 shows the maximum concentration measured in the Year 2013. The air quality measurement was conducted at around the proposed New Kelani Bridge. The result shows that SO_2, NO_2, CO and PM_{10} were below the Ambient Air Quality Standards stipulated by the Ministry of Environment and Natural Resources of Sri Lanka. Also measured existing ambient air quality levels with respect to SPM was within the Ambient Air Quality Standards stipulated under the Extraordinary Gazette, No.850/4, December 20, 1994, by the CEA of Sri Lanka.

Table 3-2 Result of maximum concentration in Colombo in 2013

Parameter	Average	Unit	Result	Permissible Air Quality Standards, Sri lanka	WHO Ambient Air Quality Guideline
SO2	24hr	ug/m^3	31	80	20 -125
NO2	24hr	ug/m^3	33	100	200 (1 hour)
CO	8hr	ppm	6.7	9.00	-
CO2	1120	ppm	1120	-	-
SPM	168	ug/m^3	168	-	-
PM10	24hr	ug/m^3	68	100	50

Source:EIA of the New Kelani Bridge Project in Colombo

3.2.5 Noise and Vibration

(2) Noise

Noise measurements were carried out at selected locations mainly aiming sample noise sensitive receptors such as temples, schools, residential areas etc. Noise measurements were carried out by ITI. Noise levels were measured at strategic locations during week days and weekend. Locations for noise levels measurements have been indicated in Table 3-3 and Figure 3.3 below.

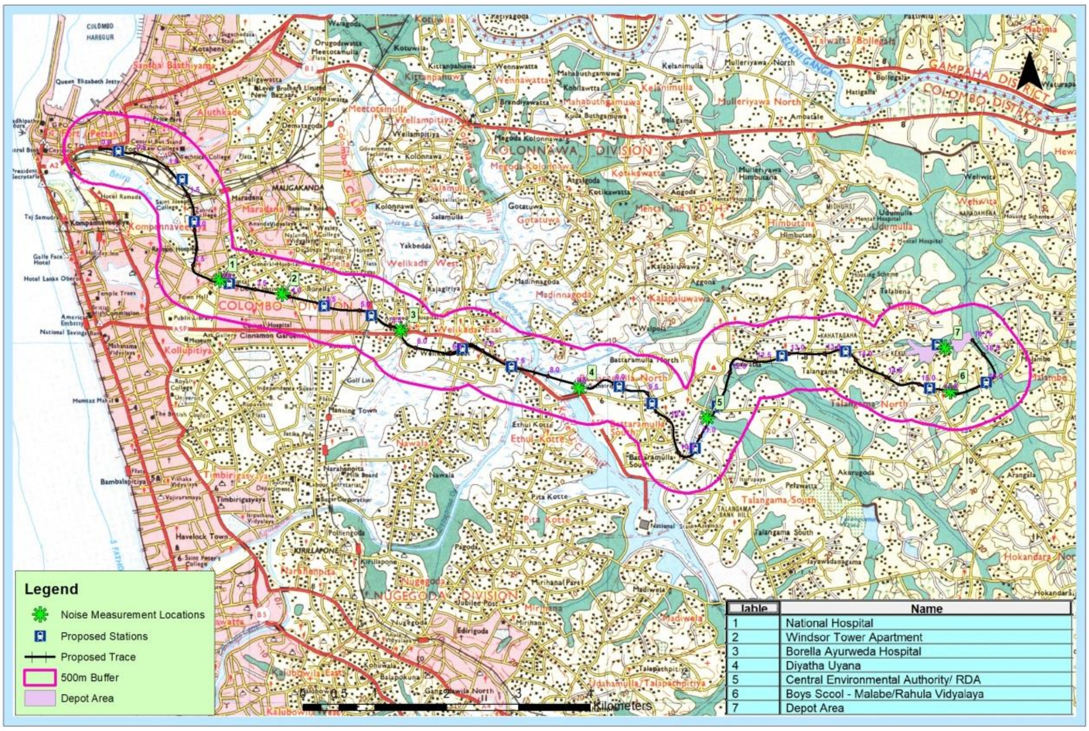
Sample average noise levels day, evening and night during a weekday are presented in

Table 3-4 below. In addition, 15-minute interval noise measurements for these locations for 24 hours are available. All the baseline noise levels are indicated in Annex D.

From the sample noise measurements, it seen that at some locations both day and night time noise levels have exceeded the permitted noise levels of the National Environmental (Noise Control) Regulations No. 1 of 1996 i.e. for urban residential areas day time 60dB and night time 50dB. Such noise level exceedances are mainly due to traffic noise.

Table 3-3 Noise Measurement Locations

Measurement Location	G.P.S. Point	Location
N 1	6°54'31.98"N 79°57'26.93"E	No. 852/71, Asokarama Road, Malabe
N 2	6°54'13.22"N 79°57'25.36"E	Malabe Boys' School, Malabe
N 3	6°54'2.12"N 79°55'37.11"E	Central Environmental Authority, 104, Denzil Kobbekaduwa Mawatha, Battaramulla
N 4	6°54'14.17"N79° 54'41.83"E	Diyatha Uyana (Park in Sri Jayawardenepura Kotte), Kaduwela Road, Sri Jayawardenepura
N 5	6°54'41.80"N 79°53'15.69"E	Jayawardanaramaya Temple, Dr. N.M. Perera Mawatha, Colombo 08
N 6	6°54'56.22"N79° 52'23.66"E	Windsor Tower, Ward place, Colombo 08
N 7	6°55'1.83"N 79°51'57.45"E	National Hospital Colombo, 10



lable	Name
1	National Hospital
2	Windsor Tower Apartment
3	Borella Ayurweda Hospital
4	Diyatha Uyana
5	Central Environmental Authority/ RDA
6	Boys Scool - Malabe/Rahula Vidyalaya
7	Depot Area

Figure 3.3 Noise Sampling Points

Table 3-4 Noise Level Results

Measurement Location	**Assessment time period- Day (6:00-18:00)**			**Assessment time period- Evening (18:00-22:00)**			**Assessment time period- Night (22:00-6:00)**		
	ABL **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**	***ABL*** **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**	***ABL*** **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**
N1	61	67	72	64	67	72	51	53	67
N2	61	62	73	56	60	69	49	50	65
N3	41	45	57	43	47	57	41	43	54
N4	56	57	63	54	56	65	46	49	56
N5	55	61	67	53	56	62	44	49	56
N6	58	66	75	61	64	75	45	46	68
N7	64	66	72	59	62	69	43	45	63

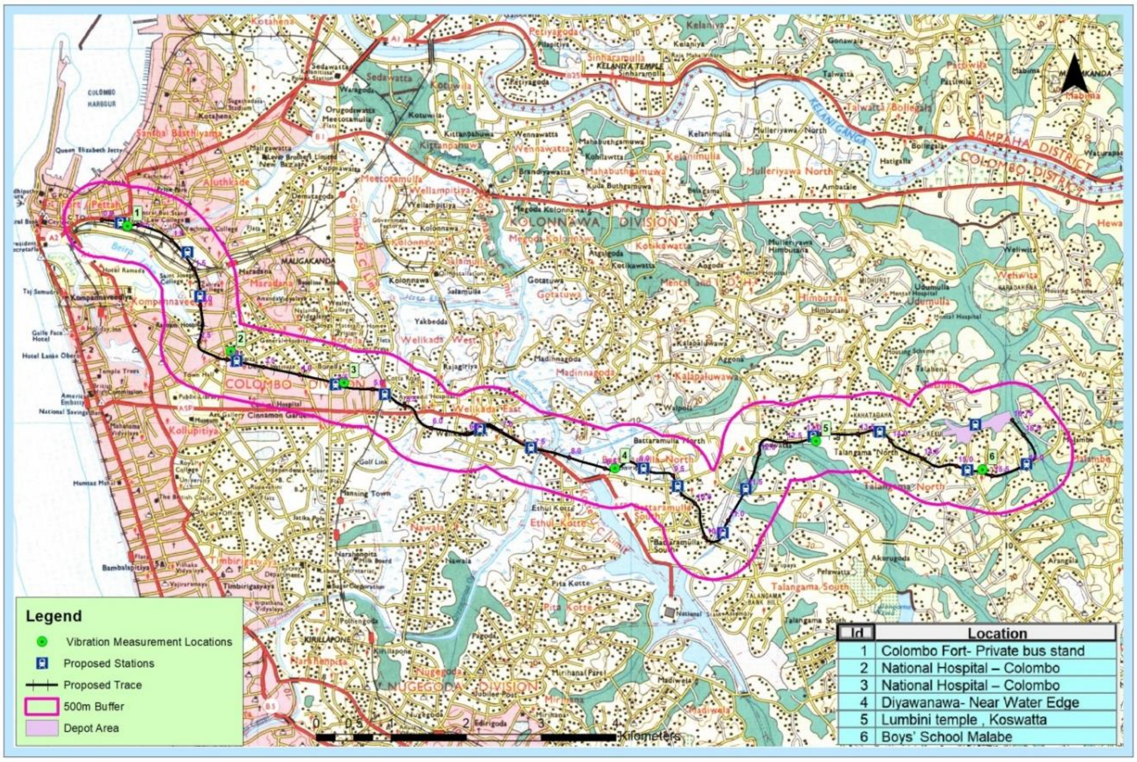
ABL -Assessment background level (LA90,15min);
RBL - Rating background level (LA90,15min);
ENL -Existing noise level (LAeq,h) h-hour

(3) Vibration

Vibration measurements recorded in 2014 at several points along the LRT route is shown in Table 3-5. Location of the sampling points is shown in Figure 3.4. The results show that existing vibration levels at some points along the route are way below the vibration limits for sensitive structures (made of lightweight materials), set by the CEA.

Table 3-5 Vibration Level Results

Location	Run time (min)	Vibration level	
		Frequency Range (Hz)	Vibration in ppv (mm/sec)
Interim Standard for Vibration Levels by the CEA (Type 3 structures, made of lightweight materials)		0-10 10-50 over 50	2.0 4.0 8.0
1	0-15min	10-50	0.19
	15-30min	10-50	0.30
	30-45min	10-50	0.38
	45-50min	10-50	0.29
2	0-15min	0-10	0.22
	15-30min	10-50	0.14
	30-45min	0-10	0.14
	45-50min	0-10	0.16
3	0-15min	0-10	0.22
	15-30min	0-10	0.21
	30-45min	0-10	0.18
	45-50min	0-10	0.25
4	0-15min	0-10	0.21
	15-30min	0-10	0.36
	30-45min	0-10	0.34
	45-50min	0-10	0.26
5	0-15min	10-50	0.07
	15-30min	10-50	0.07
	30-45min	10-50	0.09
	45-50min	10-50	0.08
6	0-15min	10-50	0.10
	15-30min	10-50	0.20
	30-45min	10-50	0.21
	45-50min	10-50	0.16



Id	Location
1	Colombo Fort- Private bus stand
2	National Hospital – Colombo
3	National Hospital – Colombo
4	Diyawanawa- Near Water Edge
5	Lumbini temple , Koswatta
6	Boys' School Malabe

Figure 3.4 Vibration measurement points

3.2.6 Surface and Groundwater Quality

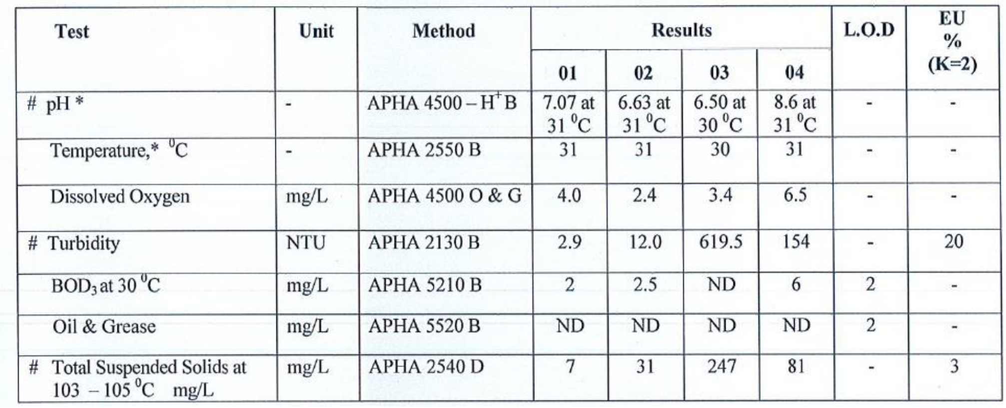
(1) Surface Water

Surface water quality was measured in the main waterbodies such as Diyawanna Lake (1), Palanthuna Junction Canal (2), Madewela East Diversion (3)-the canal close to the proposed depot and Beria Lake (4). Parameters pH, Temperature, Dissolved Oxygen(DO), Turbidity, Biochemical Oxygen Demand (BOD), Oil and Grease and Total Suspended Solids (TSS) were measured. Measurements were carried out by the Industrial Technology Institute (ITI) Sri Lanka. Results are given in Table 3-6. Water quality report is given in **Annex E**.

These parameters were compared with the Proposed Inland Water Quality Standards (PIWQS) for Different Uses (Drinking water – Only Disinfection, Bathing, Fish and Aquatic Life, Drinking Water Conventional Treatment, Irrigation and Agriculture, Other) (refer to Table 3-7 below). The analysis results are summarised in

Table 3-8. In general, all sites are compliant with the set standard for certain parameters, except Beira Lake (exceeded pH, DO and BDO).

Table 3-6 Surface Water Quality Measurements

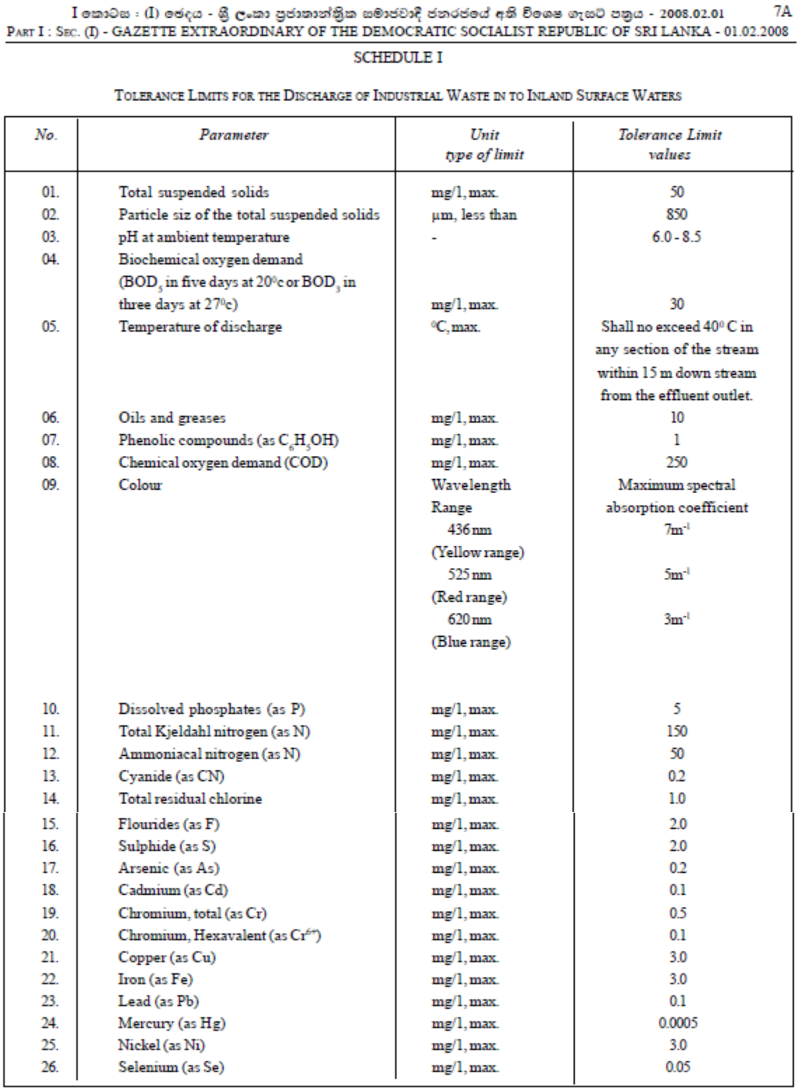


Test	Unit	Method	Results				L.O.D	EU % (K=2)
			01	02	03	04		
# pH *	-	APHA 4500 – H^+ B	7.07 at 31 °C	6.63 at 31 °C	6.50 at 30 °C	8.6 at 31 °C	-	-
Temperature,* °C	-	APHA 2550 B	31	31	30	31	-	-
Dissolved Oxygen	mg/L	APHA 4500 O & G	4.0	2.4	3.4	6.5	-	-
# Turbidity	NTU	APHA 2130 B	2.9	12.0	619.5	154	-	20
BOD_3 at 30 °C	mg/L	APHA 5210 B	2	2.5	ND	6	2	-
Oil & Grease	mg/L	APHA 5520 B	ND	ND	ND	ND	2	-
# Total Suspended Solids at 103 – 105 °C mg/L	mg/L	APHA 2540 D	7	31	247	81	-	3

Source: ITI Water Quality Report- Annex.

Note: Sample Location Identification- Diyawanna Lake (1), Palanthuna Junction Cana (2), Madewela East Diversion (3)-the canal close to the proposed depot and Beria Lake (4). ND= Not Detected

Table 3-7 Proposed Ambient Water Quality Standards for Inland Waters in Sri Lanka



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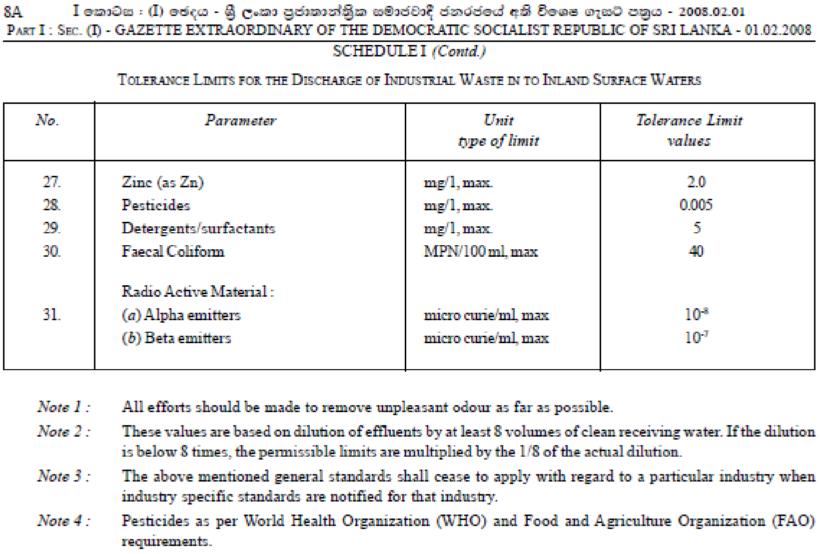
PART I : SEC. (I) - GAZETTE EXTRAORDINARY OF THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA - 01.02.2008

SCHEDULE I

TOLERANCE LIMITS FOR THE DISCHARGE OF INDUSTRIAL WASTE IN TO INLAND SURFACE WATERS

No.	*Parameter*	*Unit type of limit*	*Tolerance Limit values*
01.	Total suspended solids	mg/l, max.	50
02.	Particle siz of the total suspended solids	µm, less than	850
03.	pH at ambient temperature	-	6.0 - 8.5
04.	Biochemical oxygen demand (BOD_5 in five days at 20°c or BOD_3 in three days at 27°c)	mg/l, max.	30
05.	Temperature of discharge	°C, max.	Shall no exceed 40° C in any section of the stream within 15 m down stream from the effluent outlet.
06.	Oils and greases	mg/l, max.	10
07.	Phenolic compounds (as C_6H_5OH)	mg/l, max.	1
08.	Chemical oxygen demand (COD)	mg/l, max.	250
09.	Colour	Wavelength Range 436 nm (Yellow range) 525 nm (Red range) 620 nm (Blue range)	Maximum spectral absorption coefficient $7m^{-1}$ $5m^{-1}$ $3m^{-1}$
10.	Dissolved phosphates (as P)	mg/l, max.	5
11.	Total Kjeldahl nitrogen (as N)	mg/l, max.	150
12.	Ammoniacal nitrogen (as N)	mg/l, max.	50
13.	Cyanide (as CN)	mg/l, max.	0.2
14.	Total residual chlorine	mg/l, max.	1.0
15.	Flourides (as F)	mg/l, max.	2.0
16.	Sulphide (as S)	mg/l, max.	2.0
17.	Arsenic (as As)	mg/l, max.	0.2
18.	Cadmium (as Cd)	mg/l, max.	0.1
19.	Chromium, total (as Cr)	mg/l, max.	0.5
20.	Chromium, Hexavalent (as Cr^{6+})	mg/l, max.	0.1
21.	Copper (as Cu)	mg/l, max.	3.0
22.	Iron (as Fe)	mg/l, max.	3.0
23.	Lead (as Pb)	mg/l, max.	0.1
24.	Mercury (as Hg)	mg/l, max.	0.0005
25.	Nickel (as Ni)	mg/l, max.	3.0
26.	Selenium (as Se)	mg/l, max.	0.05



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PART I : SEC. (I) - GAZETTE EXTRAORDINARY OF THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA - 01.02.2008

SCHEDULE I *(Contd.)*

TOLERANCE LIMITS FOR THE DISCHARGE OF INDUSTRIAL WASTE IN TO INLAND SURFACE WATERS

No.	*Parameter*	*Unit type of limit*	*Tolerance Limit values*
27.	Zinc (as Zn)	mg/1, max.	2.0
28.	Pesticides	mg/1, max.	0.005
29.	Detergents/surfactants	mg/1, max.	5
30.	Faecal Coliform	MPN/100 ml, max	40
	Radio Active Material :		
31.	(*a*) Alpha emitters	micro curie/ml, max	10^{-8}
	(*b*) Beta emitters	micro curie/ml, max	10^{-7}

Note 1 : All efforts should be made to remove unpleasant odour as far as possible.

Note 2 : These values are based on dilution of effluents by at least 8 volumes of clean receiving water. If the dilution is below 8 times, the permissible limits are multiplied by the 1/8 of the actual dilution.

Note 3 : The above mentioned general standards shall cease to apply with regard to a particular industry when industry specific standards are notified for that industry.

Note 4 : Pesticides as per World Health Organization (WHO) and Food and Agriculture Organization (FAO) requirements.

Table 3-8 Comparison of Water Quality Results and PIWQS

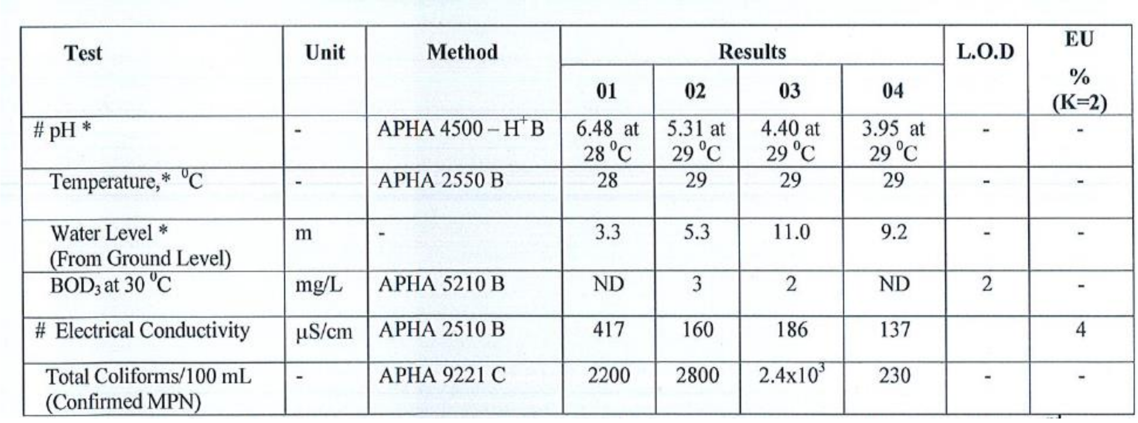
Parameter	**Location No. and Name**			
	1-Diyawanna Lake	**2-Palan Thuna Junction Canal**	**Madiwela Est Diversion Canal**	**Beria Lake**
PH	7.07	6.63	6.50	8.6
Comments on pH	**Within limits for all use types**			**Has exceeded the upper limit 8.5 by 0.1**
Temperature	31	31	30	31
Comments on Temperature	**Not given in the standard but no high temperature values exit.**			
Dissolved Oxygen(DO)	4.0	2.4	3.4	6.5
Comments on DO	**Lower than the minimum upper limit (5 for Bathing)**			**Above the maximum lower limit (6 for Drinking & Aquatic Life)**
Turbidity	2.9	12.0	619.5	154
Comments on Turbidity	**Not given in the standard**			
BOD	2	2.5	ND	6
Comments on BOD	Within the limits for all uses	Exceeds drinking water limit (2) by 0.5 mg/l	Good for all uses	Exceeds maximum standards for all users
Oil & Grease	ND	ND	ND	ND
Comments on oil & grease	Has not exceeded minimum limits			
Total Suspended Solids	7	31	247	81
Comments on Total Suspended Solids	Not given in the standards			

(2) Groundwater

Water quality of groundwater was measured in selected dug wells close to the LRT trace. The locations are Well at Parakumbura Maha Vidyalaya (1), Well at the premises of P W Joachim 487/11 Talahena (2), Well at the premises of D P R Dias 146 Batalawatte Talahena (3), Well at Asokatamaya Temple Malabe (4) Measurements were carried out by Industrial Technology Institute. Results are shown in

Table 3-9. Water quality report is given in Annex E.

Table 3-9 Groundwater Quality Measurements



Test	Unit	Method	Results				L.O.D	EU % (K=2)
			01	02	03	04		
# pH *	-	APHA 4500 – H^+ B	6.48 at 28 ^{0}C	5.31 at 29 ^{0}C	4.40 at 29 ^{0}C	3.95 at 29 ^{0}C	-	-
Temperature,* ^{0}C	-	APHA 2550 B	28	29	29	29	-	-
Water Level * (From Ground Level)	m	-	3.3	5.3	11.0	9.2	-	-
BOD$_3$ at 30 ^{0}C	mg/L	APHA 5210 B	ND	3	2	ND	2	-
# Electrical Conductivity	µS/cm	APHA 2510 B	417	160	186	137		4
Total Coliforms/100 mL (Confirmed MPN)	-	APHA 9221 C	2200	2800	2.4x10^3	230	-	-

Source: ITI Water Quality Report- Annex E.

Note: Sample Locations - Well at Parakumbura Maha Vidyalaya (1), Well at the premises of P W Joachim 487/11 Talahena (2), Well at the premises of D P R Dias 146 Batalawatte Talahena (3), Well at Asokaramaya Temple Malabe (4)

These parameters were compared with Sri Lanka Potable Standards 2013 for drinking water (SLS 614) and the comments on each parameter have been set out in Table 3-10 below.

Table 3-10 Groundwater Quality Measurements

Parameter	**Sample Locations** - Well at Parakumbura Maha Vidyalaya **(1)**, Well at the premises of P W Joachim 487/11 Talahena **(2)**, Well at the premises of D P R Dias 146 Batalawatte Talahena **(3)**, Well at Asokaramaya Temple Malabe **(4)**				**Values Given in SLS 614 Potable Water Standard**
	1	**2**	**3**	**4**	
PH	6.48	5.31	4.4	3.95	6.5 to 8.5
Comments on pH	**Within tolerance limits. Satisfactory.**				
Temperature	28	29	29	29	Not Given
BOD	ND	3	2	ND	Not Given
Electrical Conductivity	417	160	186	137	Not Given
Total Coliform	2200	2800	2.4X10^3	230	3
Comments Total Coliform	**Outside tolerance limits. Unsatisfactory.**				

Notes: Units for parameters are given in Table.. above.

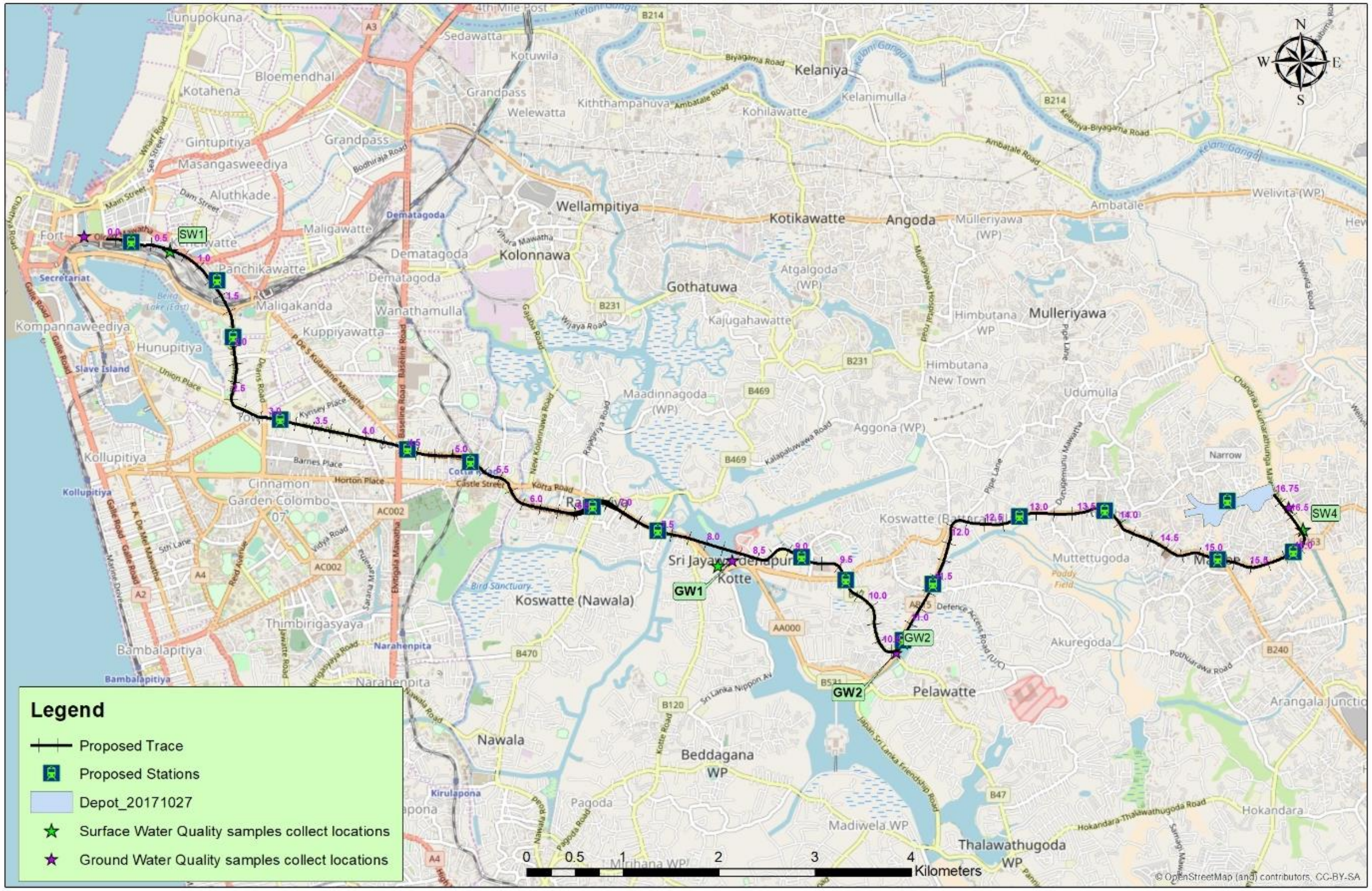
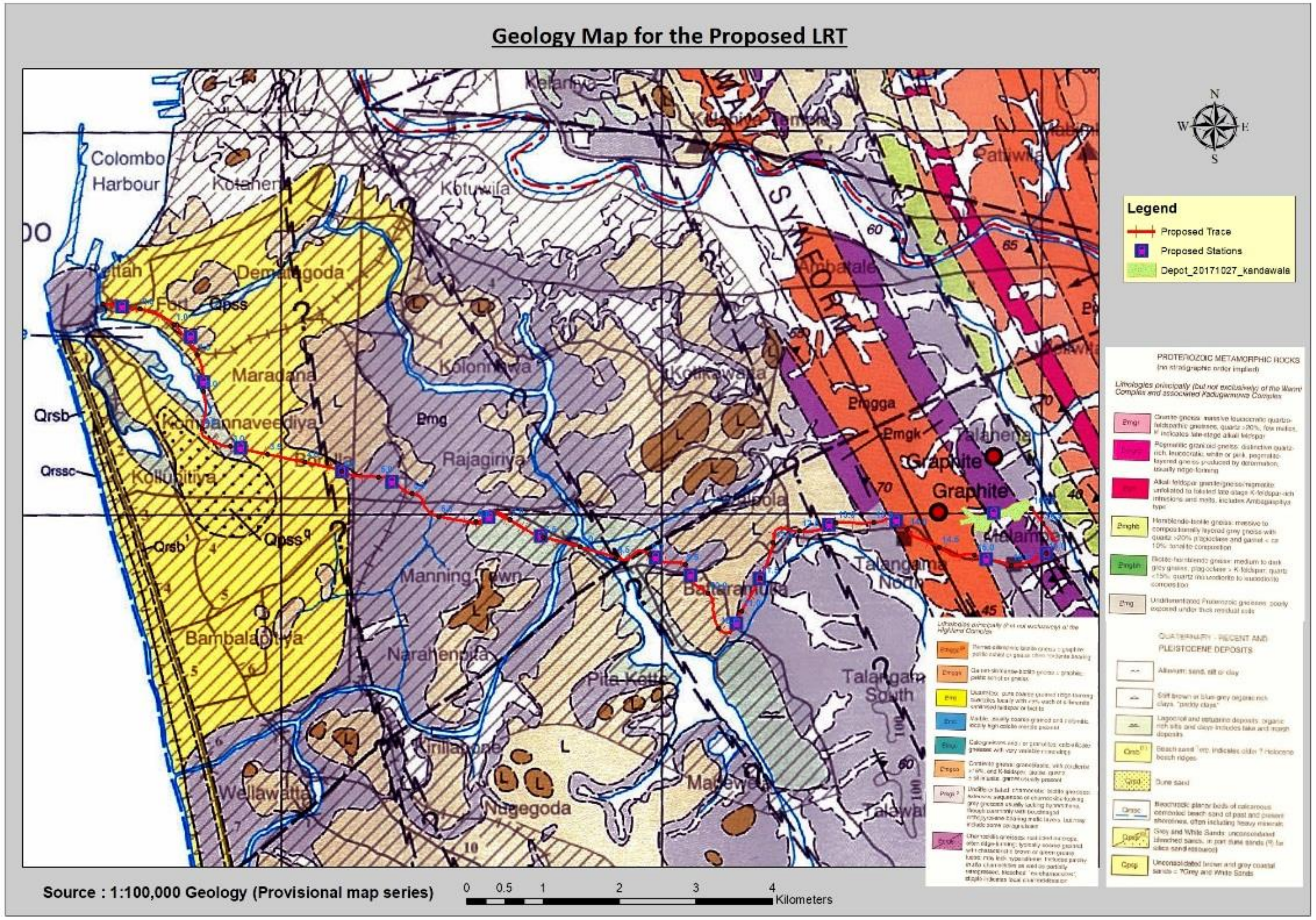


Figure 3.5 Surface & Groundwater Sampling Points

3.2.7 Geology

The geological details of the area around the LRT route are presented as a map in Figure 3.6 below. Based on the Figure, the main geological strata of the LRT route consist of quartzites, undifferentiated Proterozoic gneiss, garnet-sillimanite-biotite gneiss.



Source : 1:100,000 Geology (Provisional map series)

Figure 3.6 Geology Map

3.3 Socio-cultural Environment

3.3.1 Socio-Economic Profile of the Project Area

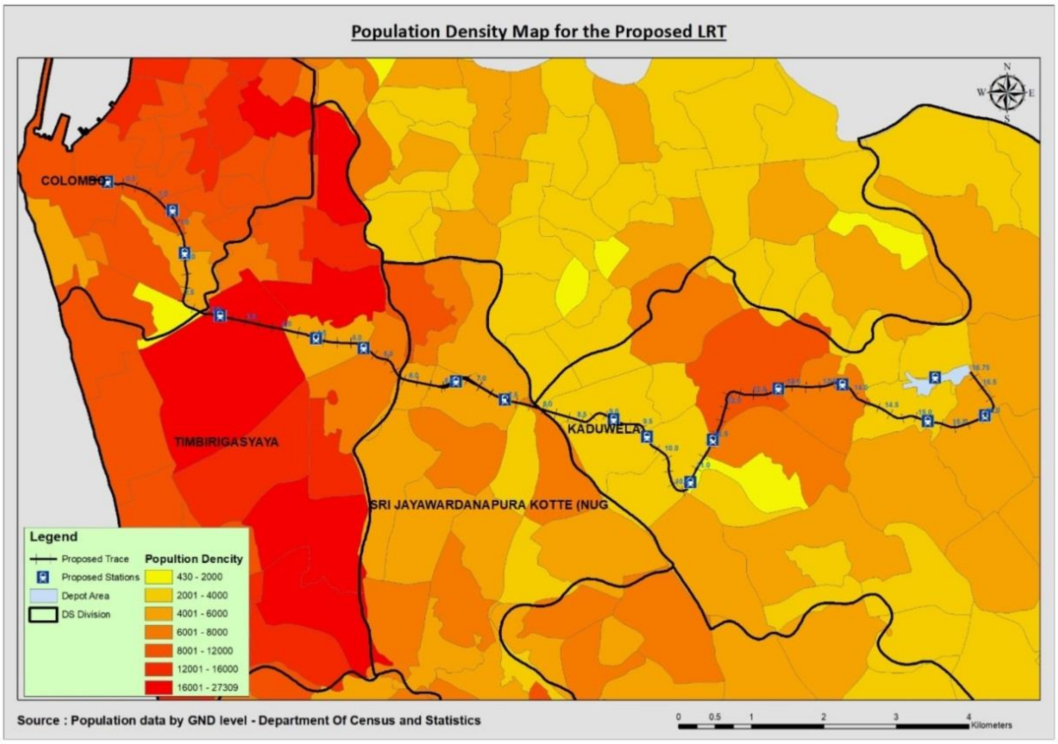
(1) Demography

The estimated mid-year population in 2016 in Colombo district is 2,395,000 persons and this includes 1,175,000 males and 1,220,000 females. This is the highest populated district in the country representing 11.4% of population with a population density of 3438 per km^2 (Source: Department of Census and Statistics 2012). Table 3-11 presents the population data of affected DS divisions. The highest populated DS division is Colombo. Figure 3.7 presents the population density map. It can be seen that population density decreases as one goes outside of Colombo.

Table 3-11 Population Distribution (Gender)

Divisional Secretariat Division	Male	Female	Total
Colombo	162,798	160,459	323,257
Thibirigasyaya	118,660	119,397	238,057
Sri Jayawardhanapura Kotte	51,992	55,933	107,925
Kaduwela	123,572	128,469	252,041
Total	457,022	464,258	921,280

Source: Department of Census and Statistics 2012



Source: Census Data (2013)

Figure 3.7 Population Density Map

In consideration of the ethnicity of the district population, 76.5% are Sinhalese, 11.2% are Tamil, 10.7 are Moor and 1.6% is other (Source: Department of Census and Statistics 2012). The sample of 200 surveyed in the light rail corridor further confirmed this ethnic distribution having 86% of Sinhalese household heads and 9.5% of Moor household heads.

In terms of education, a little over one third of the total population (35%) has completed the secondary education and only 3% have not gone to school. Further, around 6.2% of the population have attained graduate or post graduate qualifications.

Table 3-12 Educational Attainment

Divisional Secretariat Division	Primary	Secondary	GCE (O/L)	GCE (A/L)	Degree and Above	No schooling	Total
Colombo	71,175	127,855	49,694	28,635	5,174	13,383	295,916
Thibirigasyaya	35,607	70,962	45,456	44,798	20,166	6,627	223,616
Sri Jayawardhanapura Kotte	13,175	27,224	21,744	25,671	11,799	2,278	101,891
Kaduwela	32,883	73,561	56,413	51,068	16,286	3,975	234,186
Total	152,840	299,602	173,307	150,172	53,425	26,263	855,609

Source: Department of Census and Statistics 2012

The education attainments of the population of the project area through the sample survey are similar to the above situation. Around 43% of the population has studied up to G.C.E O/L and G.C.E. A/L and around 25% have passed G.C.E. A/L.

(2) Livelihood

Out of the 15 years and above population in four DS divisions, 48% are employed while another 48% are considered as economically not active. The unemployed rate is around 2%. The table below depicts this information.

According to the labour force survey-2015, in Colombo district, majority of the employed population (70.5%) is engaged in the service sector and around 27.7% are engaged in Industries. The agriculture sector is around 1.8%.

Table 3-13 Employment Status

Divisional Secretariat Division	Employed	Unemployed	Economically Not Active	Total
Colombo	110,920	6,209	123,301	240,430
Thibirigasyaya	93,421	3,960	93,432	191,113
Sri Jayawardhanapura Kotte	45,778	2,191	40,155	88,124
Kaduwela	101,044	4,820	92,982	198,846
Total	351,163	17,180	349,870	718,513

Source: Department of Census and Statistics 2012

Establishments along the proposed LRT route are primarily commercial or business premises. According the survey conducted, 53 out of 62 establishments (approximately 85%) surveyed are commercial establishments. The survey team has identified 92 workers employed in these business premises. Around 75% of business places has employed up to four number of employees around 12% of business places have employed 10-24 number of employees.

In Kaduwella DS division, there are areas used for paddy cultivations. Majority of these paddy lands are cultivated by tenant (*Ande*) farmers. These cultivations are making a significant contribution to households' food security.

(3) Health

According to the Annual health bulletin 2015, in Colombo district crude birth rate for 1,000 population is 14.4% and the crude death rate is 7%. Maternal mortality rate is 12.5% and infant mortality rate is 13.6%. The district maintains an average situation compared to other districts.

(4) Vulnerable Households

The poverty headcount index is 1.4% in Colombo and it is the lowest in the country. Thibirigasyaya, Sri Jayawardanapura Kotte and Kaduwella are categorised as least poor DS divisions. The table below summarises the number of samurdhi beneficiaries in the project area. The sample consists of 16% of female-headed households and around 12% of the participants is above 65 years and more.

Table 3-14 Samurdhi Beneficiaries in the Project Area

Divisional Secretariat Division	Number of Beneficiaries	Population	% of Beneficiaries
Colombo	5,901	323,257	1.8
Thibirigasyaya	3,232	238,057	1.3
Sri Jayawardhanapura Kotte	1,863	107,925	1.7
Kaduwela	5,019	252,041	1.9
Total	16,015	921,280	1.7

Source: District Secretariat, Colombo – 2017

3.3.2 Existing Social Infrastructure

(1) Physical Structures

Physical structures located in the project affected DS divisions are presented in Table 3-15. Around 94% of the units are classified as permanent structures. Single single-story buildings are higher in Kaduwela DS division while above two-story buildings are a higher number in Colombo and Thibirigasyaya DS divisions. Flats and condominiums are also higher in these DS divisions compared to other DS divisions. When considering the tenure, 72% are owned by the owners and around 16% rent or lease private owned.

Table 3-15 Physical Structures in the affected DS Divisions

Divisional Secretariat Division	Permanent	Semi-Permanent	Improvised	Un-classified	Total
Colombo	60,512	5,157	121	41	65,831
Thibirigasyaya	49,955	2,758	50	0	52,763
Sri Jayawardhanapura Kotte	25,442	1,636	66	0	27,144
Kaduwela	61,867	2,646	126	152	64,791
Grand Total	**197,776**	**12,197**	**363**	**193**	**210,529**

Source: Department of Census and Statistics 2012

As discussed above. Most of the structures along the study area are commercial in nature. Residential strips are mixed with commercial establishments (e.g. at Ward Place). There are also public and religious establishments such as Hyde Park, Pettah Railway Yard, Temples, Churches and two considerably old buildings (Railway Museum and Peoples' Bank Building near Pettah Railway Yard). The photos below present some of the structures located along the LRT Route.

Business premises located at Ibbanwala Junction

Lakviru Sevana

Borella Super Market

(2) Service Uses

Information about energy, water and sanitary utilities being used in the project area is summarized below. Detailed information can be found in Annex G.

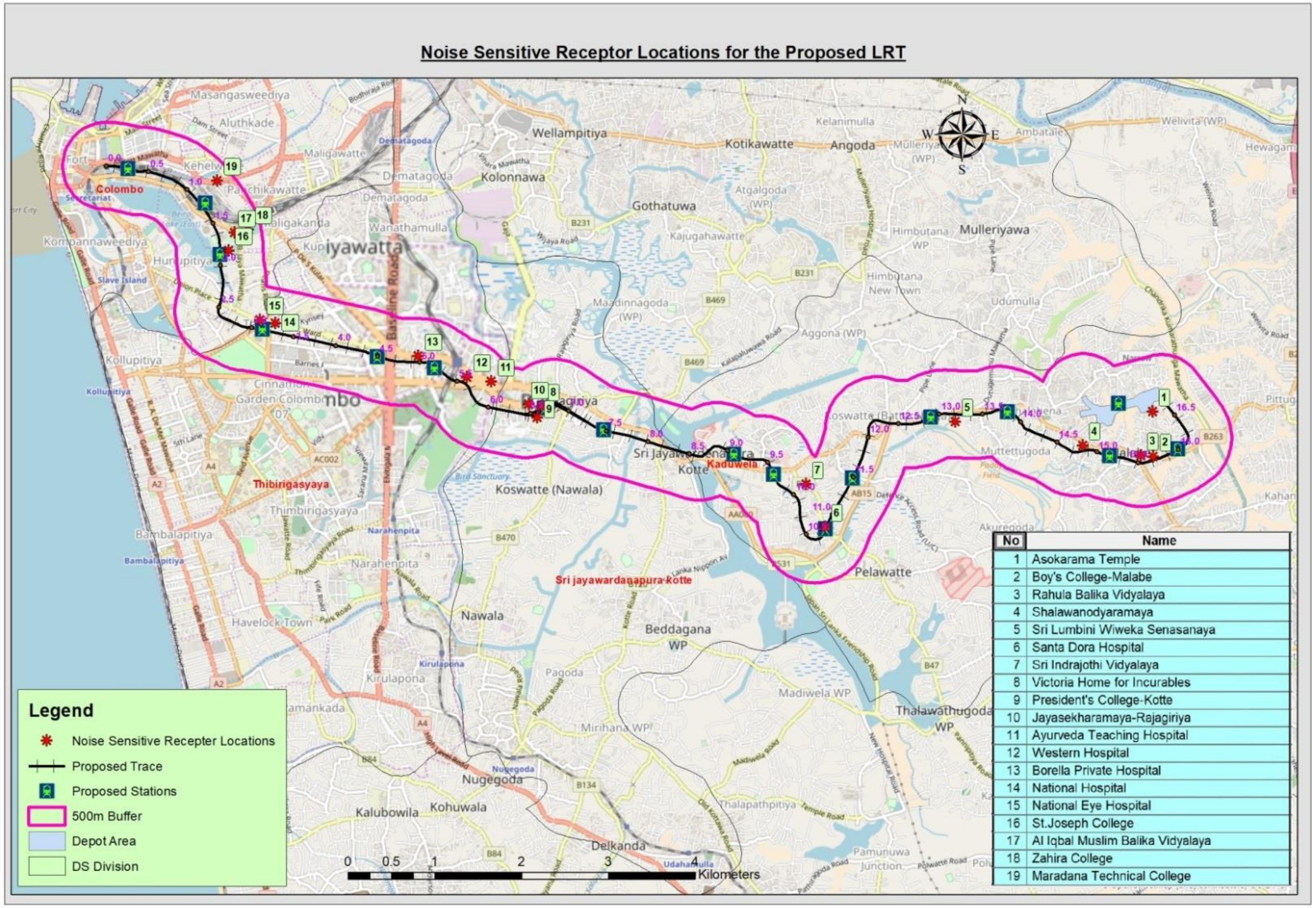
- Around 89% of the population use drinking water supplied by the National Water Supply and Drainage Board.
- 96% use electricity as source of lighting.
- 63% use LP gas, while 26% use electricity for cooking,
- Majority (73%) use private latrine facilities and 25% use public facilities. Majority use flush toilets (52%) and water sealed (42%) facilities.

3.3.3 Noise Sensitive Receptors

The LRT is traversing along the existing roads where schools, hospitals and religious places are located in the vicinity of the project area. The noise sensitive receptors are listed in Table 3-16 and mapped in Figure 3.8. There are seven hospitals, eight schools and four religious place/temple.

Table 3-16 Noise Sensitive Receptors

DS division	**Names of the place (school, Hospital and Religious Places)**	
Kaduwela	Sri Indrajothi Vidyalaya	School
	Malabe Boys College,	School
	Rahula Balika Maha Vidyalaya,	School
	Shalawanodyaramaya,	Temple
	Asokaramaya,	Temple
	Sri Lumbini Wiweka Senasanaya,	Religious
	Santa Dora Hospital	Hospital
Sri Jayawardenapura Kotte	Ayurweda Teaching Hospital,	Hospital
	President College	School
	Rajagiriya Jayasekhararamaya,	Temple
	Victoria Home for Incurables	Hospital
Thibirigasyaya	National Eye Hospital,	Hospital
	National Hospital,	Hospital
	Borella Private Hospital,	Hospital
	Western Hospital	Hospital
Colombo		
	Zahira College,	School
	St. Joseph College,	School
	Maradana Technical College,	School



No	Name
1	Asokarama Temple
2	Boy's College-Malabe
3	Rahula Balika Vidyalaya
4	Shalawanodyaramaya
5	Sri Lumbini Wiweka Senasanaya
6	Santa Dora Hospital
7	Sri Indrajothi Vidyalaya
8	Victoria Home for Incurables
9	President's College-Kotte
10	Jayasekharamaya-Rajagiriya
11	Ayurveda Teaching Hospital
12	Western Hospital
13	Borella Private Hospital
14	National Hospital
15	National Eye Hospital
16	St.Joseph College
17	Al Iqbal Muslim Balika Vidyalaya
18	Zahira College
19	Maradana Technical College

Figure 3.8 Noise Sensitive Receptors

3.3.4 Cultural Heritage

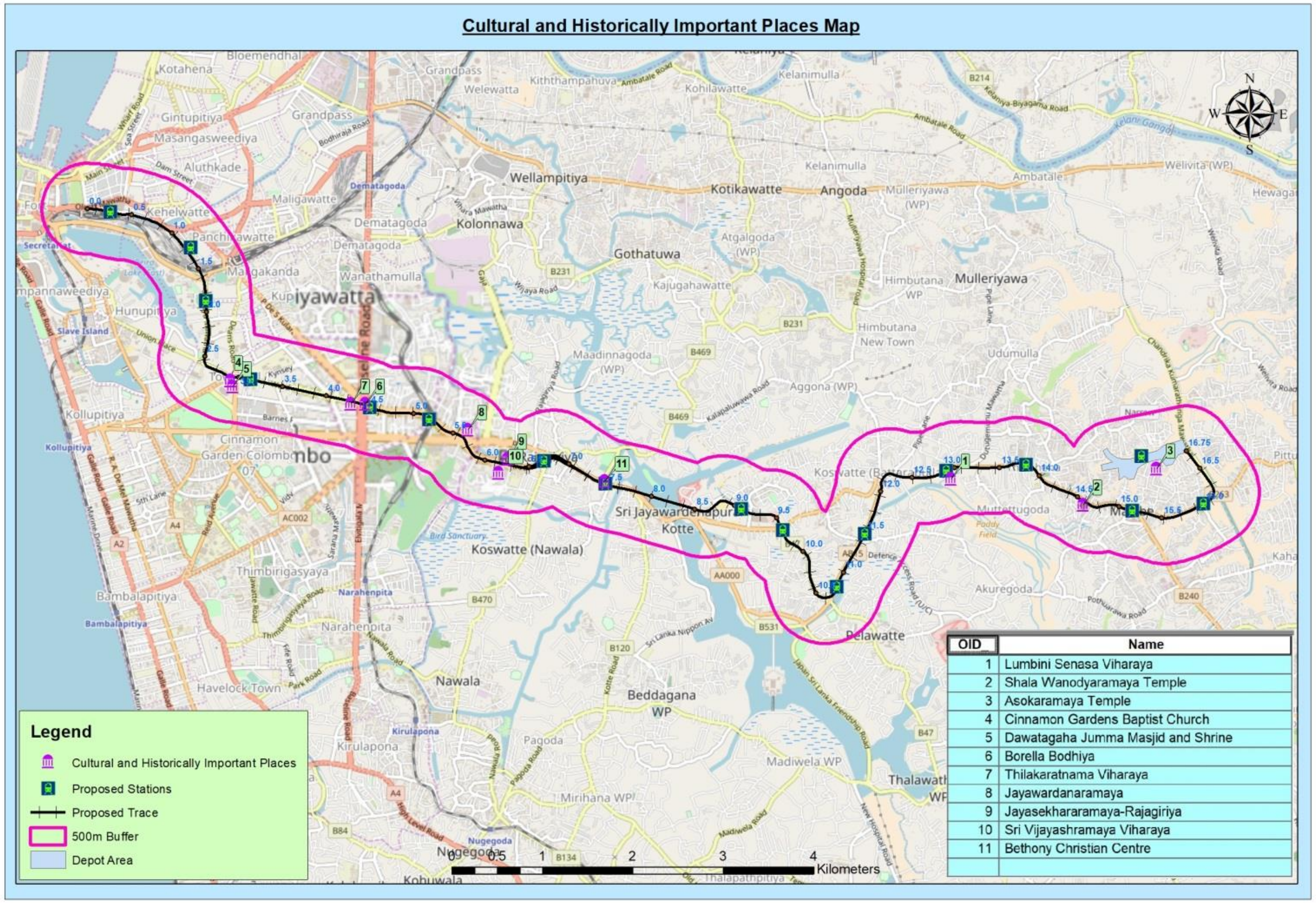
(1) Cultural Heritage Sites

A significant number of religious centers can be seen within 500-meter radius from the boundary of the proposed rail trace. These centers will not be directly impacted, however, there can be some disturbances during construction phase of the project.

Religious and culturally important properties which are located in the study area include six (06) temples, one (1) church, one (1) mosque and three (3) religious places. Details of the culturally and historically significant places are presented in Figure 3.9.

Table 3-17 Culturally and historically significant places

DS division	Names of the place	
Kaduwela	Sri Lumbini Wiweka Senasanaya,	Religious place
	Shilawanodyaramaya,	Temple
	Asokaramaya	Temple
Sri Jayawardenapura Kotte	Sri Vijayashramaya Viharaya,	Temple
	Rajagiriya Jayasekhararamaya,	Temple
	Jayawardanaramaya	Temple
	Bethany Christian Centre	Religious place
Thibirigasyaya	Cinnamon Gardens Baptist Church	Church
	Dawatagaha Jumma Masjid and Shrine	Mosque
	Borella Bodhiya,	Religious place
	Thilakaratnama Viharaya	Temple
Colombo	-	-



OID	Name
1	Lumbini Senasa Viharaya
2	Shala Wanodyaramaya Temple
3	Asokaramaya Temple
4	Cinnamon Gardens Baptist Church
5	Dawatagaha Jumma Masjid and Shrine
6	Borella Bodhiya
7	Thilakaratnama Viharaya
8	Jayawardanaramaya
9	Jayasekhararamaya-Rajagiriya
10	Sri Vijayashramaya Viharaya
11	Bethony Christian Centre

Figure 3.9 Location of Culturally and Historically Important Places

(2) Bo Trees

The reconnaissance surveys revealed that there are 14 Bo Trees (sacred trees) along the LRT route. The location of these Bo trees is shown in Figure 3.10. Some of photos of these Bo Trees are provided below. **Annex F** provides more details about the Bo trees.

Shalawanodyaramaya Bo Tree (in between Thalahena and Malabe) A branch of the Bo tree may be impacted

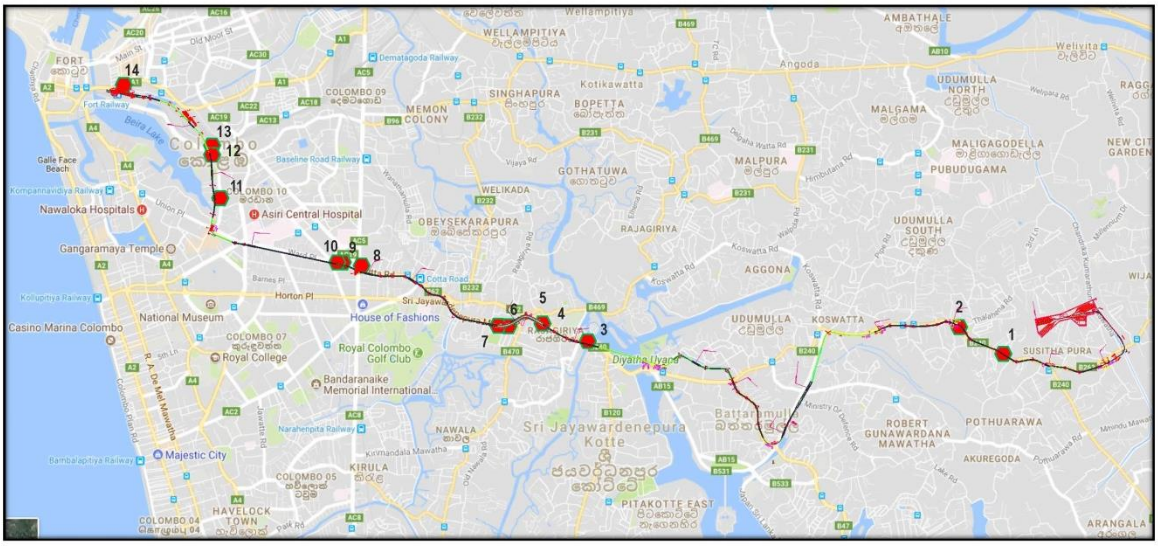
Bo Tree Near Rajagiriya President's College

Thalahena Bo Tree

Bo Tee at Gamini Hall Junction

Bo Tree at Borella Junction

Borella Bo Tree, A branch may need trimming.



ID	NAME OF PLACE	LATITUDE	LONGITUDE		ID	NAME OF PLACE	LATITUDE	LONGITUDE
1	Salawanoddyaramaya Temple Bo Tree	6°54'16.93"N	79°57'0.92"E		8	Borella Junction Bo Tree	6°54'52.59"N	79°52'40.42"E
2	Thalahena Junction Bo Tree	6°54'29.05"N	79°56'42.27"E		9	This Bo Tree belongs to Thilakarathnaramaya Temple	6°54'53.10"N	79°52'35.80"E
3	Close to KFC (Rajagiriya) Bo Tree	6°54'22.92"N	79°54'12.61"E		10	The Bo Tree Near the Word Place	6°54'53.71"N	79°52'33.37"E
4	Near Rajagiriya Fly Over Bo Tree	6°54'32.56"N	79°53'49.41"E		11	The Bo Tree Near the Nestle company	6°55'17.46"N	79°51'43.55"E
5	Rajagiriya Junction Bo Tree	6°54'34.33"N	79°53'45.65"E		12	Gamini Hall Bo Tree	6°55'36.76"N	79°51'42.26"E
6	In front of Rajagiriya Victoria Home Bo Tree	6°54'30.32"N	79°53'37.47"E		13	Near the Gamini Hall Bo Tree	6°55'37.69"N	79°51'41.79"E
7	Rajagiriya Janadhipathi Vidyala Mawatha Bo Tree	6°54'29.84"N	79°53'34.98"E		14	E.W Bastian Mawatha Bo Tree	6°56'2.68"N	79°51'4.05"E

Figure 3.10 Affected Bo Trees

(3) Archaeologically Important Places

Based on the preliminary archaeological survey conducted by the Department of Archeology, there are two buildings along the trace that are potentially significant. These are Peoples' Bank premises and the Railway Museum close to it. Locations of these two places are indicated in Figure 3.11 below.

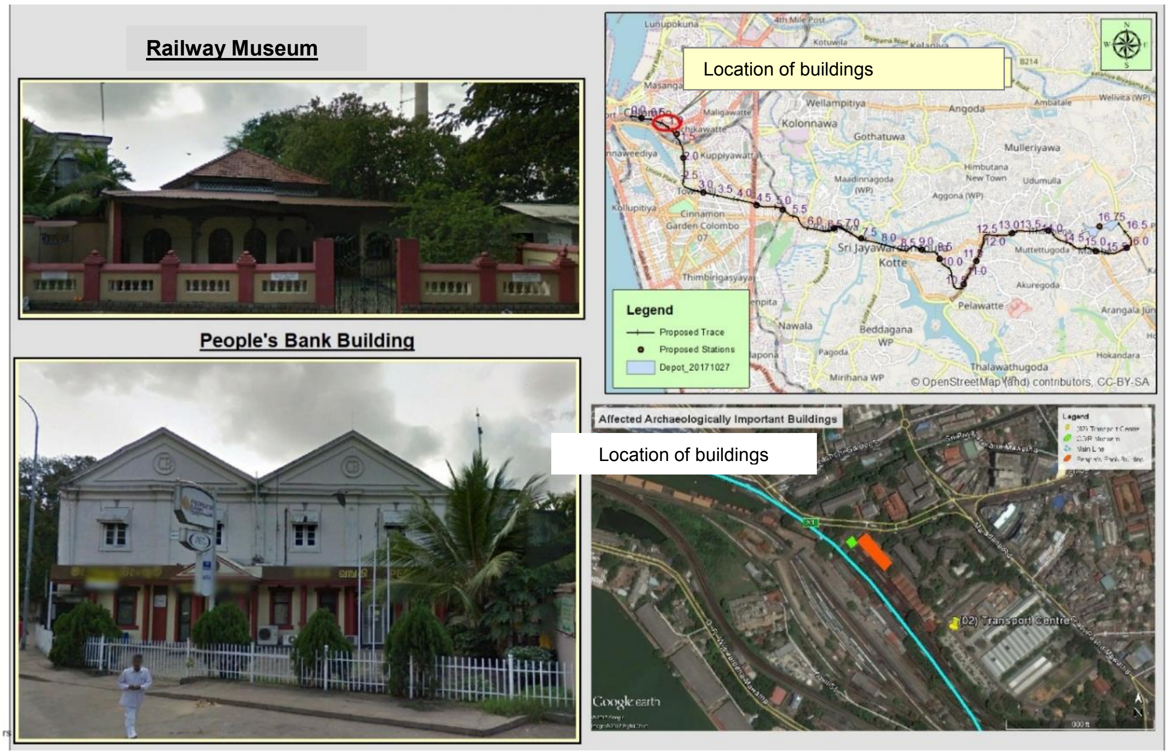


Figure 3.11 Archaeologically Important Structures

(4) Existing Utilities

All the national roads through which LRT trace runs have been used to establish drinking water, sewerage lines, telecommunication transmission lines and electricity lines which both includes underground and overhead lines. To collect a data/information regarding utilities, several consultations have been conducted with relevant agencies/organizations including, National Water supply and Drainage Board, Sri Lanka Telecom, Ceylon Electricity Board and Lanka Electricity Company. Based on these consultations and utility layout maps, it is likely that, in most of the cases, drinking water lines, telecommunication lines and electricity lines have been buried in one side of the national roads. Depth of these lines are considered to be around 1~3m below from the ground level, but depth and location of these lines vary depending on the area.

On the proposed route, there are many distribution lines crossing roads. Height of lines crossing is approximately 5 m. There are mainly two transmission lines running near the project area. One is 132kV line which runs northside of LRT route and pass the northern edge of marshland which is proposed Depot site. The other one is 220kV line which run south/north direction and cross Malabe road between proposed Malabe station and IT park station.

Storm water sewers and sewerage network maps obtained from CMC is given in **Annex G**.

3.3.5 Existing Transport Network

The LRT line will be constructed on existing roads for majority of its route except for the sections near Sethsiripaya Station and near Kotte-Bope Road. The characteristics of the roads along the proposed LRT route and other roads affected at key intersections are listed in Table 3-18. According to the Table, several roads are multi lane roads with centre median and in some areas, one-way traffic schemes are in place. Besides vehicular traffic, there is high pedestrian flow along most of these roads.

Also, the proposed LRT route is located along heavily congested highway network within Colombo City and along one of the major arterial roads that carry traffic to Colombo from Malabe - Battaramulla direction. Peak hours are often congested with speeds in the range of 10km/hr or less (see Figure 3.12). In addition to bus routes which run on the road links where the LRT will be constructed, most other bus routes pass through key nodes in the network (e.g. Borella and Pettah).

Therefore, the existing traffic condition presents a good opportunity for an alternative mode of public transportation. The LRT can cater to existing road users and provide good connectivity to transportation hubs and strategic locations (e.g. business centers, government offices).

Table 3-18 Characteristics of Roads affected by the LRT Construction

No.	Road Name	Class	Start node (a)	End node (b)	Node Type (a)	(b)	Road type	No. of lanes	Carriageway width (m)	Sidewalk width (m)
1	W E Bastian Mawatha		1	2	3	4S	One way	2	10	2.0-4.0m
2	Olcott Mawatha	A01	2	3	4S	3	Divided	5	21	> 4.0m
3	Trace Ln		3	4	3	3	Undivided			
4	T B Jayah Mawatha		4	5	3	3S	Divided	4	18	> 4.0m
5	Dr Colvin R de Silva Mawatha		5	6	3S	RS	Median Seperated	4	13	2.0-4.0m
6	Ward Place		6	7	RS	5S	Divided	4	13	2.0-4.0m
7	Cotta Rd	B62	7	8	5S	4S	Median Seperated	4	15	2.0-4.0m
8	Sri Jayawardenepura Mawatha	B240	8	9	4S	5	Median Seperated	6	24	2.0-4.0m
9	Sri Jayawardenepura Mawatha	B240	9	10	5	-	Median Seperated	6	21	> 4.0m
10	Sri Jayawardenepura Mawatha		10	11	-	3	-		-	-
11			11	12	3	3S	-	-	-	-
12	Battaramulla Rd	B47	12	13	3S	4S	Median Seperated	4	14	2.0-4.0m
13	Denzil Kobbekaduwa mawatha		13	14	4S	-	Undivided	4	12	> 4.0m
15	Kaduwela Rd	B240	14	15	-	3	Undivided	2	10	2.0-4.0m
16	Kaduwela Rd	B240	15	16	3	3	Undivided	2	10	<2m
17	Kaduwela Rd	B240	16	17	3	3	Undivided	2	10	<2m
18	Chandrika Kumaratunga Mwa		17	18	3	-	-	2	-	2.0-4.0m

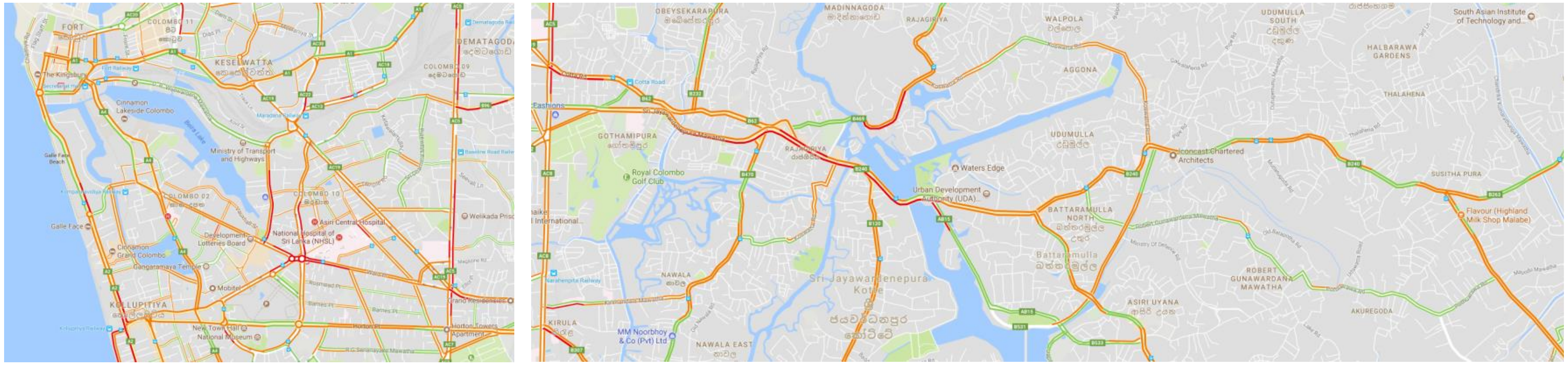
Note: The junction type (at the node) and the traffic control mechanism is indicated as follows,

3	3 way (Y/T junction)	4	4 way	R	Roundabout	*S	Signalized

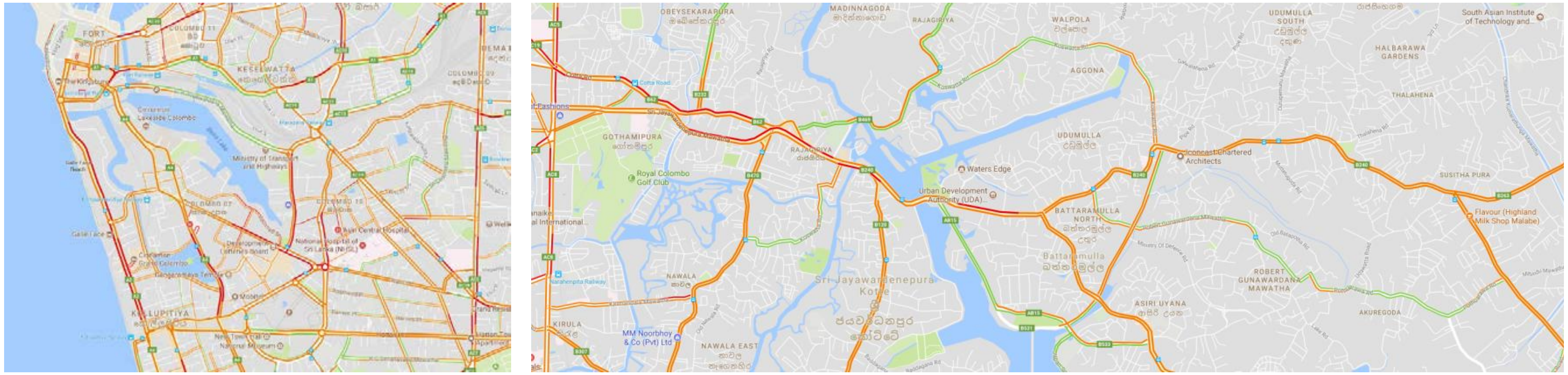
Note

Midblock nodes are indicated as empty

Sections that are not constructed over existing major road links are highlighted in grey.



a) Colombo area (AM) b) Kotte Area (AM)



c) Colombo area (PM) d) Kotte Area (PM)

Figure 3.12 Traffic Condition in the Study Area during Peak Hours

3.3.6 Planned Development Activities

Some planned development activities in the vicinity of LRT route consist of several highway projects and real estate developments. One big development project is the Colombo Port City Development Project wherein a combination of retail, business and residential premises will be developed on a reclaimed area close to the existing port.

The locations of these planned developments are shown in Figure 3.13.

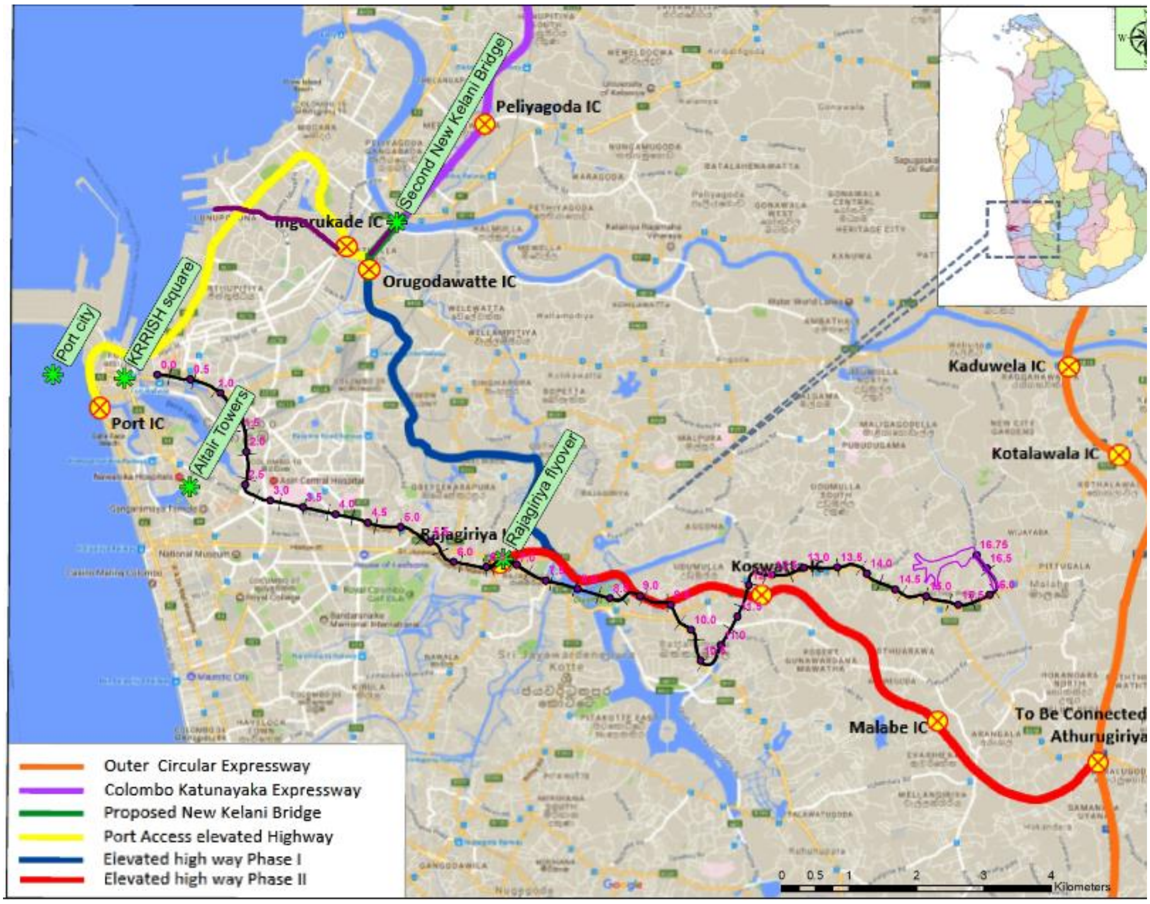


Figure 3.13 Planned development projects in Colombo

(1) Transformation of Fort Area into a Multimodal Transport Hub Project

There are plans to develop Fort Station into a multi-modal transport hub. Upon the development of the LRT, the Fort Station will be a focal point to several transportation modes such as buses, and provincial railway lines. The Project is still in the conceptual stage. Thus, the LRT Project needs to closely coordinate with the responsible entities of the MmTH project to ensure proper integration and optimum resource use.

(2) Elevated Highway from New Kelani Bridge to Rajagiriya – Phase 1

An elevated highway project is planned by RDA from proposed New Kelani Bridge to Rajagiriya. The proposed project will start from Orugodawatta new bridge over Kelani River and will connect the Buthgamuwa road of Rajagiriya. The project will be a four-lane elevated road with a length of 7 km. The environment and social assessments for the project is ongoing.

(3) Port Access Elevated Highway

This proposed project of RDA starts from the interchange to Port of proposed New bridge over Kelani River project. The project has two major components; first is construction of an elevated expressway from Ingurukade junction to Port city. The width of this road varies from 23.4m to 32.3m. The expressway will be equipped with toll gate facilities and street lighting. The second component of the project is widening of existing Port access road to be six lane road.

(4) Rajagiriya Flyover

The flyover construction at Rajagiriya junction is an ongoing project by RDA. The length of the flyover is 534m including ramps. The flyover is four lane and width is approximately 17.4m. The objective of the project is to ease the traffic and accidents at the four-legged junction.

(5) Colombo Port City Development Project

The Colombo Port city project is a Public-Private-Partnership (PPP) between government of Sri Lanka and China Harbor Engineering Company (CHEC). The project proponent is Ministry of Megapolis and Western Development. The project includes 269 hectares of land development and this total land area will be divided in to separate purposes such as commercial areas, residential areas, public areas and beach areas.

(6) Sewerage Construction Project of Sri Jayawardanapura Kotte

National Water Supply and Drainage Board (NWSDB) is implementing a sewerage improvement project in Sri Jayawardanapura Kotte DS division. It is a project funded by JICA and this division was selected under 15 major cities of Sri Lanka. The main objective of the project is to alleviate water pollution through implementation of sewerage development.

(7) Sewerage Project Colombo

The Greater Colombo Wastewater Management Project is designed to improve the urban environment and public health for the urban and suburban residents in Colombo through improvements of wastewater management services. The project involves in upgrading the sewerage infrastructures, strengthening institutional and operational capacity and project management and implementation.

(8) KRRISH Transworks Mixed Development Project

This project is named as “KRRISH Square” and is a mega multi complex real estate project with about five million square feet and includes super tall structures. It comprises 1. Ultra-luxury residential apartments 2. Commercial space for shopping and recreational activities and 3. A 450 room five-star hotel with banquet halls and suits. The project is located in Fort GND in Colombo DS division along York Street, Chatham Street, Lotus road and Chittampalam A Gardiner Mawatha. The project proponent is Krrish multi-national company based in New Delhi, India.

(9) Mix Development Condominium Project

The proposed project focuses on developing mix development condominium facility and the project proponent is E.A. Macro Holdings. The total land area of the project is 3,870 m^2. The project is located in Bambalapitiya GN division of Thibirigasyaya DS division along Colombo – Galle road.

3.4 Biological Environment

3.4.1 Surrounding Environment

Existing biological (both floral and faunal) environment of the project area and immediate surrounding was considered under two categories. First, the general LRT route that is planned along the existing main road where the effect on the existing vegetation will be minimal and second, specific locations where the LRT route traverses away from the main road where vegetation will be affected due to construction activities.

The habitats found within LRT trace can be described as a mosaic with number of different habitat types found intermixed with one another creating various ecotones. These habitats can be broadly categorized in to six major types based on the vegetation such as tree dominated wetlands (woodlands), herb dominated wetlands (Marshes), water bodies with submerged or floating vegetation, open water bodies, tree-dominated terrestrial habitats and roadside vegetation.

3.4.2 Wetlands and Streams

Wetlands, water bodies, flood plains within the project area comprise a major part of Colombo's drainage network. The drainage pattern of the project area, which include lakes and wetland areas crossed by the LRT, is shown in Figure 3.14, along with the proposed LRT route.

Although the proposed LRT route mostly follows the existing roads, it can be noticed in the Figure below that there are four areas part of the drainage network, that are close to and are part of the route. These areas are:

- LRT Depot to Malabe-Kaduwela Road passing through herb dominated wetlands (mostly abandoned paddy fields) on to the left of the Madiwela East Diversion Canal;
- Koswatta to Palan Thuna Junction that passes through the lower end of the command area of the Thalangama tank that is a mosaic of tree dominated wetlands (woodlands), herb dominated wetlands (Marshes), water bodies with submerged or floating vegetation, open water bodies and tree-dominated terrestrial habitats;
- Battramulla to Pita Kotte junction that passes through the Diyatha Uyana, which is an open water type habitat; and
- Rajagiriya that passes over Heen ela, which is an open water type habitat.

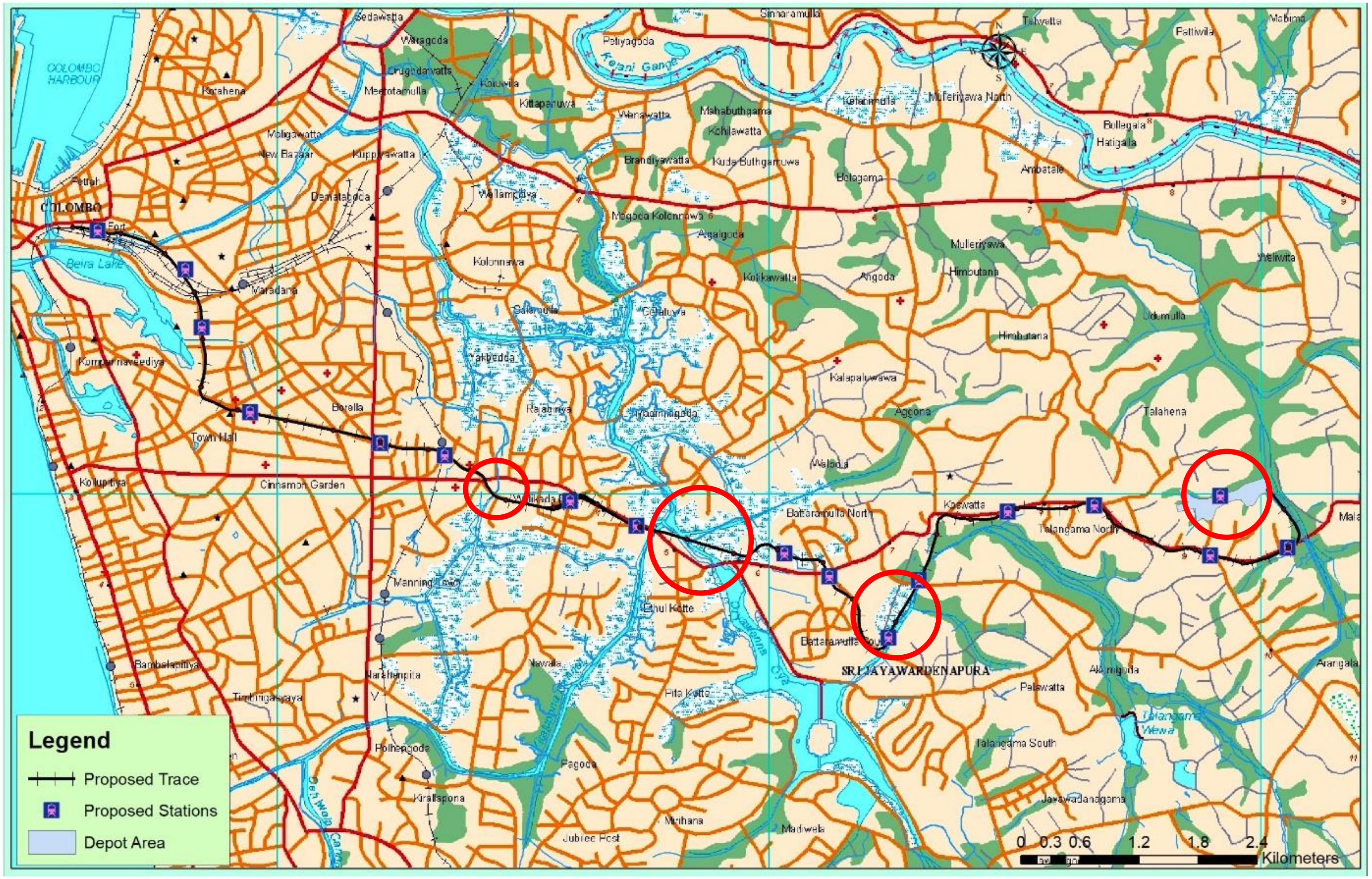


Figure 3.14 Drainage Map

3.4.3 Flora

An ecological survey conducted along the LRT route reveals that a total number of 203 plant species exist. This included 3 endemic, 3 nationally threatened and 5 nationally near threatened plant species. About 45% (93 species) of the recoded plant species are exotic to the country indicating that the vegetation present in the habitats located on the LRT trace is highly disturbed by human activities. Further, these exotic species included nine plants that are listed as Invasive Alien Species (IAS) in Sri Lanka (Wijesundara, 2010[1]). A detailed list of the plant species recorded in the habitats found in the LRT trace is given in Annex H.

3.4.4 Fauna

A total number of 132 animal species including 4 endemic species were recorded during the field survey (Table 3-19). The species recorded also included 6 threatened species (Endangered (EN) - 3 and Vulnerable (VU) - 3). Further, 5 species listed as Near Threatened (NT) was also recorded. The faunal species recorded included 5 species of introduced or exotic species which included 3 species of potentially invasive alien fauna listed for Sri Lanka. A detailed list of the animal species recorded during the field survey within LRT trace is given in **Annex H**.

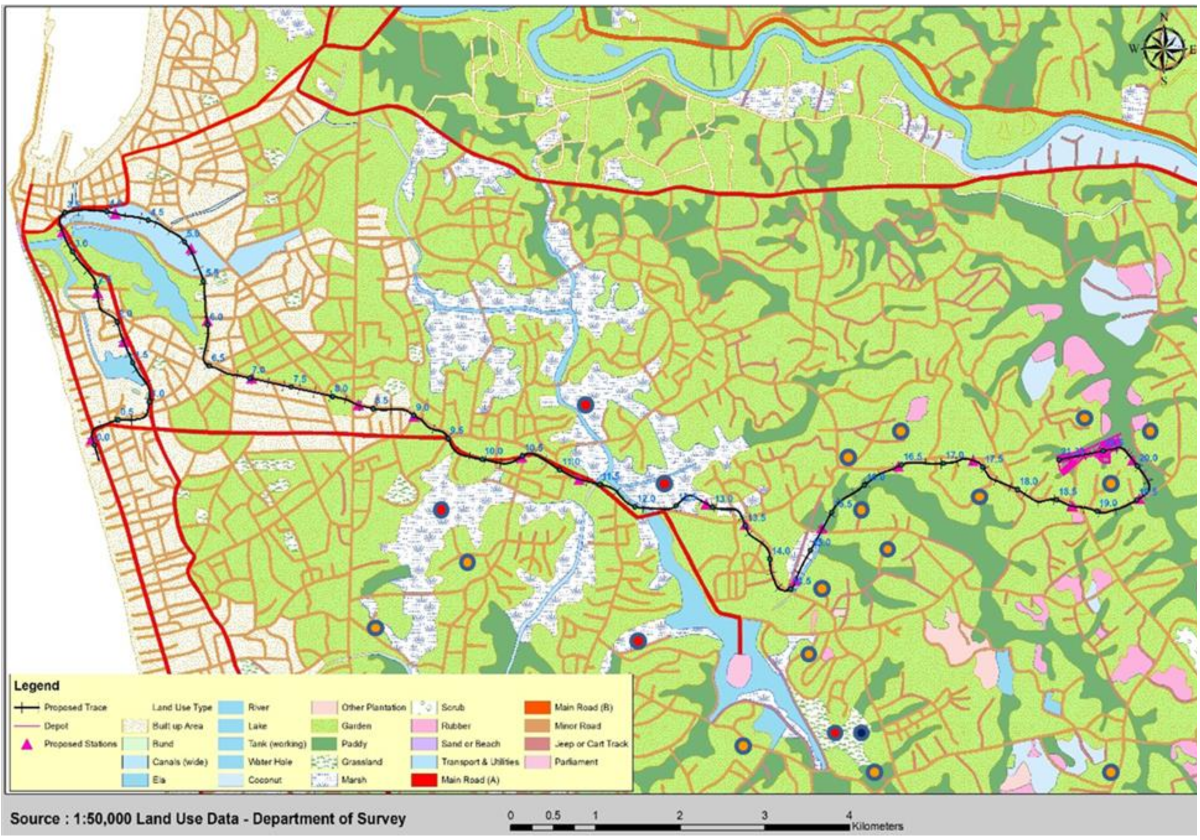
Table 3-19 Observed Fauna along the LRT route

Taxonomic Group	Total	Endemic	Exotic	Conservation Status				
				CR	EN	VU	DD	NT
Dragonflies	19	0	0	0	0	1	0	4
Butterflies	52	0	2	0	0	2	0	1
Freshwater fish	8	2	3	0	1	0	0	0
Amphibians	3	0	0	0	0	0	0	0
Reptiles	13	1	0	0	0	0	0	0
Birds	33	0	0	0	0	0	0	0
Mammals	4	1	0	0	2	0	0	0
Total	132	4	5	0	3	3	0	5

Abbreviations Used: CR - Critically Endangered, DD - Data Deficient, EN- Endangered, LC - Least Concern, NT - Near Threatened, VU- Vulnerable

Three main threatened species was observed in and around the project affected area. These include Fishing cat (*Prionailurus viverrinus*), Purple-faced leaf langur (*Semnopithecus vetulus*) and Eurasian otter (*Lutra lutra*). Out of these three species, Purple-faced leaf langur is listed as Globally and Nationally Endangered (EN) species, Fishing cat as Nationally Endangered and Globally Vulnerable species while Eurasian otter is listed as Nationally Vulnerable and Globally Near threatened species.

Figure 3.15 shows the locations where the three endangered mammal species were recorded in the project area. Red dots indicate Fishing cat, Yellow dots indicate Purple-faced leaf langur and the blue dot indicates Eurasian otter. Purple-faced leaf langur shows a wide distribution in the project area as it inhabits many home gardens. It is listed as threatened as their habitat is severely threatened due to rapid urbanization. The other two species Fishing cat and Eurasian otter occurs mostly in wetlands where the former shows a much wider distribution in the wetlands of the Colombo Metropolitan region while the latter shows a much-restricted distribution.



Source : 1:50,000 Land Use Data - Department of Survey

Figure 3.15 Planned development projects in Colombo

3.4.5 Affected Trees

To assess the tree species that can be potentially impacted by the establishment of the LRT the proposed LRT trace was divided into 6 sections, namely:

- LRT Depot to Malabe,
- Malabe to Koswatta,
- Koswatta to Battaramulla,
- Battaramulla to Borella Junction,
- Borella Junction to Floating Market, and
- Floating Market to Fort Station.

A tree survey was carried out on 12th August and 26th September 2017 in each of these sections and the trees observed on either side of the LRT trace were identified and recorded along with the height and GBH (Girth at Breast height in cm) for each tree observed. Refer to Annex H for the detailed list of trees recorded in these 6 sections along with the GBH and height of each of the trees recorded.

Altogether, 652 trees belonging to 82 species have been identified along the proposed LRT route. However, it should be noted that the extent of impact (how many trees will be affected) is difficult to determine at this stage. This can only be assessed once the LRT track is finalized and the exact ROW has been determined because even if the trace shifts by few meters the impact can change completely (from pruning to uprooting or vice versa). Approximately 64% of the identified 652 trees that is likely to be impacted by the proposed LRT comprise of exotic species (417 trees represented by 44 species). These 652 trees included 1 endemic tree (*Dipterocarpus zeylanicus;* Hora) and 234 (37%) native trees represented by 37 species. Refer to Annex H for a detailed list of trees that is likely to be impacted by the proposed LRT in the six sections surveyed long with the GBH and height of each tree and their value.

The 652 trees that is likely to be impacted by the proposed LRT included 1 tree species that is listed as Nationally Endangered (*Diospyros ebenum*; Ebenum - 2 trees), 1 tree species that is listed as Nationally Vulnerable (*Pericopsis mooniana*; Nedun - 1 tree) and 3 tree species that are listed as Nationally Near Threatened (*Dipterocarpus zeylanicus*; Hora - 1 tree, *Lagerstroemia speciosa*; Murutha - 17 trees and *Madhuca longifolia*; Me - 18 trees).

With respect to use value the 84 species that are likely to be affected by the establishment of the proposed LRT, comprise of 29 species that has timber value, 15 species that are considered as fruit trees, 7 species that are listed as ornamental plants, 3 species that can be used as vegetables, 4 species that provide multiple uses, 1 species of medicinal plant, 1 species of spice value, 1 species of religious value (refer to Section 3.3.4 for a detailed description of the distribution of these trees and stakeholder perceptions) and 2 species that can be used as fodder.

3.4.6 Landscape

The ROW of the LRT passes mainly along the centre line of the main roads. The first three sections of the ROW from the LRT depot to Battaramulla have a high green cover and accounts for about 52% of the trees affected by the proposed project. The remaining three sections accounts for the other 48% of the trees affected. The total removal of trees are expected in the first three segments while in the remaining three sections mostly pruning is expected as the trees are located on the periphery of the proposed ROW.

3.4.7 Protected Areas

There are two wetland sites, Sri Jawardenapura-kotte and Thalangama Tank, in close proximity to the project affected area that have been designated as protected areas under the Fauna and Flora Protection Ordinance and National Environment act respectively.

Sri Jawardenapura Bird Sanctuary, with an extent of 449 ha has been declared in 1985 as a sanctuary[2] considering the value of this area as a wetland ecosystem that supports high species diversity, especially aquatic birds and three globally endangered mammal species, namely fishing cat (*Prionailurus viverrinus*), otter (*Lutra lutra*) and Purple-faced langur (*Semnopithecus vetulus*). It also serves as a high security zone for the Sri Lanka's parliament.

The Thalangama Environmental Protection Area (EPA)[3] comprises of Thalangama Tank and its command area that spreads across a land extent of 118 ha. The Thalangama tank is an ancient irrigation tank managed by the Department of Irrigation. The EPA has been declared in 2007 due to the high biodiversity supported by the Thalangama tank. Altogether, 110 plant species including three endemic species, three threatened species and five near threatened species as well as 174 faunal species including 16 endemic species, six threatened species and five near threatened species have been recorded in the Thalangama tank and associated marshes. Therefore, it is one of the wetlands within Colombo Metropolitan Area that supports high biodiversity. The tank is also used as a roosting and breeding site by large number of aquatic birds.

The proposed LRT trace passes through the periphery of these two protected (see Figure 3.16) areas and therefore does not have a significant impact on either of these protected areas.

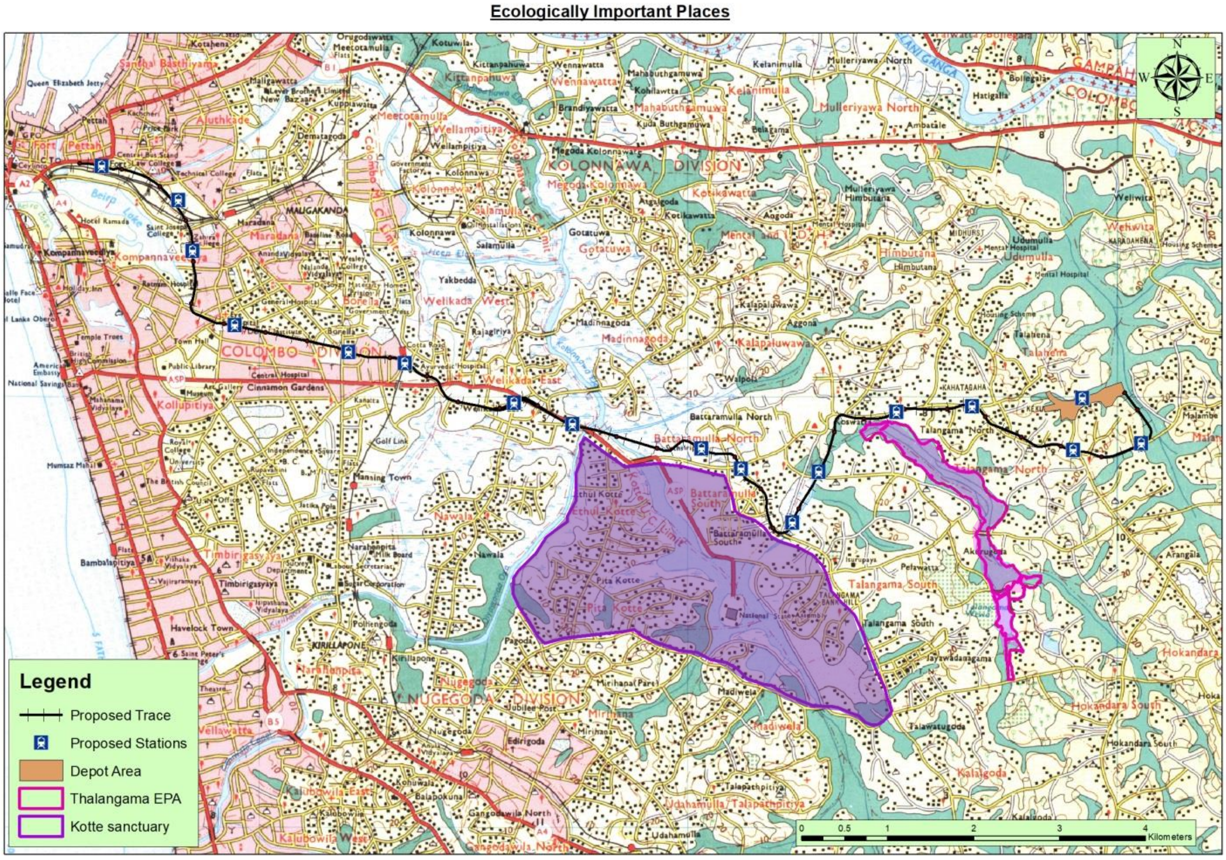


Figure 3.16 Protected Areas along the LRT Route

3.4.8 Rare, threatened and endemic species

The plants recorded in the project affected area included 3 endemic, 3 nationally threatened and 5 nationally near threatened plant species (see
Table **3-20**).

Table 3-20 Threatened, Near Threatened and Endemic Flora

Family	Scientific Name	Common English Name	NCS	Origin
Araceae	*Lagenandra praetermissa*	Ketala	LC	E
Dipterocarpaceae	*Dipterocarpus zeylanicus*	Hora	NT	E
Ebenaceae	*Diospyros ebenum*	Kaluwara	EN	N
Leguminosae	*Pericopsis mooniana*	Nadun	VU	N
Linderniaceae	*Lindernia ciliate*		NT	N
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N
Rhizophoraceae	*Carallia brachiate*	Dawata	NT	N
Rubiaceae	*Oldenlandia auricularia*	Geta Kola	VU	E
Sapotaceae	*Madhuca longifolia*	Me	NT	N

Note: CR-Critically Endangered, DD-Data Deficient, EN-Endangered, LC-Least Concern, NT-Near Threatened, VU-Vulnerable

Altogether four endemic faunal species, six threatened species and five near threatened species were observed in the project affected area (Table 3-21).

Table 3-21 Threatened, Near Threatened and Endemic Fauna

Family	Scientific Name	Common English Name	NCS	Origin
Hesperiidae	Parnara bada	Smallest Swift	NT	N
Nymphalidae	Ideopsis similis	Blue Glassy Tiger	VU	N
Hesperiidae	Telicota bambusae	Dark Palmdart	VU	N
Libellulidae	Orthetrum luzonicum	Marsh Skimmer	NT	N
Libellulidae	Orthetrum pruinosum	Pink Skimmer	NT	N
Libellulidae	Neurothemis intermedia	Paddyfield Parasol	NT	N
Libellulidae	Rhodothemis rufa	Spine-legged Redbolt	NT	N
Coenagrionidae	Onychargia atrocyana	Marsh Dancer	VU	N
Aplocheilidae	Aplocheilus dayi	Day's killifish	EN	E
Cyprinidae	Dawkinsia singhala	Filamented barb	LC	E
Colubridae	Dendrelaphis schokari	Schokari's bronze back	LC	E
Cercopithecidae	Semnopithecus vetulus	Sri Lanka Purple-faced langur	EN	E
Felidae	Prionailurus viverrinus	Fishing cat	EN	N

Note: CR-Critically Endangered, DD-Data Deficient, EN-Endangered, LC-Least Concern, NT-Near Threatened, VU-Vulnerable

CHAPTER 4 Impact Assessment

4.1 Noise and Vibration Impacts

4.1.1 Noise Impacts

(1) Construction stage

Construction of railway structure and station

During construction, noise levels would increase in the vicinity of the construction site. The major sources of noise pollution during construction are the noise generating activities at the construction site, including pilling, excavation or compaction. Although the noise from construction activities will be significant, the effect would be temporary. Table 4.1 presents noise level of construction activities.

Table 4.1 Approximate noise levels of construction equipment

Construction equipment	**Noise level (dB(A))**
Excavator	113
Earth driller	97
Crawler Crane	98
Truck Crane	110
Bulldozer	104
Backhoe	107
Tractor shovel	107
Clamshell	97
Macadam roller	100
Tire roller	94
Asphalt paver	102
Concrete mixer	101
Concrete pump car	105

Source:JICA study team

Using the values given in, noise levels generated from the equipment in construction works were calculated. Noise levels experienced in the vicinity of working places (noise source) is given by the following equation and predicted noise level generated from construction work is shown in Table 4.2.

$$L = Lw - 20\log(r) - 8dB(A)$$

Where,
L = Noise level at a distance of r (m) from the noise sources (dB (A))
Lw = Noise power level of noise source (dB (A))
8dB(A)= Noise level at l m from the noise source

In addition, the combined noise level generated from the operation of several construction machineries is given by the following equation;

$$L = 10\log(\frac{10^{L1}}{10} + \frac{10^{L2}}{10} + \cdots + \frac{10^{Ln}}{10})$$

Where,
L = Combined noise level (dB (A))
L1, L2,…, Ln=Noise level of each equipment (dB (A))

Table 4.2 Predicted noise level generated from construction works

Construction type	Major Tasks	Activity	Equipment	Noise power level (dB(A))	Predicted noise at Project boundary	Cumulative noise level (dB(A))	With Noise Barrier Fence
LRT general elevated structure/ station	Structure construction	Concrete placement	Concrete pump car	105	77.0	78.5	68.5
			Concrete mixer	101	73.0		
		Pilling	Crawler Crane	98	70.0	85.0	75.0
			Excavator	113	85.0		
		Temporal work/ sheet pile	Crawler Crane	98	70.0	82.5	72.5
			Truck Crane	110	82.0		
			Earth driller	97	69.0		
		excavation/ filling	Backhoe	107	79.0	82.0	72.0
			Tractor shovel	107	79.0		
	Road work	clearance/ excavation	Bulldozer	104	76.0	77.8	67.8
			Macadam roller	100	72.0		
			Tire roller	94	66.0		
		Roadbed work	Macadam roller	100	72.0	73.0	63.0
			Tire roller	94	66.0		
		Pavement	Macadam roller	100	72.0	76.5	66.5
			Tire roller	94	66.0		
			Asphalt paver	102	74.0		
LRT crossing over reservoir	Temporal bridge	Construction road/temporary bridge placement	Bulldozer	104	76.0	86.5	76.5
			Tractor shovel	107	79.0		
			Crawler Crane	98	70.0		
			Excavator	113	85.0		
	Base structure	temporal work	Excavator	113	85.0	86.2	76.2
			Crawler Crane	98	70.0		
			Backhoe	107	79.0		
			Clamshell	97	69.0		
	Upper structure	Concrete placement	Truck Crane	110	82.0	83.6	73.6
			Concrete pump car	105	77.0		
			Concrete mixer	101	73.0		

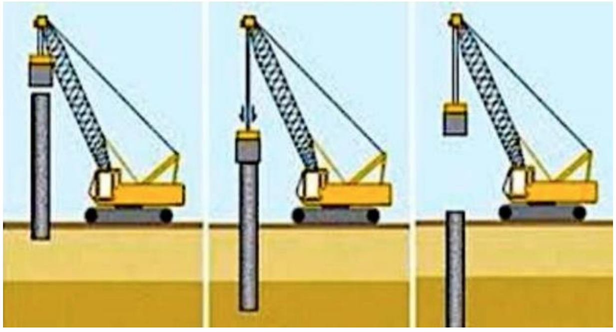
Construction type	**Major Tasks**	**Activity**	**Equipment**	**Noise power level (dB(A))**	**Predicted noise at Project boundary**	**Cumulative noise level (dB(A))**	**With Noise Barrier Fence**
		Pavement	Macadam roller	100	72.0	76.1	66.1
			Asphalt paver	102	74.0		
Depot	Depot	Levelling/excavation	Backhoe	107	79.0	83.0	73.0
			Tractor shovel	107	79.0		
			Bulldozer	104	76.0		
		Pilling	Crawler Crane	98	70.0	85.0	75.0
			Excavator	113	85.0		
		structure construction	Concrete pump car	105	77.0	78.5	68.5
			Concrete mixer	101	73.0		
		levelling/ pavement	Bulldozer	104	76.0	79.3	69.3
			Macadam roller	100	72.0		
			Tire roller	94	66.0		
			Asphalt paver	102	74.0		

Source: JICA study team

Noise associated with construction works will be high when several equipment and machineries are used at the same time. Thus, during construction works, surrounding communities may be disturbed since noise levels tend to exceed the permissible day time limit (75dB (A)), stipulated in Sri Lanka's noise regulation. With the use of noise barrier fence (3m height), noise level can be reduced by up to 10 dB. Therefore, by using the noise barrier fence, noise levels from most of the construction activities can be managed to meet noise standards.

Construction of Depot

The Depot will be an elevated structure consisting of slab and pile foundation. Several piling activities will be conducted simultaneously, which would create cumulative noise impact. The pilling activities will be carried out using a drop hammer with crawler crane. In hammer piling, a hammer, with approximately the weight of the pile, is raised a suitable height in a guide and released to strike the pile head (refer to Figure 4.1).



Source: The Constructor Civil Engineering Home

Figure 4.1 Hammer piling

The elevated structure will be composed of 120 units. Each unit has a dimension of 50m x 20m. As an estimate, there will be 4 to 5 contractors, which will construct the Depot area simultaneously and each contractor will work at each unit. Therefore, 4 to 5 piling activities will be conducted simultaneously to construct each 50 x 20 unit.

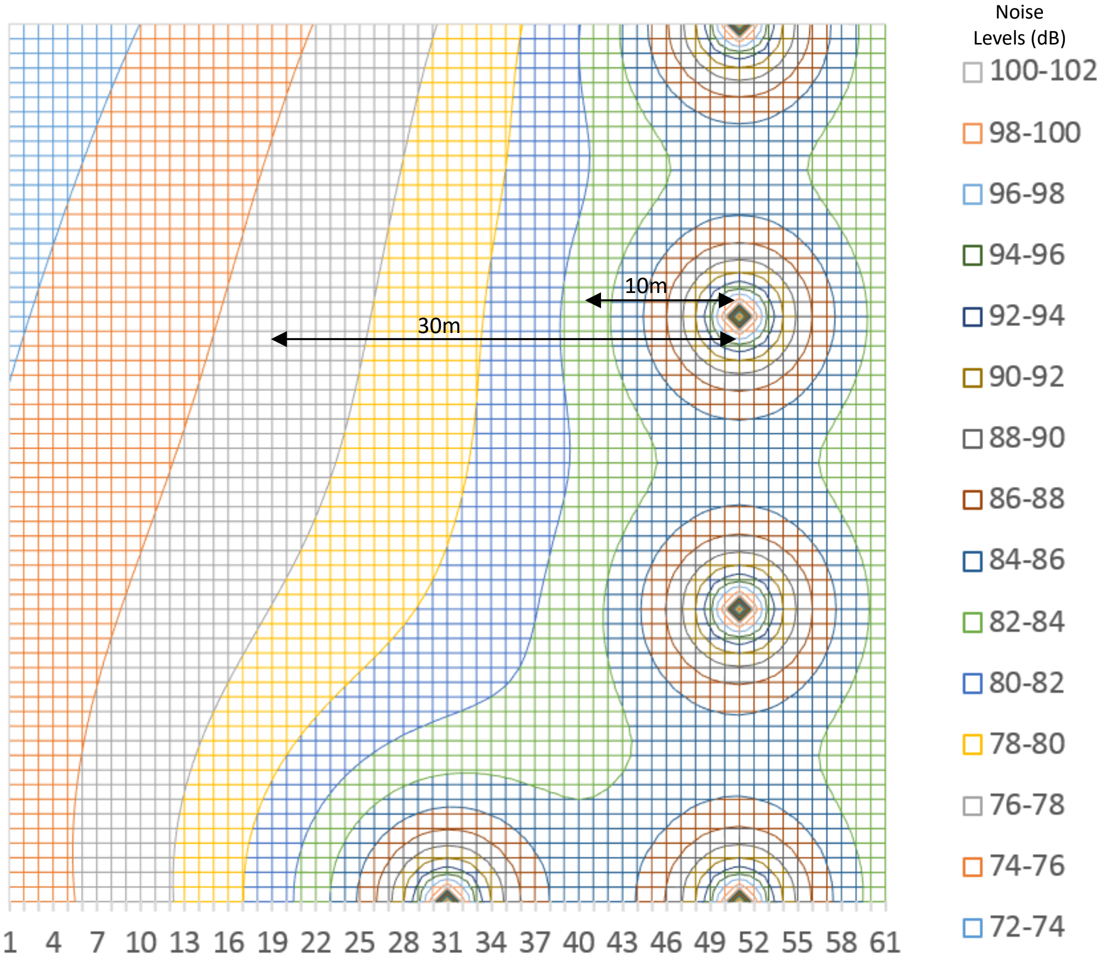
For noise prediction for the construction at Depot area, assumptions are listed in Table 4.3 below.

Table 4.3 Assumptions for Modelling of Cumulative Vibration Impacts

Item	Unit
Maximum noise level from piling activity	97.9dB[1]
Number of piling per day	3 piles
Number of hit per piling	80 times
5 piling activities are conducted simultaneously	-

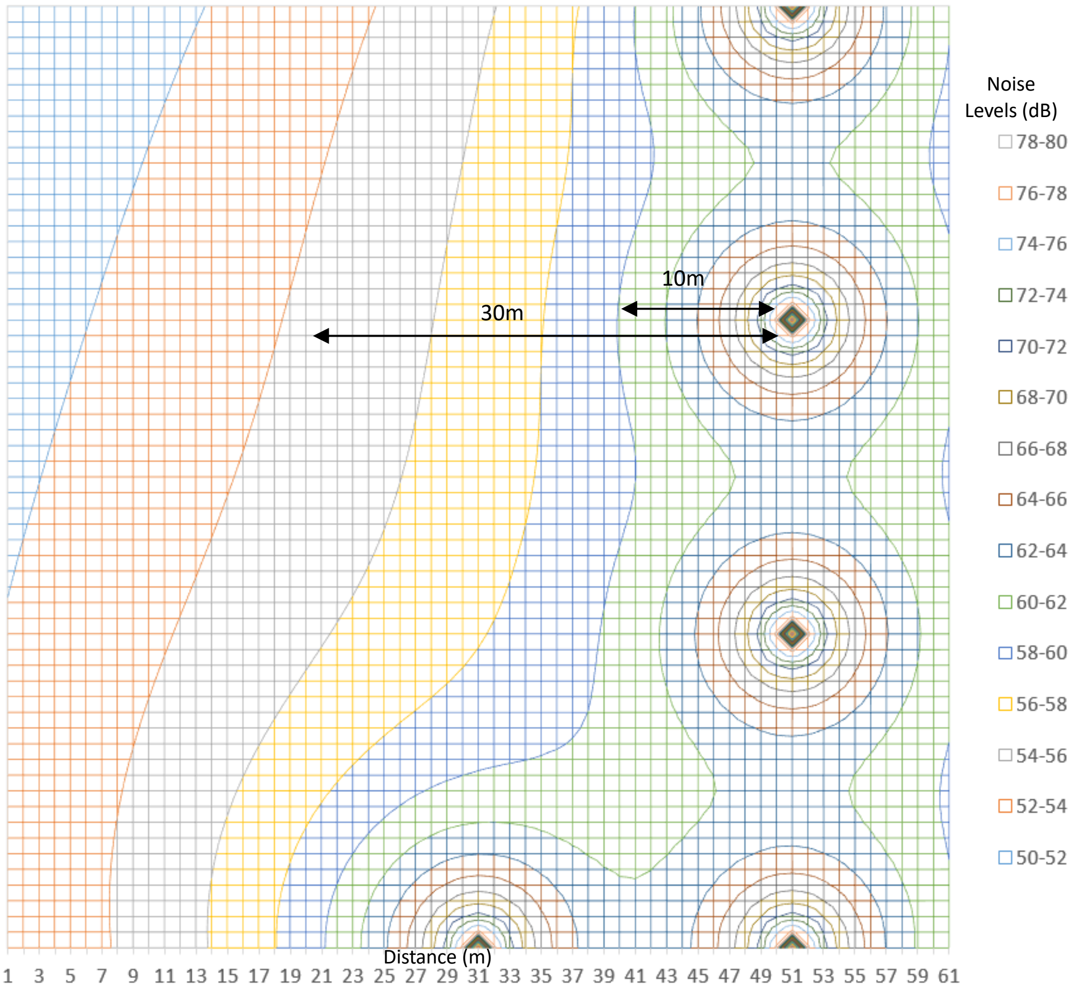
Source: JICA Study Team

The cumulative noise level is calculated using same formula used in above calculation. The noise contour of cumulative noise level is shown in Figure 4.2 for maximum noise level and in Figure 4.3 for average noise level.



Source: JICA study team

Figure 4.2 Cumulative maximum noise level (Lamax)at Depot area



Source: JICA study team

Figure 4.3 Cumulative average noise level (Laeq)at Depot area

Noise level at the closest residential area, which is about 10m from the noise source, is expected to be around 61dB for average noise level (Laeq) (average of 12 hours in day time) and about 84dB for maximum noise level (Lamax). The expected average noise level of 61 dB (Laeq) is below CEA standard for construction activity at daytime (75dB (A). There is no limit stipulated for Lamax in Sri Lanka.

It is important to consider that the duration of construction work at each unit will be approximately 1 month (no work during night-time and weekend). Thus, exposure such noise level at a certain area will be 1~2 months. As the construction moves forward from one zone to the next one, noise level at a certain area will be reduced. Considering that the working unit is 20 m x 50m, the noise source will move at least 20m far away after the completion of piling activity at one unit. This means that after completion of the first unit and the piling activity will move forward by 20m, the noise level at the closest residential area will be 77dB(Lamax) for maximum noise level and 55dB (Laeq) for average noise level.

Although the noise level from the construction activity at Depot area will meet the noise limit (Laeq), appropriate mitigation measures will be implemented to minimise the disturbance to the residence around the area. The mitigation measures are described in the mitigation chapter (Chapter 5).

(2) Operational stage

During operation, noise generated from the LRT depends on volume, speed, and the type of vehicle. Generally, an increase in volume, speed or vehicle size will increase traffic noise levels. Vehicular noise is a combination of noises from the engine and tyres. Noise impact from the LRT operation was examined with reference to "Proposal of a Prediction Model for Noise of Conventional Railway, Noise Control Engineering 1996, Institute of Noise Control Engineering, Japan" and "EIA report for Kita-Osaka railway extension project, Osaka Prefecture".

1) Noise Standard

Due to the unique characteristic of noise, noise standard specific for railway noise is normally set up for those countries with an established railway system. Since there is no such rail way noise standard in Sri Lanka, noise level guidelines for railway in in Japan (Japan Noise Guideline) and in Australia (NSW Noise Guideline) have been used as reference for this study.

As discussed in both guidelines, noise levels from the LRT would relatively have a constant in magnitude when a train passes by. Average noise level (LAeq) metric represents the equivalent continuous noise level over a specific time period. However, as discussed in the Australian guideline, LAeq metric by itself is not an adequate predictor of the potential noise level that may disturb people. Thus, it is proposed to also use LAmax to addresses the maximum noise level due to individual pass-by events and to account for the potential disturbance from such individual events (NSW EPA, 2013). Based on these guidelines, a noise standard for this project is set as Table 4.4.

Table 4.4 Noise Standard for LRT project

Noise Standard dB (A)			
Metric	Day (7am – 10pm)	Night (10pm – 7am)	Evaluation point
LAmax	80*	80*	Residential receiver
LAeq	60**	55**	12.5m from center of railway system at 1.2m height

Source:
*Rail Infrastructure Noise Guideline, Environmental Protection Agency in New South Wales (2013)
**Manual for noise measurement of general rail, Ministry of Environment, Japan (2010) and Rail Infrastructure Noise Guideline, Environmental Protection Agency in New South Wales (2013)

In order to confirm the compliance with Noise standard set for LRT project, the following noise assessment studies were conducted (Table 4.5).

Table 4.5 Approach for noise assessment

No	Subject of noise assessment	Methodology
1	Noise prediction against LRT Peak noise level (LA_{max})	Review of actual noise monitoring result for noise level of similar elevated LRT system in Japan
2	Noise prediction Equivalent noise level (L_{Aeq})	Use of noise modeling software (IMMI)

Source: JICA study team

2) LRT Peak noise level (LAmax)

In order to evaluate the noise impact expected from the proposed LRT system and to compare with the established noise standard, expected noise level from the LRT system was studied. Measured average peak noise level (LAmax) of some elevated railway system in Japan are described in Table 4.6. The measurement point was 12.5m from the centre of Railway system and at 1.2m above the ground, in accordance with noise level guideline in Japan. Calculated peak noise levels range between 68 ~74dB with speed of 38 ~73km/hr. These values are below the noise standard for noise peak level (80dB). Considering that average speed of proposed LRT for most of the route would be between 35 ~40dB, the LRT peak noise level would be similar or below than the examples in Japan. Therefore, it is expected that LRT Peak noise level would be maintained below noise standard.

Table 4.6 Approach for noise assessment

Railway system	Location	Structure	Speed (km/hr)	Peak Noise(dB)	Noise Standard(dB)
Keihintohoku-line	NakaRokugo	Elevated	-	70.0[1]	80
Tokyu-Oiamchi-line	Nakanobe	Elevated	58	74[2]	
Keio Inokashira-line	Kichijyoji	Elevated	38	73[2]	
Toei Mita-line	Itabashi Sakashita	Elevated	60	68[2]	

Source:
1 Railway noise monitoring result for Tokaido line and Keihintohoku-line in 2012(Tokyo prefecture)
2 Railway noise monitoring result in Tokyo in 2008 (Tokyo prefecture)

3) Equivalent noise level (LAeq)

In order to calculate the equivalent noise level around the project area, noise modelling was performed with internationally recognized noise modelling software (IMMI). For noise modelling, LRT operational condition (speed, traffic volume), LRT structure and surrounding environment including building height was used as inputs.

a. LRT operational Condition

The number of train trips and expected speed are summarized in Table 4.7.

Table 4.7 The number of operated trains

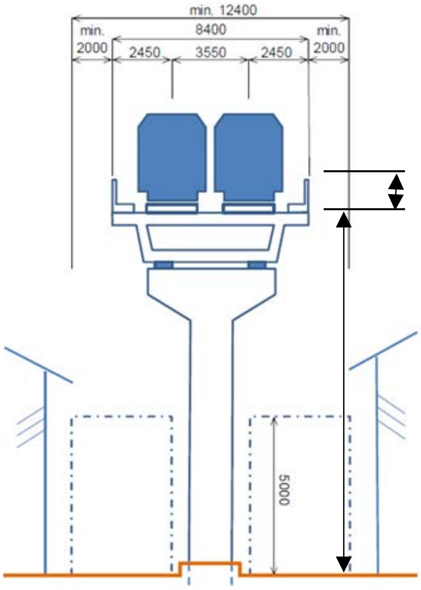
Track	Day Time		Night Time	
	Number	Km/hr	Number	Km/hr
Track -1	176	40	33	40
Track- 2	176	40	33	40

Source: JICA study team

b. Structural Condition

Structural characteristics of LRT system used for the noise modelling are described below (refer to Figure 4.4).

- Height from ground to noise source (railway): 10m
- With of elevated structure: 8.4m
- Slide wall (Noise Barrier): 1m



Source: JICA Study Team

Figure 4.4 Structural condition of LRT system

c. Modelling assumptions

Following assumptions were made during the modelling work.

- **Use the noise emission spectrum of a single Train according to "SRM LL" element library.**

This element library contains the Dutch calculation method for railway noise. IMMI implements the SRM II railway noise. SRM is an acronym for "Standard Reken Methode". This Dutch calculation method for railway noise is fully compliant with the requirements of both EU Directive 2002/49/EC and recommendation 2003/613/EU. Since the type of train implemented for LRT project is not yet decided, as a conservative approach, the category with highest noise emission was selected from the library and applied to the modelling Table 4.8.

Table 4.8 Noise spectrum of a single train unit at 40kmh.

Frequency/Hz	63	125	250	500	1000	2000	4000	8000
Sound Pressure Level/dB (A)	72.0	79.6	92.2	97.6	94.2	90.5	84.1	76.0

Source: IMMI

- **Environmental parameters**

The following values were considered as environmental parameters for the modelling.

Table 4.9 Environmental Parameters for Noise Modelling

Parameters	Day Time	Night Time
Temperature	31°C	26°C
Relative humidity	60%	80%

Source: ITI noise modelling report

d. Horizontal Grid Noise Map

Noise mapping study was conducted at following selected sections, considering its noise sensitivity. The predicted vertical noise contour maps were generated considering LRT operation and buildings surrounding.

Table 4.10 Selected Locations for Noise Modelling

ID*	Section
L1	National Hospital Area-Ward Place
L2	Windsor Tower apartment Area– Ward Place
L3	Rajagiriya Ayuweda Hospital

To present the modelling results, colour contour noise maps were generated with 5dB steps for selected locations. The horizontal grid calculation is performed at a height of 1.2m from the ground level in accordance with Japan's noise guideline.

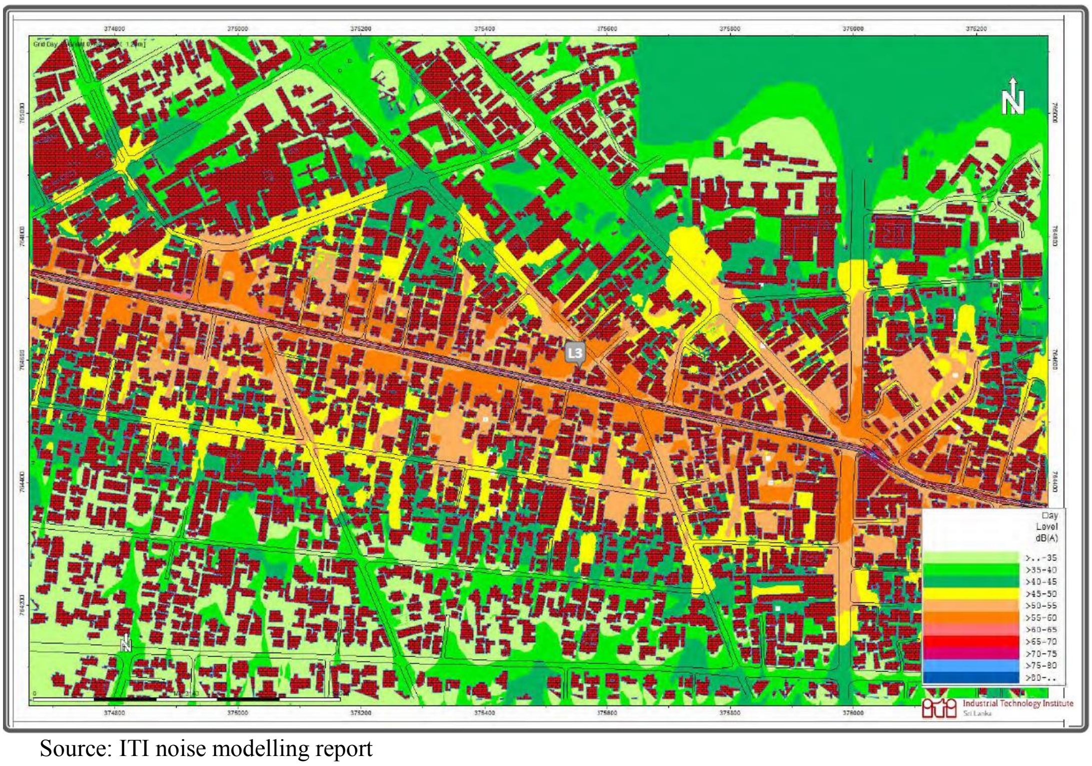
Noise contour maps are shown in Figure 4.5 up to Figure 4.10 below. Based on the results, noise propagation highly depends on the presence of obstacles such as buildings – particularly, the location and geometry. Most buildings located near the LRT lines have average noise levels below 60dB (A) at day time and bellow 55dB (A) at night time – both levels are below the applicable noise standard. However, some areas along Sri Jayawardenapura mawattha is predicted to have noise level of 60-65dB.

Source: ITI noise modelling report

Figure 4.5 Noise Mapping at National Hospital-Ward Place: Day time

Source: ITI noise modelling report

Figure 4.6 Noise Mapping at National Hospital-Ward Place: Night time

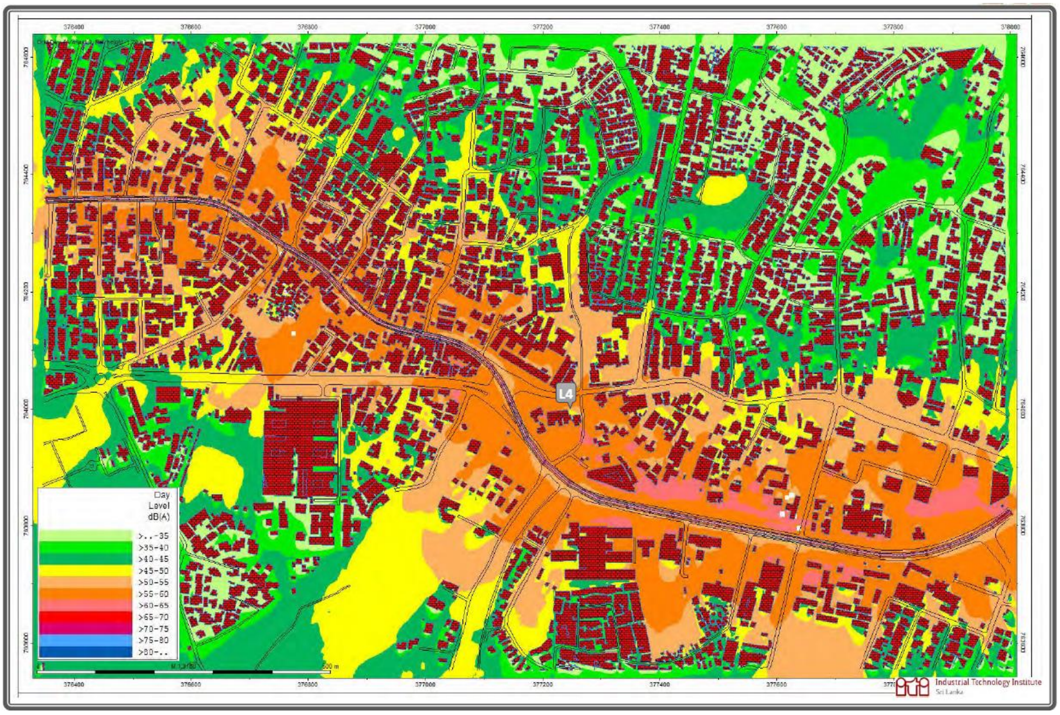


Source: ITI noise modelling report

Figure 4.7 Windsor Tower apartment – Ward Place: Day time

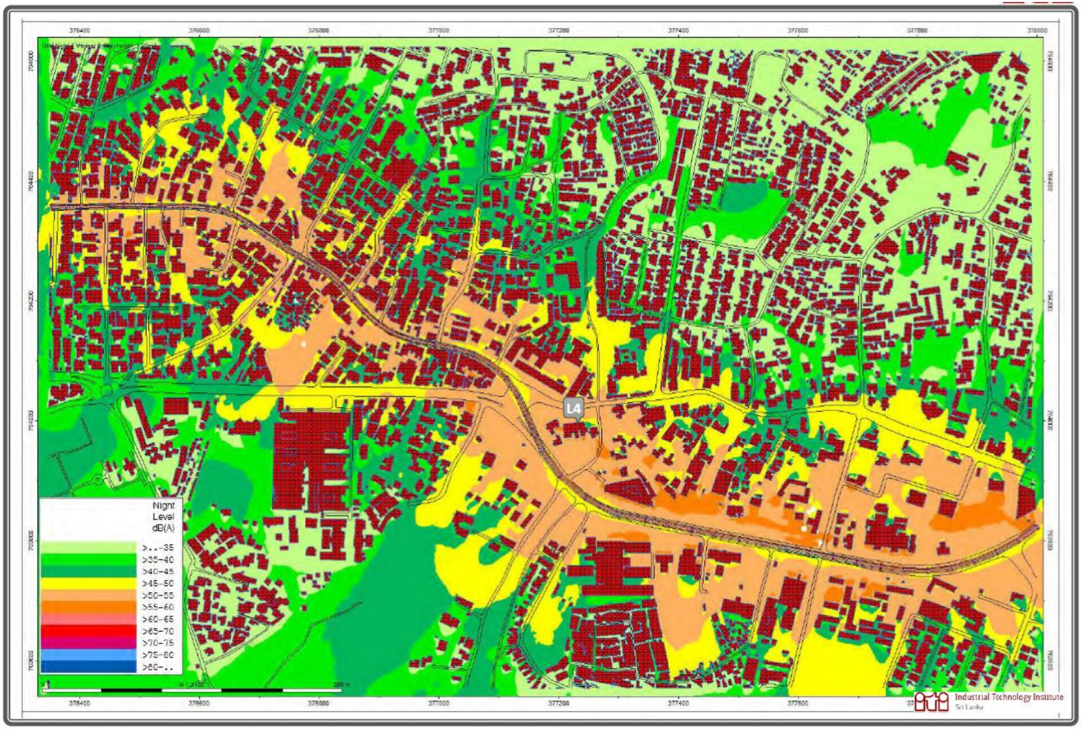
Source: ITI noise modelling report

Figure 4.8 Noise Mapping at Windsor Tower apartment: Night time



Source: ITI noise modelling report

Figure 4.9 Noise Mapping at Rajagiriya Ayuweda Hospital Day time



Source: ITI noise modelling report

Figure 4.10 Noise Mapping at Rajagiriya Ayuweda Hospital Night time

e. Prediction Result: Vertical Noise Map

The LRT noise of the equivalent noise level (LAeq) is predicted for the following cases at various receiving points. The results are shown in the Table 4-11 and Table 4-12 below. Vertical noise mapping results are presented in Figure 4.11 up to Figure 4.14.

- Without building
- With building (height of receptor is up to 16.2m (level of 5th floor of the building))
- Receptor point is 8m from Center of LRT
- Receptor point is 12.5m from Center of LRT

Table 4.11 Predicted Noise Level without Building nearby LRT structure

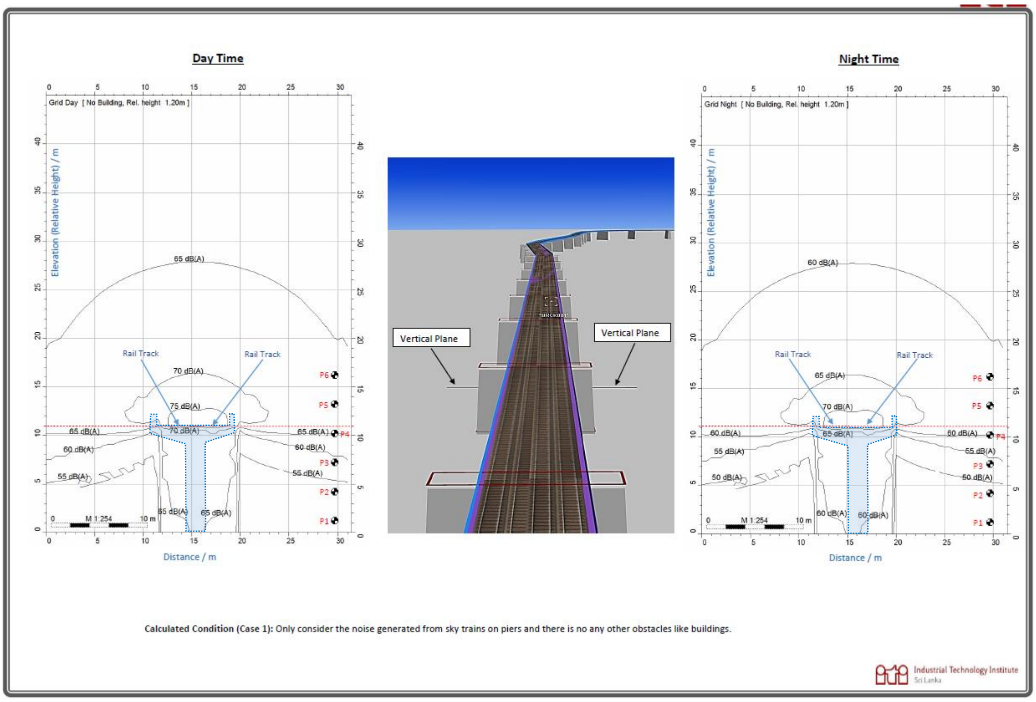
Height of receptor	Noise level at 8.0m from Center of LRT(LAeq)		Noise level at 12.5m from Center of LRT(LAeq)	
	Day	Night	Day	Night
1.2m	52.6	47.6	52.1	47.1
4.2m	55.0	50.0	54.1	49.1
7.2m	57.4	52.4	56.2	51.2
10.2m	65.9	60.9	65.1	60.1
13.2m	67.5	62.5	69.0	64.0
16.2m	65.8	60.8	67.2	62.2
Noise standard	NA	NA	60	55

Source: ITI noise modelling report

Table 4.12 Predicted Noise Level with Building nearby LRT structure

Height of receptor	Noise level at 8.0m from Center of LRT(LAeq)		Noise level at 12.5m from Center of LRT(LAeq)	
	Day	Night	Day	Night
1.2m	52.1	47.1	52.6	47.6
4.2m	54.1	49.1	55.0	50.0
7.2m	56.2	51.2	57.4	52.4
10.2m	65.1	60.1	65.9	60.9
13.2m	69.0	64.0	67.5	62.5
16.2m	67.2	62.2	65.8	60.8
Noise standard	NA	NA	60	55

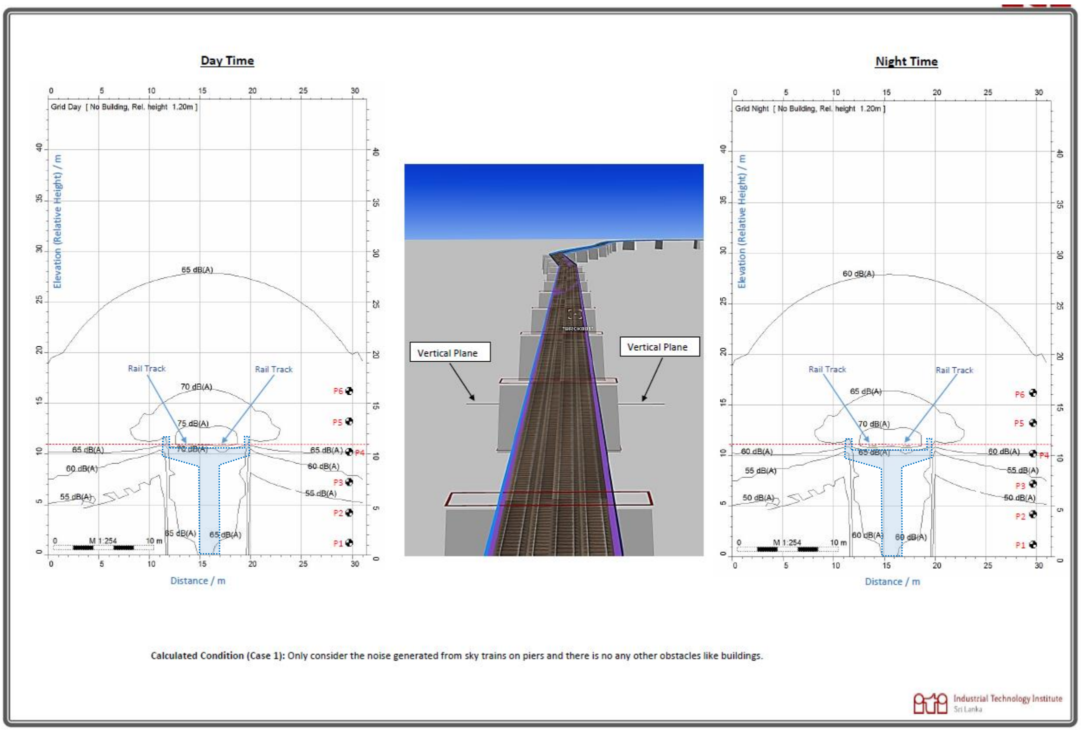
Source: ITI noise modelling report



Calculated Condition (Case 1): Only consider the noise generated from sky trains on piers and there is no any other obstacles like buildings.

Source: ITI noise modelling report

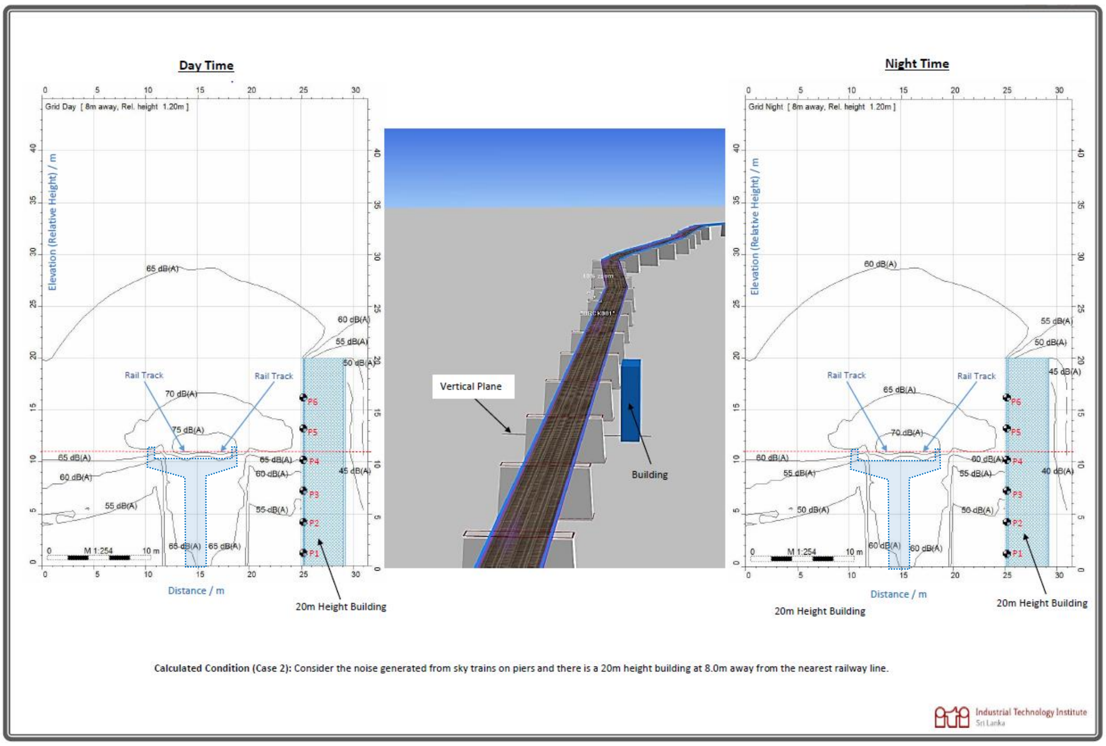
Figure 4.11 Vertical Noise Mapping: reception point at 8.0m



Calculated Condition (Case 1): Only consider the noise generated from sky trains on piers and there is no any other obstacles like buildings.

Source: ITI noise modelling report

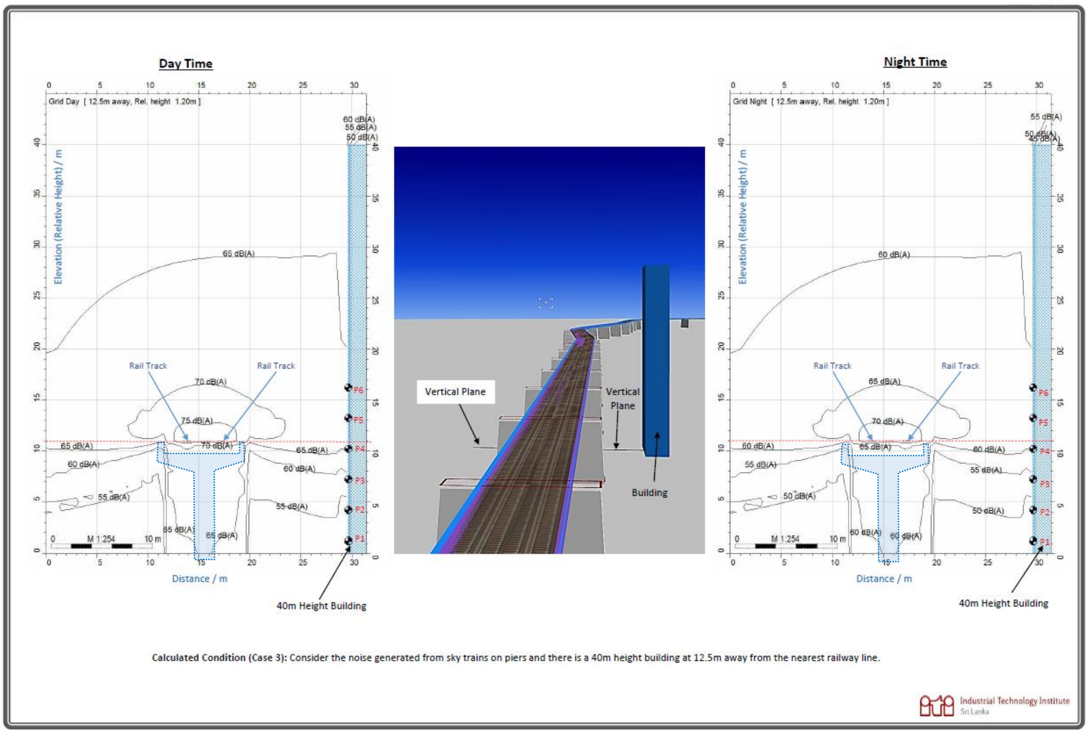
Figure 4.12 Vertical Noise Mapping: reception point at 12.5m



Calculated Condition (Case 2): Consider the noise generated from sky trains on piers and there is a 20m height building at 8.0m away from the nearest railway line.

Source: ITI noise modelling report

Figure 4.13 Vertical Noise Mapping: Building located at 8.0m from Centreline of Track



Calculated Condition (Case 3): Consider the noise generated from sky trains on piers and there is a 40m height building at 12.5m away from the nearest railway line.

Source: ITI noise modelling report

Figure 4.14 Vertical Noise Mapping: Building located at 12.5 m from Centreline of Track

4) Cumulative noise level

Cumulative noise level at each noise measurement location was analysed, while taking into consideration the baseline noise level measured for this study in order to evaluate the impact on noise sensitive receptors. Receptors along the LRT route include hospitals, schools, and temples. Cumulative noise level was calculated based on the expected noise level from LRT alone and baseline noise level.

Noise level of 52.6dB (Day) and 47.6dB (Night) (LAeq) was used for LRT noise for this study. The result is shown in Table 4-13.

The result indicates that cumulative noise level exceeds Noise Standard except N3 of Denzil Kobbekaduwa Mawatha. Exceedance can be attributed to high background noise level. The expected increase over the existing ambient noise due to LRT operation is approximately between 0.01 and 1.35 dBA. An increase of 3dB is generally considered to be negligible, which means that the noise impact at at the noise sensitive receptors would be minor. Also, Sri Lanka National Noise regulation (Schedule II (Regulation 3) stipulates that an increase of 3dB from baseline noise level is allowed, if the background noise level already exceeds the limit.

Table 4.13 Cumulative noise level

ID	Location	Background Noise Level (dB (A))		LRT Noise level (dB (A))		Cumulative Noise Level(dB (A))		Increased Noise level		Noise Standard	
		Day	Evening	Day	Evening	Day	Evening	Day	Evening	Day	Evening
N1	Asokarama Road, Malabe	72	72	52.6	47.6	72.05	72.02	0.05	0.02	60	55
N2	Malabe Boy`s School	73	69	52.6	47.6	73.04	69.03	0.04	0.03	60	55
N3	Denzil Kobbekaduwa Mawatha	57	57	52.6	47.6	58.35	57.47	1.35	0.47	60	55
N4	JiyathaUyana	63	65	52.6	47.6	63.38	65.08	0.38	0.08	60	55
N5	Jayawardana ramaya Temple	67	62	52.6	47.6	67.15	62.15	0.15	0.15	60	55
N6	Windsor Tower,Ward place	75	75	52.6	47.6	75.02	75.01	0.02	0.01	60	55
N7	National Hospital	72	69	52.6	47.6	72.05	69.03	0.05	0.03	60	55

Source: JICA study team

5) Conclusion on Noise Impact

- During the operation of the LRT project, noise level from LRT is expected to meet the noise level standard for railway for both Peak noise level (LAmax) and Equivalent noise level (LAeq).
- In terms of vertical noise level, noise level at receptor point may exceed the level of noise standard both for 8m and 12.5m at a height above 10.2m. However, noise sensitive receptors along the LRT route are not high-rise facilities. Most of the high-rise facilities along the LRT route are commercial buildings.
- For cumulative noise impact (Baseline and LRT noise level), expected increase over the existing ambient noise due to LRT operation is expected to be between 0.01 and 1.35 dBA. An increase of 3dB is generally considered to be negligible
- There might be a disturbance especially around noise sensitive areas as identified in Chapter 3.2.4, including six hospitals including General hospital and Ayurveda hospital, five schools and four education institutes. Therefore, implementation of noise mitigation measures at these areas such as noise barriers or double pane windows shall be considered during detail design stage for the use of operational stage.

4.1.2 Vibration Impacts

(3) Construction stage

Depending on construction methods and activities employed by the prospective Contractor, there could be vibration impacts especially on the buildings adjacent to the LRT route. Vibration could be generated through the following activities:

- boring the road surface to excavate the trench for the pillars,
- vibrators used to compact concrete and
- construction equipment travelling, launching of beams/girders.

In general, ground vibration from construction activities very rarely reach the level that can damage structures but can reach levels that are audible and can be felt by humans close to the construction site.

1) Human exposure

Prediction method

The prediction model for human exposure developed in the Technical Handbook for Environmental Impact Assessment of Roads (2007) is applied. Vibration transmits from a source to a receiving point according to the following formula:

$$L_{(r)} = L_{r_o} - 15log_{10}\frac{r}{r_o} - 8.68\alpha(r - r_o)$$

Where,
$L_{(r)}$ = Vibration level at receiving point (dB)
$L_{(ro)}$ = Vibration level at reference point (dB)
r = Distance from a source (e.g. construction machinery) to receiving point (m)
r_o = Distance of reference point (=5m)
$\boldsymbol{\alpha}$ = Internal damping ratio

Vibration level at reference point

The power levels of main construction machinery are shown in Table 4.14

Table 4.14 Vibration Level of Construction Machinery and Damping Ratio

Construction machinery	Vibration level at reference point (dB)	Internal Damping Ratio
Pile drivers (hydraulic pile hammer)	81	0.01
Rock drilling (soft rock)	64	0.001
Slope surface splay	48	0.01
Asphalt pavement	59	0.01

Source: JICA study team

Location of vibration source and receiving point

The construction machinery is assumed to be set on the center of the track. During the construction temporary wall (3.0m) will be set at the edge of the ROW (construction limit). The height of the receiving point is 1.2m.

Results of the prediction and evaluation

The projected vibration levels during construction were calculated based on the formula above. The results are shown in Table 4.15. In Sri Lanka, there is no standard for human perspective threshold.

Table 4.15 Vibration Level of Construction Machinery and Damping Ratio

Construction work		Distance from the edge of the ROW to Receiving point (m)					Perspective threshold of vibration for human (dB)[2]
Activity[1]	Vibration level (dB)	0	5	10	15	20	
Pile drivers	81	77.6	75.0	72.3	70.1	68.3	55
Rock drilling (soft rock)	64	60.9	58.5	56.2	54.4	53.0	
Slope surface splay	48	44.6	42.0	39.3	37.1	35.3	
Asphalt pavement	59	55.6	53.0	50.3	48.1	46.2	

Source: : JICA Study team

1 Technical Handbook for Environmental Impact Assessment of Roads, 2007

2 Technology and Laws Regulation for pollution control, 2000" Japan Environmental Management Association for Industry"

It is predicted that vibration from the operation of pile driver and rock drilling may be felt at areas close to the construction site as these exceed the human perspective threshold.

2) Vibration effects on building contents

<u>Construction of railway structure and station</u>

In Sri Lanka, the maximum permissible vibration levels for different type of structure are regulated by the Central Environmental Authority. In general, transportation and construction sources generate vibration levels within the range of 10-30Hz, normally close to 15Hz.[1] Applying this range in an intermittent method, the applicable vibration permissible limits for different types of structures, are shown in the table below.

The potential vibration impacts (at different points away from the source) from major construction activities with relatively high vibration levels (e.g. piling and rock drilling), have been identified through secondary sources. These estimates are also presented in Table 4.16 below to compare with the applicable vibration standards.

Table 4.16 Vibration levels of construction activities

Construction activity	Predicted vibration level (mm/s)	Maximum permissible vibration level (mm/sec) [3]			
		Structure type (see below reference)			
		Type1	Type2	Type3	Type4
Pile Driver[1]	8.5mm/s at 5m 4.5mm/s at 10m 1~3mm/s at 15~20m	15.0	8.0	4.0	1.0
Rock drilling[2]	4.5mm/s at 5m 1.30mm/s at 10m 0.4mm/s at 20m				
Type1	Multi story buildings of reinforced concrete or structural steel, with filling panels of block work, brick work or precast units not designed to resist earthquakes				
Type2	Two-storey domestic houses and buildings constructed of made of reinforced block work, precast units, and reinforced floor & roof construction, or wholly of reinforced concepts or similar, not designed to resist earthquakes.				
Type3	Single and two storey houses and buildings made of lighter construction, using lightweight materials such as bricks, cement blocks etc, not designed to resist earthquakes.				
Type4	Structures that, because of their sensitivity to vibration, do not correspond to those listed above 1,2 & 3, & declared as archeologically preserved structures by the Department of Archaeology				

Source: CEA
1 comparison between ground vibrations induced by impact piling and boing piling (ICSBE2016-231)
2 EIA report for Northern Expressway Environmental Impact Assessment Report
3 Maximum Permissible interim Vibration levels (Intermittent, Vibration Frequency at 10-50Hz), CEA

Considering that construction activities that may cause vibration, will be conducted at the center of roads, the distance of the vibration source to the structures is more than 10m. Based on the results in Table 4.17, rock drilling will not have significant impact on all Types of structures (except Type 4). However, piling activities my impact Type 3 and 4 structures. For some sections, such as Malabe area where road width is narrow, the distance could be around 8m. Based on Table 4.17, it is predicted that vibration levels from construction activities will exceed the maximum permissible limit for Type 3 and 4 structures and potentially for Type 2.

Overall, special care must be taken for old, fragile buildings located along the LRT route, which may have cultural/historical significance (preserved structure by the Department of Archaeology).

Construction of Depot

As mentioned in the Noise section, several piling activities will be conducted to construct the numerous columns that would support the elevated depot structure. This means around 4-5 pile drivers may be operated at the same time. Similar to noise impact, simultaneous piling activities may generate vibration impacts that may affect humans and surrounding built structures.

In order to estimate the vibration impacts on surrounding areas of simultaneous piling activities, modelling has been conducted. Cumulative vibration impact was calculated with the following assumptions (refer to Table 4.16 below).

Table 4.17 Assumptions for Modelling of Cumulative Vibration Impacts

Item	Unit
Vibration level at point source (e.g. pile driver)	90dB
Distance of nearest receptor	10m
Internal damping ratio	0.01
Five machineries (e.g. pile driver) operate at the same time	-

Note: Internal damping ration is 0.01-0.02 for clay; 0.02-0.03 for sand-silt
Source: JICA Study Team

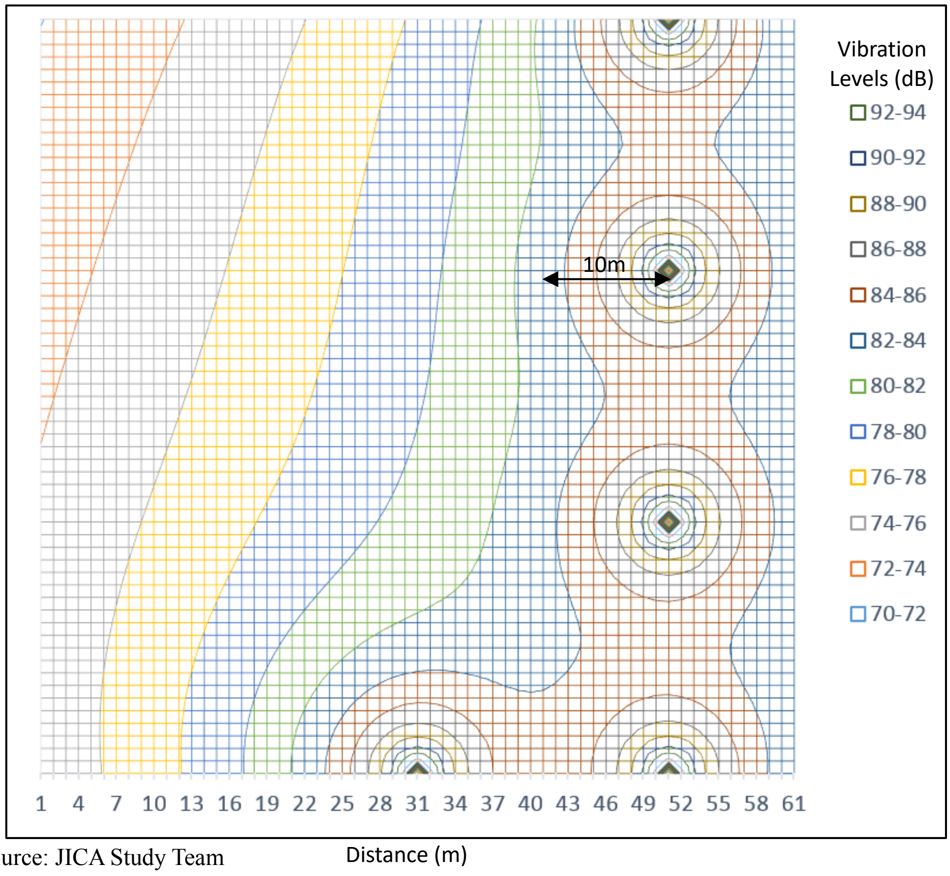
The following equation was used to calculate the cumulative vibration level (similar to combined noise level):

$$L = 10\log(\frac{10^{L1}}{10} + \frac{10^{L2}}{10} + \cdots + \frac{10^{Ln}}{10})$$

Where,
$L_{(sum)}$ = Combined vibration level (dB)
L1, L2,…, Ln = Vibration level of each equipment (dB)

The modelling results are presented in Figure 4.15. The Figure maps out vibration levels of surrounding areas, assuming that five pile drivers operate at the same time. It is assumed that piling activity would create 90dB vibration at 10m from the source for a conservative approach[3]. However, the vibration acceleration values had to be adjusted to remove human perception intrinsic in the measurement methods.

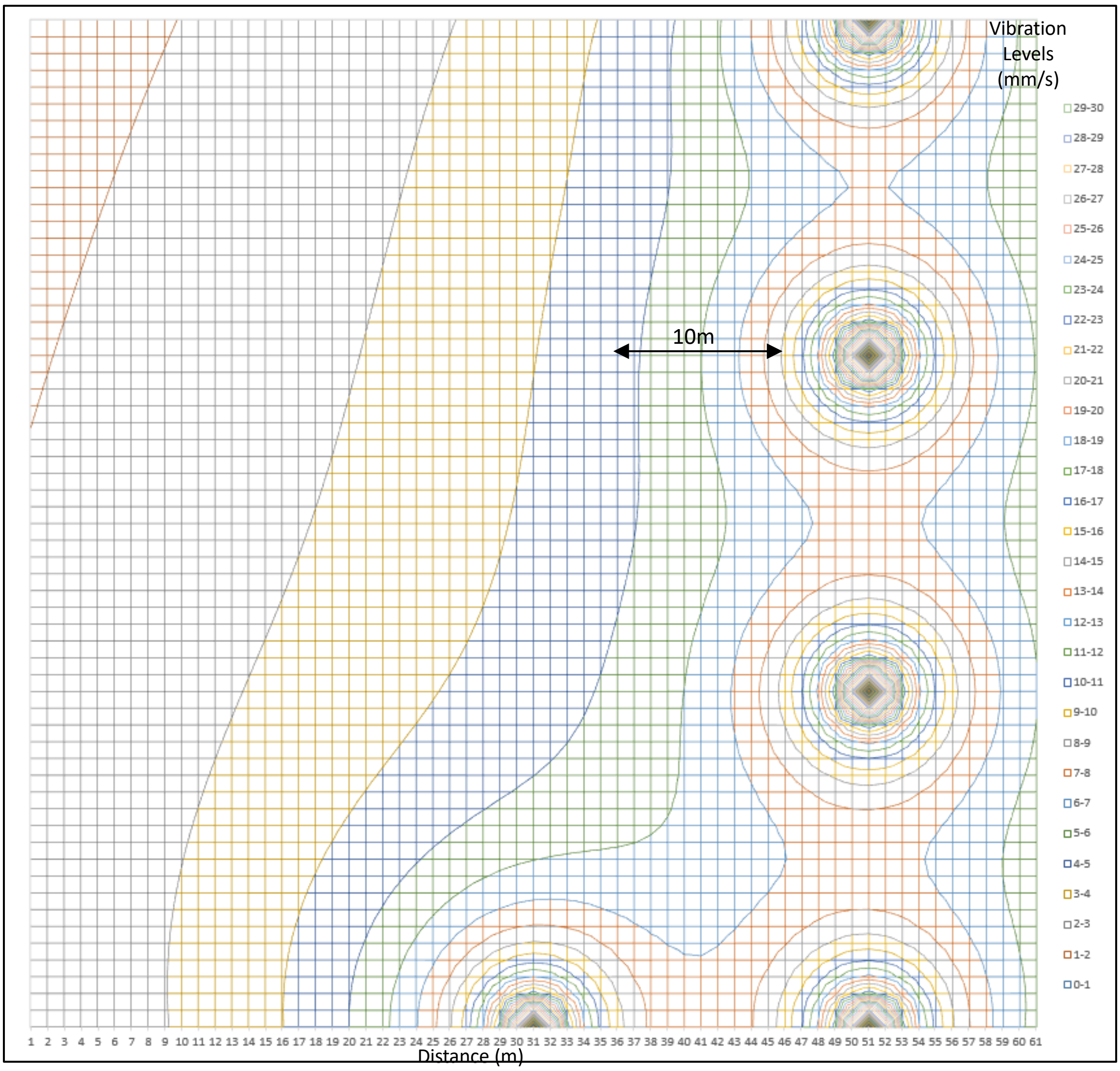
Based on the results, vibration level at 10m away from the vibration source (middle of circle), is expected to be approximately 82-84dB (refer to Figure 4.15). This result reflects the combined impact from the other piling activities. This range is higher than the human perceivable vibration level.



Source: JICA Study Team

Figure 4.15 Cumulative vibration level (dB) at Depot area

It is important to note that vibration limits stipulated in the Sri Lankan regulation is in terms of peak particle velocity (PPV) in the unit mm/s (millimetre per second). This measurement takes into account movement of particles in the ground and the potential impacts on built structures. The modelling results have been converted into PPV unit (mm/s)[4] in Figure 4.16. According to the results, vibration levels at a distance of 10m from the vibration source (both in the left and right side of the source in the Figure) is estimated at approximately 5-7 mm/s, depending on the location.



Source: JICA Study Team

Figure 4.16 Cumulative vibration level (mm/s) at Depot area

As mentioned earlier, transportation and construction sources generate vibration levels within the range of 10-30Hz, normally close to 15Hz.[3] Thus, the same regulatory limits (Intermittent, Vibration Frequency at 10-50Hz) apply (Refer to Table 4.18). As a result, it is estimated that simultaneous piling activities will not have significant impacts on Type 1 and 2 structures that are located within 10m from the piling activities. However, these activities may affect Type 3 and 4 structures located within the 10m boundary.

Table 4.18 Vibration levels of simultaneous piling activities

Construction activity	Predicted vibration level (mm/s)	Maximum permissible vibration level (mm/sec)			
		Structure type (see below reference)			
		Type1	Type2	Type3	Type4
Simultaneous piling activities	9mm/s at 5m 6mm/s at 10m 3~5mm/s at 15~20m	15.0	8.0	4.0	1.0
Type1	Multi story buildings of reinforced concrete or structural steel, with filling panels of block work, brick work or precast units not designed to resist earthquakes				
Type2	Two-storey domestic houses and buildings constructed of made of reinforced block work, precast units, and reinforced floor & roof construction, or wholly of reinforced concepts or similar, not designed to resist earthquakes.				
Type3	Single and two storey houses and buildings made of lighter construction, using lightweight materials such as bricks, cement blocks etc, not designed to resist earthquakes.				
Type4	Structures that, because of their sensitivity to vibration, do not correspond to those listed above 1,2 & 3, & declared as archeologically preserved structures by the Department of Archaeology				

Source: Maximum Permissible interim Vibration levels (Intermittent, Vibration Frequency at 10-50Hz), CEA

Overall, special care must be taken for old, fragile buildings located close to the boundaries of the proposed depot, particularly those structures made of lightweight materials.

(4) Operation Stage

During the operation of the LRT, there will be vibration on the pillars and on the foundation which could be transmitted to nearby buildings through ground. In order to evaluate the vibration impact from the proposed LRT system, vibration measurement conducted for elevated railway systems in Japan is analysed. The measurement point was at 12.5m from the centre of the railway system and at 1.2m above the ground according with noise level guideline in Japan. Measured average vibration levels are as shown in Table 4-19.

According to the measurement result, peak vibration level was measured at 49-57dB with speed of 38-60km. considering that the average speed of the proposed LRT is between 35 and 40dB, it can be inferred that vibration generated by the LRT would be below than the results of railway systems in Japan.

Therefore, the vibration level from the LRT operation may potentially exceed the perceptible threshold of humans (55dB). However, it is expected that there would not be significant adverse vibration impact on surrounding structures.

Table 4.19 Vibration levels of elevated railways in Japan

Railway system	Location	Structure	Speed (km)	Vibration level (dB)	Perspective threshold of vibration for human (dB)[3]
Keihintohoku-line	NakaRokugo	Elevated	-	49[1]	55
Tokyu-Oiamchi-line	Nakanobe	Elevated	58	51[2]	
Keio Inokashira-line	Kichijyoji	Elevated	38	57[2]	
Toei Mita-line	Itabashi Sakashita	Elevated	60	54[2]	

4.2 Traffic Impacts

4.2.1 Road Link Capacity Reduction during Construction Stage

The proposed LRT line will be constructed on the major arterial roads in Colombo. More than 50% of these roads have a daily vehicle traffic demand in excess of 50,000 vehicles. There are several critical intersections that will be affected during construction activities that may have network wide impacts. These critical intersections include the following:

- T.B.Jaya Mw – D.R.Wijewardene Mw intersection
- Ibbanwala junction
- De Soysa Circus / Lipton Circus
- Borella junction
- Ayurveda junction
- Rajagiriya junction
- Koswatta junction

A minimum of 10m wide work-zone is required for the LRT construction. Therefore, most road links may lose 2-3 lanes as per standard lane width allocation. Assuming, temporary lane widths of 2.7m given and 1-2m of sidewalks allocated for temporary roadways during the construction stage, the number of temporary lanes that can be provided on the affected roads is estimated and given in Table 4-20. This would require removal of the existing centre medians, if any and relocation of road side utility facilities. The temporary lane allocation would result in a capacity reduction of 30%-50% on most roads.

Table 4.20 Temporary lane number estimation

Link	Road Name	Road type	No. lanes	Carriageway (m)	Sidewalk (m)	Width avail. During construction	Temp. lanes
1	Colombo-Batticaloa Highway	Median Separated	6	23	> 4.0m	15	5
2	Olcott Mawatha	One way	5	20	2.0-4.0m	12	4
3	Olcott Mawatha	Divided	5	21	> 4.0m	13	4
4	W E Bastian Mawatha	One way	2	12	2.0-4.0m	3	1
5	T B Jayah Mawatha	Divided	4	18	> 4.0m	10	3
6	Dr Colvin R de Silva Mawatha	Median Separated	4	13	2.0-4.0m	5	1
7	Ward Place	Divided	4	13	2.0-4.0m	5	1
8	Cotta Rd	Median Separated	4	15	2.0-4.0m	6	2
9	Sri Jayawardenepura Mawatha	Median Separated	6	24	2.0-4.0m	16	5
10	Battaramulla Rd	Median Separated	4	14	2.0-4.0m	6	2
11	Denzil Kobbekaduwa mawatha[1]	Undivided	4	12	> 4.0m	9	3
12	Kaduwela Rd[1]	Divided	2	10	2.0-4.0m	7	2

Source: JICA study team

Note: 1. Assume LRT line will be constructed on the edge of the carriageway and 5m on the existing roadway will be utilized for construction work zone.

The traffic impact assessment given in **Annex C** has identified the following traffic impacts.

- Temporary road lane allocation for LRT construction will reduce the traffic capacity of the affected roads by 30%-50%.
- Seven road intersections will be affected by the LRT construction
- There will be road network wide impacts in addition to the impacts on individual roads because of the impacts on road intersections.

The LRT route will run along already congested roads and will mostly be built at the center median. Thus, traffic congestion may worsen due to the construction activities at the centre of the road. Vehicular speed at the road intersections and in the roads on which the LRT will be constructed will slow down. In addition, the following impacts are expected to the traffic impact described in above chapter, following impact is expected.

- **Pedestrian movement**

Pedestrian movement will be severely hindered during construction work; therefore it is recommended to ensure walkable paths maintained for pedestrian movement especially where high density of pedestrian flow is expected at areas such as Olcott Mawatha, Liberty Roundabout, and Borella junction area.

Also, there are one access road and one-foot path across the proposed depot area in Malabe which may not be passable during construction.

- **Bus operation**

Bus operations are likely to be severely affected during the construction work. This includes the recently established bus lane operation in some corridors. It would be required to change the operational path of some bus routes and to relocate bus stops etc. The most critical segment would be that of Olcott Mawatha and Bastian Mawatha where the bus and rail terminals are located.

4.2.2 Road Link Capacity Reduction During Operation Stage

After completion of the LRT balance road lane width will become insufficient in some of the narrow road segments such as Battaramulla Pannipitioya Road and Denzil Kobbekaduwa Mawatha. Because of the insufficient lane width there will be traffic congestion.

4.2.3 Improvement of Traffic Condition in off LRT Routes During Operational Stage [Positive Impact]

Once the LRT project becomes operational, traffic condition is expected to improve in Colombo. The phase one of the LRT covers Colombo – Malabe corridor, which will be extended to cover other corridors in the future. This corridor has the potential to cover/cater to densely populated suburban areas (i.e. Kaduwela DS – 252,041 population, Homagama DS – 237,905, Seethawaka – 113,807, Maharagama – 196,423, Sri Jayawardhanepura Kotte – 95,506 population 2012). Thus, the LRT project would trigger the development of a more comprehensive public transport network, providing a solution to the traffic issue in Colombo. The LRT project can offer an alternative mode of transportation for the public and this can contribute to address and ease traffic congestion in Colombo.

4.3 Landscape Impacts

4.3.1 General

In terms of the aesthetic aspect, the impacts of the LRT project on existing and proposed land use pattern of the catchment area, built and natural environment as a whole depends on the: (i) degree of “Sensitivity” of the existing built and natural environment, and (ii) the design of the LRT system. Since currently the project is under feasibility study level, this evaluation is focused on the sensitivity of the road trace. Analysis of aesthetic aspects is somewhat questionable and arguable because the outcomes are mostly associated with value judgments. Therefore, the following criteria were used for the analysis;

- Existing and proposed land use pattern;
- Scenic areas (built environment, natural environment, and the streetscape route trace);
- Existing and proposed urban re-generation projects/programmes;
- Existing road widths; and
- Objectives of the urban development plans/urban designs of the project areas

In order to establish details of the impacts, the road trace is divided into 12 sections as illustrated in Figure 4.17 to Figure 4.20. These figures show land use zoning plans prepared by the UDA for the respective urban areas (i.e. City of Colombo, Sri Jayawardhanapura Kotte, and Kaduwela Municipal Council Areas). The division of the road trace into 12 sections is based on its sensitivity.

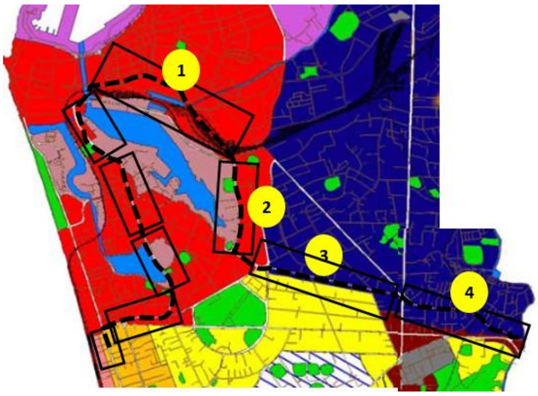


Figure 4.17 From Fort to Cotta Road (Ayurveda Hospital Junction)

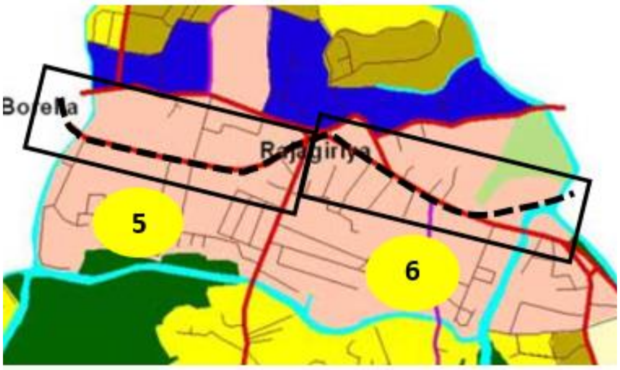


Figure 4.18 From Ayurveda Junction to Rajagiriya Junction, and to Ethulkotte Junction

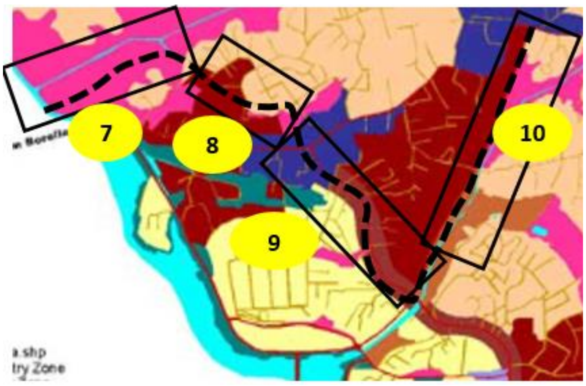


Figure 4.19 From Ethulkotte Junction to Koswatta Junction

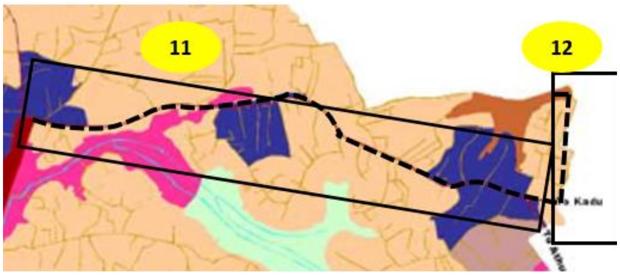


Figure 4.20 From Koswatta Junction on Kaduwela Road up to LRT Depot

4.3.2 Landscape Aesthetic Degradation

Section 1 –Olcot Mawatha – Bastian Mawatha

Description	At present, the only interesting urban landscape along this stretch is the Floating market and the integrated water front recreational facility along Bastian Mawatha. The LRT will create additional “built up congestion atmosphere to the only open space available at this location.
Degree of impact	Minor
Mitigation Measure	Introduction of hard and soft landscaping elements along the LRT trace to make it integrated with the Beira Lake open space, using compatible hard and soft landscape materials.

Section 2 - Along Railway Yard up to Gamini Hall Junction

Description	No impacts can be enumerated due to the current status of the built and natural environment of the area.
Degree of impact	Minor
Mitigation Measure	The design team of the LRT need to study the proposed urban regeneration programme for Pettah and Railway Yard and integrate the LRT with the proposals of the urban regeneration programme.

Section 3 – T.B. Jaya Mawatha

Description	No major impacts on the existing aesthetic environment are enumerated.
Degree of impact	Minor
Mitigation Measure	This section of the LRT should require more landscaping, mostly soft landscaping to reduce the impact of the existing congested urban environment, particularly on the left hand side of the road. Thus, the LRT on this section can make a positive impact.

Photos of Ward Place

Section 4 - Hyde Park Corner via Union Place around Lipton circle, ward place to Borella Junction-

Description	**From Union Place to Lipton Circus** The modern LRT structure particularly its height will have an adverse impact on the heritage buildings, particularly that of the Victoria Memorial Building of the hospital. An overhead pedestrian bridge constructed across the Ward Place near the Victoria Memorial Building earlier was removed due to the adverse negative impact it created on the heritage value of the Victoria Memorial Building. **Ward Place** The surface coverage of the road by the LRT structure will reduce and shrink the openness of the ward place built and natural environment. Most of the buildings along the road are 2-3 floors. Therefore the proposed structure will cover most of the buildings completely horizontally and vertically.
Degree of impact	**Major**
Mitigation Measure	▪ From the Baptist Church to the Victoria Memorial building, the LRT structure should follow a compatible architecture design to make it a part of such buildings and light colours to reduce its bulkiness. (i.e. arches similar to those structures) ▪ The section on Ward Place should be of light colours with softer landscaping to match the existing built environment.

Section 5 - Cotta Road- Borella Junction to Ayurveda Junction

Description	Other than the visual impacts for the residents and workers of high rise buildings at the LRT level, no major visual impacts can be enumerated, as this section of the LRT trace does not have a special character.
Degree of impact	Minor
Mitigation Measure	▪ The LRT along this stretch can be designed to add special character to the area. It needs to be made the most prominent and unique physical feature in the streetscape and thereby it will wipe off the gloomy nature and the sense of deadly feeling along the stretch. A mix of both hard and soft landscaping can be considered, with more attention to soft landscaping. The structure can have brighter colours so as to highlight its image.

Photo of Sri Jayawardenepura Mawatha close to Rajagiriya (Welikada)

Section 6 - Sri Jayawardenapura Road (Ceremonial Drive) - From Ayurveda Junction to Rajagiriya Junction

Description	The special characters maintained along the road will be destroyed. Further, Sri Jayewardenepura Road is not planned for public transport (other than the recently introduced bus lane) and presently all buses are operating along Cotta road running parallel to Sri Jayawardenapura road.
Degree of impact	**Major**
Mitigation measure	▪ During the detailed design stage, all the efforts must be taken to see the possibility of using Cotta Road up to Rajagiriya Junction, which is suitable from all the aspects other than the need for acquisition of several commercial buildings for striating the LRT line. ▪ In case of the inability to continue the trace on Cotta road, special care needs to be taken to design this section of the road to be an integral element of the Ceremonial Road. The design team in addition to the Design Engineers, should include Urban Planners, Urban Designers, Architects, Landscape Architects, and Lighting Experts. The final outcome should not be alien but enhance the existing built and natural environment.

Section 7- Continuation of Sri Jayawardenapura Road (Ceremonial Drive) Rajagiriya Junction to Ethul kotte Junction

Description	**Rajagiriya Junction – to the length of the overhead bridge** ▪ The existing overhead bridge (under construction) has covered a considerable space of the carriageway and another structure parallel to it will totally discard the urban form maintained along Sri Jayawardeanapura Mawatha. Rajagiriya Junction will turn into a stressful built environment for all the road uses (pedestrians and motorists) including the inhabitants living along the road sides. **Bridge at Etul Kotte Junction** ▪ The scenic value of Diyawanna Oya Water Body together with the recently developed “Diyatha Uyana” Public Outdoor Recreational Space is considered a treasure of the Urban Environment of the new city. The balance between the natural environment and the built environment in Diyatha Uyana is adequately maintained. Although the public administrative buildings recently developed within the “Sethsiripaya” area has distorted the balance to some extent, since there is a clear demarcation of such built environment from Diyatha Uyana, the impact of those administrative buildings is not largely noticed ▪ In the trace of the LRT, it is proposed to cut across the lake and to get connected behind the administrative complexes at Battaramulla. This trace will destroy the scenic value of Diyatha Uyana and the additional built environment will be “too much” to destroy the present balance.
Degree of impact	**Major**
Mitigation measure	▪ During the detailed design stage, all the efforts will be taken to see the possibility of placing the LRT route along Buthgamuwa Road, behind “Diyatha Uyana”. ▪ In case of the inability to continue the trace on Buthgamuwa road, special care needs to be taken to design this section of the road to be an integral element of the Ceremonial Road and Diyatha Uyana Open Space. The design team in addition to the Design Engineers, will include Urban Planners, Urban Designers, Architects, Landscape Architects, and Lighting Experts. The final outcome should not be alien but enhance the existing built and natural environment of Ceremonial Access, Diyawanna Lake and Diyatha Uyana.

Section 8-.Behind administrative complexes- Battarmulla Junction

Description	No major negative impacts can be enumerated as the area consists of largely built environment related to administrative uses with adequate open spaces.
Degree of impact	Minor
Mitigation measure	▪ The designers should give a consideration the existing administrative buildings and the proposed UDA developments in the area in the design of the LRT structure, to integrate "open space" character to the LRT, as it runs through a heavily built up area.

Section 9- Thalawathugoda road (Battaramulla Junction to-Three Bridge Junction)

Description	No significant negative impacts can be enumerated. One of the potential visual impacts would be the LRT running at the same elevation of most of the buildings (both residential and commercial) as nearly 30%-40% of the residential and commercial buildings are of two storied structures. Thus, having a visual impact of both horizontally and vertically. On the other hand, a positive impact can be expected if the LRT design and its landscaping elements will enhance the built environment of the trance.
Degree of impact	Minor
Mitigation measure	▪ Maintaining a balance of soft and hard landscaping.

Section 10-. Densil Kobbakaduwa Mw (Three Bridge Junction to Central Environmental Authority (CEA)

Description	The Aesthetic value of the stretch will be modified. The LRT will require to cut off branches of the trees as currently the branches of the trees on either side meet together at the centre making a green umbrella.
Degree of impact	**Major**
Mitigation measure	▪ Design the LRT structures of this section to resemble the existing "green" character of the stretch. ▪ Underneath the LRT trace and on the structure, introduce "soft Landscaping" with native flora. ▪ The colours of the columns and the other elements of the super structure should represent the colours of the natural environment. ▪ In order to compensate the trees that will be affected, new trees of medium to large size with at least medium sized canopies should be plated in appropriate locations. ▪ Investigate the possibility of using the service road maintained by the UDA adjoining the public administrative buildings for the LRT.

Photos of Denzil Kobbakaduwa Mawatha

Section 11 -Kaduwela Rd - IT Park Junction (from Koswatha Junction onwards)

Description	No major negative visual impacts can be enumerated. Visually a positive feature in the built environment can be expected if the LRT design can be made an interesting element of the built environment. Most of the buildings along the road are 2-3 floors. Therefore, the proposed structure will cover most of the buildings completely horizontal and vertical. There are nearly 20%-30% of residential and non-residential uses. The occupants will become victims of the direct visual impact living in the immediate impact zone as permanent residence. However, there has been a tendency to convert residential uses to non-residential uses due to the high land/rental values on the road front properties. Thus, the residential uses on the "impact zone" will experience a gradual diminish.
Degree of impact	Minor
Mitigation measure	▪ The designers need to make this part of the LRT an integral part of the whole urban corridor with integrated design interventions – architectural, landscaping, lighting etc.

Section 12- - Chandrika Kumaranatunge Mw (IT park junction to LRT station)

Description	Since this part of the road has only two lanes without a centre median, the LRT will cover the whole road width. It may further require further reclamation as to accommodate the columns of the SLR a centre median needs to be created, which will result in widening the road more towards leftward, needing reclamation of the wetlands. However, there is road winding project proposed by RDA to 4 lanes. The LRT depot will cover a large extent of wetlands, even though it is constructed on stilts the impact on the aesthetic environment of the wetland cannot be conserved.
Degree of impact	**Major**
Mitigation measure	▪ Impact on landscape due to the presence of Depot can be mitigated through landscaping, such as planting trees around the structure of Depot. ▪ Special consideration will be given in the architectural design of the depot so that it would intersperse with the environment.

4.4 Health and Safety Impacts

4.4.1 Communities' health and safety degradation during construction stage

There are anticipated temporary health impacts such as increase of stress levels of commuters and residents living nearby construction sites. Other impacts that may affect community health include noise, vibration, dust generation that may cause respiratory diseases and accidents.

4.4.2 Occupational health and safety degradation during construction stage

The project is a major infrastructure development project that will involve a number of skilled and unskilled labourers. These workers will be working at site, manoeuvring heavy machinery and material. Risk of injuries and accident at the work site cannot be ignored.

The workers may have to use power tools in making the elevated structure and there are risks of accidents and injuries. The risk of fire and electrocution will also be considered at work sites during a major project.

Exposure of works in to hazardous fumes and flames is another occupational hazard during construction. Falling from heights may also happen if the workers do not use proper safety measures when working at heights above 2 m from ground level.

Stagnant water collected from rains and waste at construction sites may lead to spread of mosquitoes and flies and may increase the risk of spreading vector-borne diseases to workers and neighbouring communities. Unhygienic site conditions will lead to spread of domestic pests. Communicable diseases also need significant consideration due to the involvement of migrant labour.

4.4.3 Occupational health and safety during operational stage

There is a risk of accidents due to improper working practice such as maintenance work at depot and inspection of the LRT structure.

4.5 Socio-economic Impacts

4.5.1 Disruption to Livelihood and economic activities during Construction stage

During construction stage, disruption of the livelihood and economic activities of businesses which are located along the LRT route is expected. These businesses will get hampered because of traffic congestion, inability to park vehicles, and temporary loss and/or impedance of access to such business premises. Details of affected business premises are given in Section 4.2.6.

Minimising land acquisition and negative social impacts is one of the major considerations in determining the LRT route. A total of 66 structures will be partially and fully affected and more than 80% of these are commercial buildings. The affected commercial places include all types of businesses: groceries, restaurants, well established vehicle sales, vegetable stalls etc.

The partially affected structures may have space to rebuild in the same land but, the fully affected structures must be relocated elsewhere. There are employees working in these commercial places. When the structures are partially affected, there will be temporary impact on the businesses and the employees may lose income temporarily. However, if the commercial places are fully affected and if they need to be relocated elsewhere, there can be permanent impact. The income of employees working in these commercial places will also be affected. They may have to find other jobs or will have to face difficulties until the businesses are re-established.

There will also be an impact on paddy lands where Depot is proposed in the Kaduwela DS division. Paddy land owners and tenant farmers may permanently lose their livelihood.

The Project may also impact people whose livelihood is linked with existing modes of transportation (e.g. 3-wheelers, bus operators) due to inaccessible roads and/or worsened traffic conditions.

4.5.2 Impact on livelihood during Operational Stage

The LRT project boosts regional economic activities along the route by providing an efficient mass transit system, which enhances workforce mobility from suburbs to centre of Colombo. In addition, presence of the stations will also attract future commercial development around the area.

While the LRT Project can increase connectivity of existing bus routes through multi-modal transport centers/hubs, it may pose as a competitor for existing transport operators (e.g. buses, 3-wheelers) in terms of servicing passengers/commuters.

4.5.3 Travel Time Saving [Positive Impact]

Once the LRT becomes operational there will be a significant travel time saving on the passengers.

4.5.4 Employment Generation [Positive Impact]

LRT will bring various employment opportunities during the construction and operational stages.

4.6 Impacts on the Biological Environment

4.6.1 Disturbance to Protected area

The proposed project will have no direct impact on the two protected areas, Sri Jawardenapura-kotte Bird Sanctuary and Thalangama EPA found in the project area as they were avoided by the design. However, there may be possibilities of indirect impacts.

4.6.2 Fauna and flora Disturbance

Altogether, 652 trees belonging to 82 species have been observed along the LRT route. These trees may be affected due to the construction of the LRT in the proposed trace. Approximately 64% (417 trees represented by 44 species) of the identified trees that are likely to be impacted by the proposed LRT comprise of exotic species, and about 37% (234 trees represented by 37 species) are native species. Among these, one endemic tree (*Dipterocarpus zeylanicus*), which is also nationally endangered, was identified along the LRT route. Since this species is a forest species observed in the dry zone of Sri Lanka, it is most likely a planted tree.

Around 89 tress along Denzil Kobbekaduwua Mawattha may need to be removed to give way to the LRT structure. Other trees along the route that may be affected will be trimmed or branches will be cut down. However, the exact impact on these three trees can be assessed only after the final ROW for the LRT has been established during the detailed design phase. Even though a large number of trees may be affected by the Project the impact on native flora is not significant because more than 64% of the identified trees are exotic species.

The LRT Project will be built within a highly urbanized and significantly altered environment. The area supports mostly common species of fauna associated with such urban habitats. As such, these species are highly adapted to disturbance and human presence. The Project will not have direct impacts on identified threatened fauna species (Fishing cat, Purple-faced leaf langur, and Eurasian otter). Also, no major avian movements were observed across the proposed light rain trace and road kills of birds are hardly recorded along the light rail trace. Thus, considering that the maximum speed of LRT is 80km/hour (average is about 40km/hour) the chances of bird strikes are likely to be near zero as these birds are highly habituated to live in a highly urbanized environment.

Overall, the impact of the project on flora and fauna in this region is negligible as the LRT route passes mainly near or on the road network.

4.6.3 Wetland Degradation

As described in section 3.3 wetlands are present in five locations of the LRT route. These are:

1) The section of the LRT route from the LRT Depot to Malabe-Kaduwela Road passing through herb dominated wetlands (mostly abandoned paddy fields) on to the left of the Madiwela East Diversion Canal
2) The section of the LRT route from Koswatta to Palan Thuna junction that passes through the lower end of the command area of the Thalangama tank that is a mosaic of tree dominated wetlands (woodlands), herb dominated wetlands (Marshes), water bodies with submerged or floating vegetation, open water bodies and tree-dominated terrestrial habitats.
3) The section of the LRT route from Battramulla to Pita Kotte junction that passes through the Diyatha Uyana, which is an open water type habitat

In addition, the proposed LRT depot will be located on a wetland that can be described as an abandoned paddy land. The approximate area impacted is approximately 15 ha. The depot will be established as an elevated platform and therefore the entire wetland area will not be impacted by the proposed project. However, during the construction stage some sections will have to be filled in order to facilitate the construction activities. During the operational stage nearly 50% of the wetland will become shaded due to the elevated structure which will result in loss of species that prefer direct sunlight while shade loving species will benefit from the increased shade. The site does not contain any critical species such as threatened or endemic species and therefore, the proposed activity will not have a significant impact on the overall wetland biodiversity of the region.

LRT trace has been designed to pass over most of the other wetlands with little or no direct impact to wetlands as the construction work will take place mostly in the highland adjacent to the wetland except in few places. Therefore, the overall impact of the proposed project on aquatic habitats is negligible. Likewise, the terrestrial habitat that is affected mostly is the roadside vegetation that is a manmade habitat that supports only a few species that are highly adapted to withstand disturbance such as noise that may result due to construction work. Since, the LRT route will be based on an elevated platform and therefore, this will not result in habitat fragmentation or disruption of movement patterns of species. The only disturbance expected is at the places where stations and bases are erected to support the viaduct. However, the expected loss of habitat is less than a few hectares speeded over a large area. Thus, the proposed project will not have a significant impact on the aquatic and terrestrial habitats in the project affected area.

Photo of the Madiwela East Diversion Canal

4.7 Impacts to utilities such as water, electricity, telecommunication During Construction

4.7.1 Disruption to Underground Utilities

As the LRT pillars will be in the middle of the existing roads there is a possibility of damaging underground utilities such as electricity cables, telecommunication lines, sewerage pipes, storm water conduits and water supply lines. During the EIA study, the Project Proponent has been coordinating continuously with the line agencies relevant to the utilities i.e. Ceylon Electricity Board (CEB), Sri Lanka Telecom (SLT), CMC and National Water Supply and Drainage Board (NWSDB). The details of utilities (layout plans) are presented in **Annex G**.

4.7.2 Disruption to Overhead Utilities

Urban and commercial activities in the affected area are facilitated by all the infrastructure facilities such as water, electricity, and telecommunication. As the LRT trace is going on an elevated structure, shifting of electricity and telecommunication lines may be required. The shifting and rearrangement of these electricity and telecommunication lines can make a temporary impact on the day today life of people near the project area. Majority of people in the project influential area depend on pipe born water and water lines can get damage during construction period due to excavations. This also can make a temporary impact to people in project area.

There are two high voltage transmission lines crossing LRT route, which need to be shifted or lifted up. One of them is 132kV transmission line, passing on Diyatha Uyana and the other is 22kV transmission line which run south/north direction and cross Malabe road.

4.8 Land Acquisition Impacts

4.8.1 Land Acquisition and resettlement of people and relocation of structures/ buildings etc. During Construction

(5) General

The proposed LRT will mainly traverse on existing major roads in four DS divisions in Colombo district. With the ribbon development in existing roads, a number of lands and structures will be affected. However, as the LRT will traverse on an elevated structure and will use existing roads as the corridor, the land acquisition will be minimal. Further, project had also taken measures to minimize displacement of people as much as possible by considering design alternatives.

(6) Project Impacts on Built Structures

There are approximately 66 built structures which will be partially and fully impacted by the project. The distribution of partially and fully impacted structures is presented in the Table below. It should be noted that only one residential houses will be impacted and around 80% of the impacted structures are commercial business premises.

Table 4.21 Structures that may be affected by the Project

DS Division	GN Division	Residential Structures		Commercial Structures		Total	
		Totally	Partially	Totally	Partially	Totally	Partially
Colombo	Fort	0	0	24	3	24	3
	Ibbanwala	0	0	1	3	1	3
Kaduwela	Kotuwegoda	0	0	0	1	0	1
	Subuthipura	0	0	2	6	2	6
	Battaramulla S	0	0	3	1	3	1
	Udumulla	0	0	2	0	2	0
	Malabe North	0	0	1	13	1	13
	Malabe West	1	0	2	3	3	3
		1	0	35	30	36	30
	TOTAL					**66**	

Source: Socio-economic Survey (2017)

(7) Details of Affected Residents

There are only two residences, located in the proposed IT Park Station (Malabe West, Kaduwela DS Division), which may be fully affected by the Project. Although the residences will be affected, the owners still own surrounding properties (land and commercial building in front). One residential house is currently not being occupied because the owner is living abroad. Depending on the detailed design of the station, relocation of families may not be necessary.

(8) Details of Affected Business Units

Since structures along the JICA-LRT route are mostly commercial in nature, the Project will primarily impact business premises, along the route and areas near proposed JICA-LRT stations. It is estimated that approximately 100 business premises, 37 property owners, 73 tenants and approximately 455 employees will be affected by the project. The clusters of businesses which will be fully affected are located in Fort, Battaramulla, Palan Thuna Junction, Koswatta Junction, and West Malabe, including food and beverage stores, motor repair workshops, bank, car dealer offices and other commercial shops. The biggest cluster of small businesses is the government-owned commercial area with a lane of hotels, canteens and fruits stands, located near Fort Station.

(9) Details of Affected Paddy Lands

For the construction of the Depot and the IT Park Station at Malabe (IT Park Junction), partially abandoned and partially cultivated paddy lands in Kaduwela DS Division may be acquired. The 2 paddy land areas have an approximate total area of about 17 Ha (in Thalahena North, Thalahena North B, Malabe North & Malabe West GN Divisions in Kaduwela DSD).

According to the list of farmers which was received from the Agrarian Services Office in Malabe and from the socio-economic survey, there are approximately 41 paddy land owners and 5 tenants (Ande farmers). (Table 4-22)The total sum of family members of both paddy land owners and Ande farmers is estimated at around 116 persons. However, the actual number is more than this figure because the survey response rate was only 70-80%.

Table 4.22 Affected Paddy Field Owners and Tenant Farmers

DS Division	Total No of paddy land owners & farmers	No of affected paddy land owners		No of affected Renters ("Ande" Farmers)		Total land extent (Approximately)
		HHHs	Family members	HHHs	Family members	
Kaduwela	46	41 (37*)	99	5 (4*)	17	206,195m^2**

* No. of Persons Interviewed **Measurement based on preliminary design drawings.
Source: Socio-economic Survey (2017)

(10) Extent of Impact on Properties (Lands and Building Area)

The extent of project impact in terms of affected land is summarised in Table 4-23 below. Aside from the use of existing roads, the Project will require the use of approximately 254,000m^2(25.4 Ha) of land, which comprises of about 45,000m^2(4.5 Ha) government land, 8,000m^2(0.8 Ha) private land and 200,000m^2(20.0 Ha) agricultural land. It can be observed that a bulk of the land that needs to be acquired is the agricultural land for the proposed depot area.

It is important to note that figures presented are only indicative and are subject to change during the detailed design phase. Also, some buildings have multiple storeys, thus it is difficult to calculate the actual floor area of buildings/structures, which will be affected by the project.

Table 4.23 Extent of Impact on Affected Properties

*

DS Division	Estimated Area of Impact**(Ha)	Remarks
Colombo	2.5244Ha	Mainly SLR lands / structures
Sri Jayawardanapura - Kotte	0.0163 Ha	Patches of land at the corner of Rajagiriya flyover and before entering Diyawana Lake
Kaduwela	20.6195 Ha	Paddy lands for Depot & Station area (IT Junction)
	1.5786 Ha	Government land (e.g. Diyata Uyana, Sethsiripaya, Battaramulla, Lakviru Sevina corner)
	0.5105 Ha	Proposed Station area (high land only)
	0.095 Ha	Others (Land strips of either sides of the route and the extent of the Structures
Total	25.3444 Ha	

Measurements are based on preliminary design drawings
Source: Socio-economic Survey (2017)

(11) Impacts to Government Institutions and properties

The LRT trace traverses mainly on a few government owned properties, including those of Sri Lanka Railway Department (SLR), UDA and SLLRDC.

- SLR: LRT will cross the property of SLR around Fort station, where Multimodal Transport Hub (MmTH) has been proposed. LRT will consider the future Integration with MmTH.
- UDA: UDA owns the floating market at Pettah, Diyatha Uyana, and Lakviru Sevana.
- SLLRDC owns Diyawanna Lake

4.8.2 Socio-economic benefits During Operation [Positive Impact]

Although LRT project as any other development project bring negative impacts to small population, the project will bring benefits to the majority of the population living in Colombo district. A summary of benefits from the project is shown in Table 4-24.

The project will be a solution for the traffic in the Malabe corridor. Battaramulla is developing as the new administrative centre with many government departments located in Sethsiripaya, Suhurupaya and around Battaramulla city. The Proposed LRT project will facilitate these government employees, school children and other commuters to travel comfortably with less travel time. The suburb areas, Malabe, Jayawardanapura Kotte and Kaduwela will be developed with the project.

The proposed LRT project is electricity driven and this diversified mode of public transport will enhance the quality of the environment. There will be less of accidents and road safety will be improved. According to the results of the socio-economic survey (refer to Annex L), perceived socio-economic benefits are summarised in the Table below. Majority of the respondents believe that the travel time will be reduced, and public transport will be improved with the proposed facilities.

Table 4.24 Perceived Economic Benefits of the project for the community

Economic benefits	Frequency	Rating %
Reduce Travel Times	175	32.96
Develop Extra Income	92	17.33
Reduce Living Expectance Rate	91	17.14
Improve Commercial And Work Premises	83	15.63
Develop Infrastructure	67	12.62
Fuel Effectiveness	23	4.33

Source: Socio economic survey, August 2017

Table 4.25 Perceived Social Benefits of the project for the community

Social benefits	Frequency	Rating %
Improved Public Transport Facilities	174	29.85
Received a Comfortable Transport Services	168	28.82
Increase Security	122	20.93
Increase Demand For Surrounding Lands	57	9.78
Increase Land Value	48	8.23

Source: Socio economic survey, August 2017

The details of economic benefits are outlined in the extended cost benefit analysis in Chapter 6.

4.9 Neighbouring land users related Impacts

4.9.1 Impact on neighbouring land users due to Severance of Light during Operation

The proposed LRT runs through three local authority areas namely, Colombo Municipal Council (CMC), Sri Jayawardhanapura Kotte Municipal Council (SJKMC), and Kaduwela Municipal Council (KMU). Thus, the planning and building regulations related to light and ventilation requirements of buildings are governed by the development plans prepared by Urban Development Authority for these three local authority areas. Accordingly, the light and ventilation of buildings should be managed within the sites. However, when lands are located abutting public streets, the provisions are available to obtain light and ventilation from the public streets. The impact of LRT on the light and ventilation of the buildings located along the road is minimal due to the following reasons;

- The LRT runs on the centre of the existing roads, and all such roads consist of four lanes and pedestrian walks. At the deck level, the LRT will occupy approximately 7 meters wide strip that is the space of two lanes. Thus regarding planning and building regulations, there will be adequate space for the roadside buildings to get legal light and ventilation.
- The LRT from Fort to Ibbanwala junction will largely run from North to South direction. Some parts of the trance of this section (i.e. Bastian Mawatha, Railway Yard) are void of buildings. From Gamini Hall Junction to Hyde Park junction, buildings to the East occupy relatively large plots and mostly faces Beira lake and therefore will have undisturbed light and ventilation from the East. The buildings on the other side which occupy relatively two-story type which have been in the process

of redevelopment into high rise buildings and that will have adequate contacts with the East.

- From the Hyde Park corner onwards the LRT rout gradually deviates towards East-West Direction, where buildings on either side face North and South directions. Along the ceremonial road, due to the existence of wide building setbacks, there will not be a significant impact on light and ventilation.
- Since the LRT is an elevated structure, the natural ventilation for ground floor buildings will not be impacted. Further, since the LRT deck rests on columns between which wide void spaces are maintained, no significant impact on the light and ventilation can be expected.

4.10 Impacts due to Solid Waste

4.10.1 Erosion of excavated materials, construction materials etc. and spoil and other waste generated from construction activities during Construction Stage

As the LRT route mostly follows the existing tarred roads and there is no room to temporarily store excavated material as such will be disposed to a designated disposal site, the chances of erosion of excavated material is minimal.

The LRT Project will generate both solid and liquid wastes during construction and operation stages. These can affect the quality of surface water, groundwater, and soil, if not handled and managed properly. A more detailed discussion of wastes generated and the potential impacts to water and soil quality is given below.

Wastes generated during construction stage will mainly comprise of construction wastes (e.g. rubble, wood plants, metals), excavated soil, domestic wastes, and oil wastes. These wastes will be generated for the entire LRT route.

During the construction stage the waste will consist of mostly building rubble, excavated soil, and construction waste which will be generated all along the LRT route. It is estimated that around 60,000m^3 of excavated soil and rubble will be generated when constructing the LRT route and stations and around 80,000m^3 will be generated from temporary fillings that need to be removed after constructing the depot. However, it should be noted that at this stage it is difficult to estimate the exact amount of waste that will be disposed offsite. This will depend on materials that cannot be reused or recycled.

The waste generated during the construction stage will be of a temporary nature. Construction waste if not properly managed will be a nuisance to pedestrians and other road users. The aesthetics of the city in the LRT route will be temporarily impacted.

4.10.2 Waste generated from Depot during the Operation Stage

The depot area is where maintenance, washing and servicing of rolling stocks are conducted. Typical solid and liquid wastes generated at the depot and workshop area are listed in the Table 4-26 below.

Table 4.26 Type of waste generated during operational stage

Waste	Source	Estimated quantity
Lubricant oil	air compressor and gear box	7liters/day
Sludge	wastewater treatment plant (when cleaning train and its parts)	200kg/day
Brake shoe (brake pad)	brake equipment	
Metal scraps	wheel re-profiling lathe, etc. (wheel reprofiling, and exchanging parts)	200kg/day
Rubber tube	brake system (need to exchange every 8 years depending on its specs)	
Batteries	Batteries in rolling stocks	5,000pcs/2yrs
General wastes	waste from rolling stocks, administrative buildings	200kg/day

Source: JICA Study Team

General wastes from administrative buildings in depot area will be segregated. Recyclable materials (e.g. paper, glass) will be handed to registered recyclers. Non-hazardous wastes will be disposed to in accordance with relevant local regulations (e.g. disposal to designated disposal sites). Hazardous wastes (e.g. used batteries, light bulbs) will be collected and carefully stored. Treatment and disposal of these wastes will be contracted out to a registered industrial waste company. Wastes will be collected and disposed regularly to prevent accumulation, which may cause pollution and safety risks.

4.10.3 Waste generated from Station during the Operation Stage

Domestic solid waste will be generated at the stations, by the people who use the LRT. Such waste in the stations will be mostly litter such as papers, waste as biodegradable waste (food waste, garden waste etc.), plastics, glass and paper empty plastic bottles etc. From the depot various waste belonging to railway furniture could be generated. Such waste will be various mechanical and electrical parts which has undergone wastage. These parts if dumped haphazardly in the depot site or outside will mar the aesthetics of the open spaces.

4.11 Impacts on Surface and Ground Water Quality during Construction

4.11.1 Surface water Quality Degradation during Construction

There are possibilities of surface water quality degradation during the construction of piers for Diyawanna Lake crossing and the depot. Water turbidity and alkalinity could increase.

4.11.2 Groundwater Quality Degradation during Construction

Insertion of concrete underground during construction of the structures' foundation may affect the alkalinity (pH) of groundwater. This may occur when hardening of the cement is done underground because alkaline substances dissolve in the water. For the depot area, solid concrete foundation structures will be installed. Thus, potential impact on groundwater is very limited because alkaline substances will not dissolve in the water.

Once built, the foundation structures will have negligible impact on groundwater quality.

4.12 Impacts to Culturally and Historically Important aspect during construction

4.12.1 Disruption to Bo trees and shrines

As described in Chapter 3.3.4, there are 14 Bo trees along the LRT corridor. Some of these Bo trees have small shrines and worshiped by the public. LRT route was designed to avoid and minimize the impact on Bo trees. No uprooting of Bo tree is expected, however, some braches of Bo tree overarching road may be cut downed/trimmed. Details of the likely impacts on Bo Trees as well as result of consultation with stakeholder related with Bo tree are given in Annex F.

In addition, during the constriction stage, access to religious and culturally important sites may be impaired temporarily.

4.12.2 Potential Impact on archaeological buildings

The LRT mainly goes on the existing roads and only limited number of buildings will be directly affected by the project. Based on the preliminary archaeological survey conducted by the Department of Archaeology, there are two buildings (People's Bank building and Railway Museum) that may be transversed by the LRT route. However, these structures are not designated as archeologically important.

4.13 Wastewater Impacts

4.13.1 Disposal of wastewater generated from workers camp (depot area) and construction site during construction stage

Regarding wastes generated by construction workers, there will be no workers camp required for the project since the project area is within an urban area and it is expected that construction workers will commute from their accommodation. As such, there will be no domestic waste or sewage generated during this period. However, there may be labourers who will reside in the Depot site and their waste water and sewerage will be diverted to standard cylindrical septic tanks installed for temporary toilets.

4.13.2 Spillage, leak and accidental discharge of fossil oil, waste oil generated from construction and operation stage

Construction Stage

Soil and surface water might be contaminated during construction works due to leaks and accidental spills of fuel and lubricants from construction vehicles and machineries. This could only happen from construction vehicles and equipment and such occurrences are very rare. All construction equipment will be maintained at good condition to minimize such incidents.

Operational Stage

Similar impacts could occur during the operation stage.

4.13.3 Disposal of wastewater generated from Depot (terminal buildings, rolling stocks maintenance, washing, serving etc.) during the Operational Stage

Wastewater arising from the depot operations is generated from maintenance activities, such as carriage washing or parts cleaning. Approximately 100m$^{3/}$day of wastewater is expected to be generated from an activity at Depot operation. Wastewater generated from maintenance activities may contain oil and grease, detergent, dust (possibly containing steal power).

4.13.4 Disposal of wastewater generated from stations during the Operational Stage

The wastewater generated from the station is sewage from the toilet and washing facility. It is estimated that around 20m$^{3/}$day wastewater will be generated in each station.

4.14 Impact on Water Courses

4.14.1 Backwater at Lake Crossings - During Construction and Operation

As a major part of the proposed LRT route traverses on the main roads except for the flood plains, there will not be a significant impact on the drainage pattern of the area. However, the proposed LRT route will cross Diyawanna Lake and the depot will be built in a flood-prone area. With this, there will be a marginal impact on backwater of the respective canals during the operational stage of the project. Coffer dams or sheet piling will be needed during construction stage and these coffer dams will hinder the canal water flow during flood situations. Such temporary blockage will cause flood lift impacts on the parliamentary building if implemented without mitigation measures.

4.14.2 Construction Disruption at Pocket Flooding Locations

Some places of the LRT route even outside the normal flood plains could be subject to pocket flooding and such flooding could hamper construction and could damage exposed utilities and open pile trenches. Location of areas prone to pocket flooding is presented in Figure 4.21 Details of flood levels are indicated for these places are given in Table 4-27 below.

Table 4.27 Places in LRT route subjected to pocked flooding

Location Location description	Ground level m MSL	50Yr flood height wrt ground level (m)	100Yr flood height wrt ground level (m)	50 Year Flood Level (m) above MSL	100 Year Flood Level (m) above MSL
1) Dr N.M.Perera Mawatha/Gothami Road Junction	3.00	0.36	0.56	3.36	0.92
2) Bauudhaloka Mawatha/Sri Jayawardanapura Mawatha Junction	2.14	0.42	0.59	2.56	1.01
3) Ward Place / BorellaCross Road Junction	6.25	0.45	0.61	6.70	1.06

Source: Colombo Municipal Council

Figure 4.21 Places of Pocket Flooding LRT

4.14.3 Backwater on flood plains

The impact of the LRT on flood plains was determined through two-dimensional (2D) flood modelling. Flood modelling was carried out by SLLRDC using the available flood model for Metro Colombo Development project.

In order to predict potential flood levels in the future, the magnitude of past floods from 1986 to 2011at Kelani River was used to calculate flood levels at certain return periods (refer to Table 4.28).

Table 4.28 Historical Flood Levels at Kelani River (1986-2011)

MAGNITUDE OF PAST FLOODS KELANI RIVER (AT AMBATALE) IN WATER LEVELS

Date	Water Level in (m)		Return Period	Water Level in m MSL
2/17/1986	4.37		2	4.29
10/27/1987	4.68		5	5.30
9/9/1988	4.27		10	5.96
6/7/1989	6.28		20	6.60
11/4/1990	4.35		50	7.43
6/1/1991	4.55		100	8.05
10/15/1992	4.98			
10/9/1993	4.88			
5/29/1994	4.19			
10/9/1995	4.58			
9/23/1996	4.68			
9/17/1997	4.88			
7/25/1998	4.45			
4/21/1999	5.36			
9/21/2000	4.575			
10/22/2001	3.38			
6/7/2002	3.66			
7/11/2003	3.813			
11/2/2004	4.423			
11/22/2005	5.16			
11/12/2006	4.68			
10/23/2007	4.04			
4/30/2008	5.483			
5/21/2009	4.27			
5/17/2010	4.728			
1/1/2011	0.661			

Note: The data in the table 4.28 above is more relevant to the depot site.

The impacts on flood plains will take place:

- During construction due to the pilot road which is temporarily needed to progress with the construction activities. This may cause the loss of storage areas for flood water in these areas, which may lead to extra flood lift
- During the operational stage due to the pillars of the LRT, which can cause extra flood lift. However, this flood lift will not be significant.

4.14.4 Flood Modelling for Construction and Operational Stages

(1) Hydrological/Hydraulic Modelling

The 2D modelling undertaken will show the baseline flood levels and the project induced flood levels for the Construction Stage and the Operational Stage. The model could also show the delays in flow recession if any. Hence aggravated flood lift and delayed flood recession are the hydrological impacts caused by the LRT during its construction and operation stages.

(2) Sub Models for Sensitive Flood Plains

SLLRDC uses one dimensional flood model to model flood scenarios of the Metro Colombo area. MIKE 11 flood model which is a product of Danish Hydraulic Institute is being used for this purpose. This main flood model was used to extract basic parameters for two 2D sub models using Sobek 2D flood model. Two 2D sub models were created for the following areas;

- Sub Model 1-Parliamentary lake and the flood plains of Parliament Lake (Diyawanna Lake)
- Sub Model 2-Depot area and the entry route to the proposed depot are from Malabe Kaduwela Road to the low-lying area on to the left of Chandrika Bandaranayaka Kumaranathunga Mawatha. On the flood plains of Madiwela East Diversion Canal. The Depot area is situated.

(3) Geometric Parameters Used for The Model

Following main geometric parameters were used to represent the LRT in the flood model for the construction and operational stages

Construction Stage

- Maximum temporary fill height for the depot 0.6m from existing ground level

Operational Stage

- LRT pillar size 1mx1m
- LRT pillar spacing 10m
- LRT Depot pillar spacing 10mx10m grid

(4) Modelling Results

Modelling results for the depot area and Diyawanna Lake are shown in the figures and tables below.

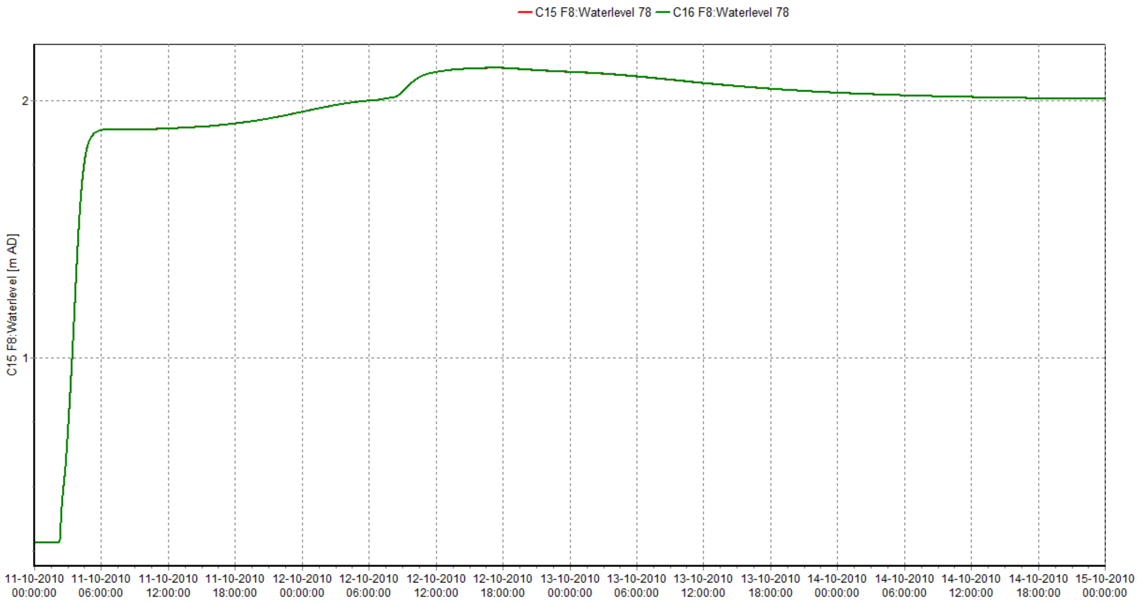


Figure 4.22 Stage Hydrograph for Diyawanna Oya with and without LRT

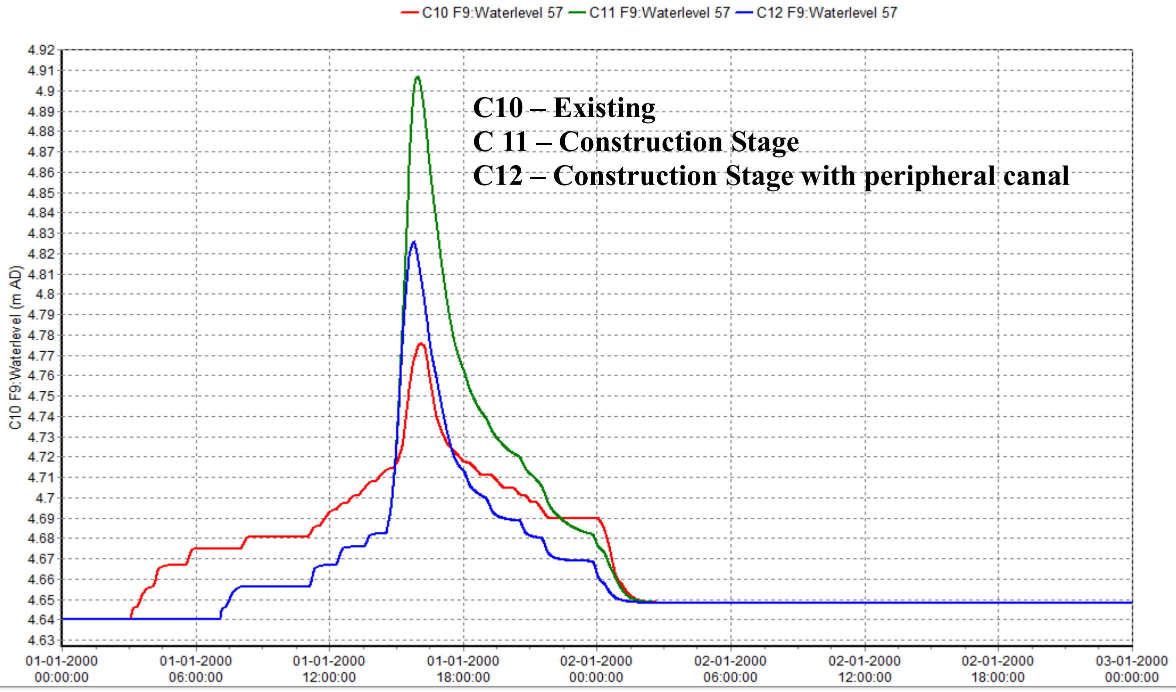
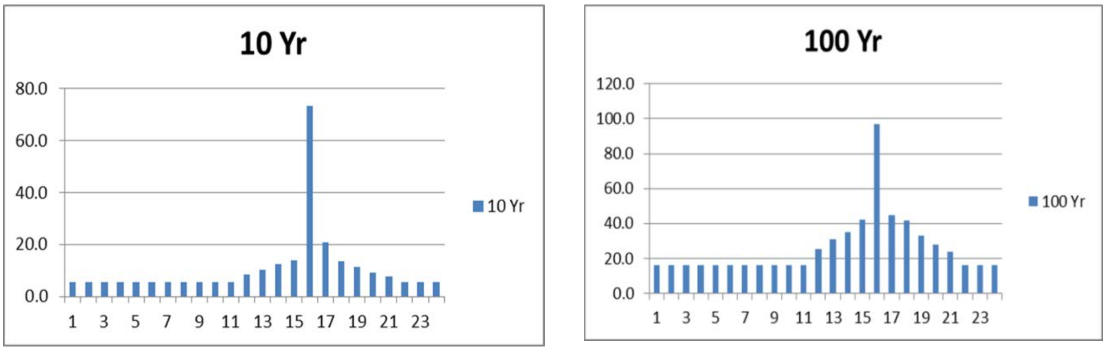


Figure 4.23 Stage Hydrograph for the Depot with and without LRT

Hyetographs used for 10 year and 100 year return periods using the updated IDF curve for Colombo are presented in the Figure below.



10yr (construction stage) 100yr (operation stage)

Figure 4.24 Hyetograph for different scenarios

Water levels with and without LRT for different scenarios for Diyawanna Lake, Depot Area and Parliament are shown in the Table below. Based on the results, significant backwater may occur at the depot area during construction stage if a peripheral canal is not provided.

Table 4.29 Water levels and extra flood lift (backwater) for selected scenarios

No	Scenario	Place	Flood Level (m)			Remarks
			Without LRT MSL	With LRT MSL (m)	Backwater (Flood Lift) (m)	
1	Baseline-10 Year	Diyawanna Lake	2.1	2.1	Nil	No significant backwater
2	Construction-10 Year					
3	Baseline-10 Year	Depot Area	4.62	**	**	**
4	Construction-10 Year		**	4.91	0.29	Backwater is considerable
5	Construction-10 Year with 3m wide peripheral canal		**	4.8	0.18	Backwater reduces with the proposed canal
6	Baseline-50 Year/100 Year		7.16/8.38	**	0.09/0.06	No backwater during the Operation Stage
7	Operational-50 Year/100 Year		**	7.25/8.42		
10	Baseline-100Year	Parliament	3.16	3.16	**	There is no difference in WL due to introduction of LRT pillars
11	Construction-100 Year		**	3.16	0.00	

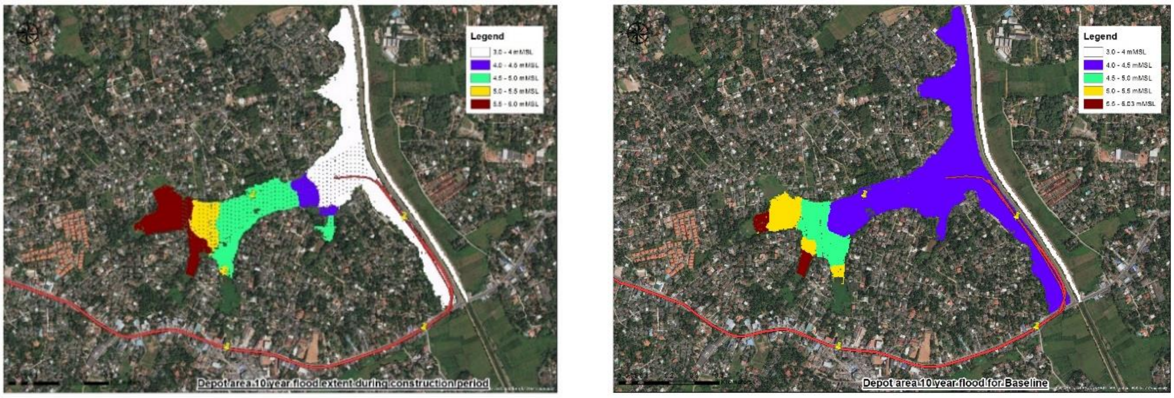
Flood recession times with and without LRT for different scenarios for Diyawanna Lake, Depot Area is shown in the table below. Based on the results, flood recession at the depot area during construction stage may take several hours and a proposed canal can significantly minimize this.

Table 4.30 Delay in flood recession for selected scenarios

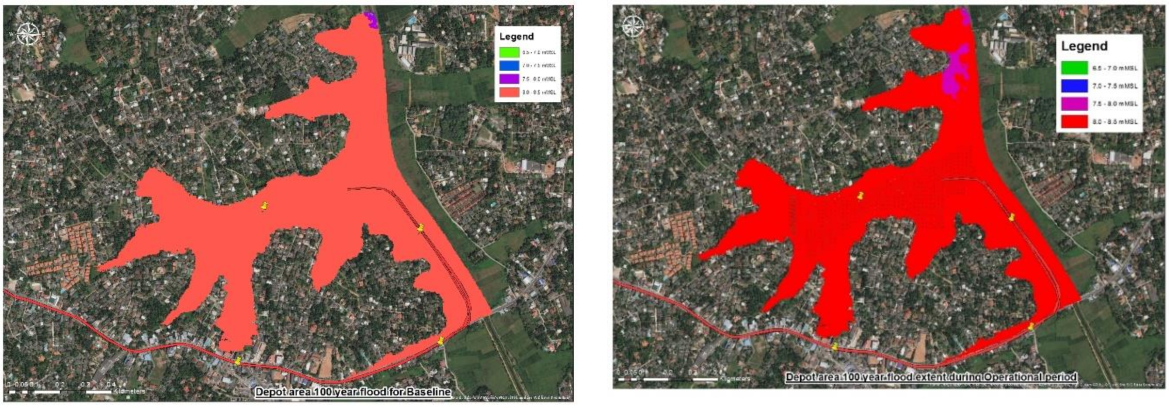
No	Scenario	Place	Flood Recession Time			Remarks
			without LRT (hrs)	with LRT (Hrs)	Delay (hrs)	
1	Baseline-10 Year	Diyawanna Lake	As there is no backwater no change in recession time.			
2	Construction-10 Year					
3	Baseline-10 Year	Depot Area	16	**	14	Flood recession delay is significant with temporary filling
4	Construction-10 Year		**	More than 30		
5	Construction-10 Year with 3m wide peripheral canal		**	15	-1.0	Proposed canal reduces recession time.
6	Baseline-50 Year/100 Year		19.5/20	**	0/0	
7	Operational-50 Year/100 Year			19.5/20		
8	Baseline-10 Year	Parliament	Since there is no backwater for both construction and operational stages for Diyawanna Oya Lake there is no backwater near Parliament which is upstream.			
9	Construction-10 Year					
10	Baseline-100Year					
11	Construction-100 Year					

Note: The durations are based on animation and propagation of flood of 2D simulation.

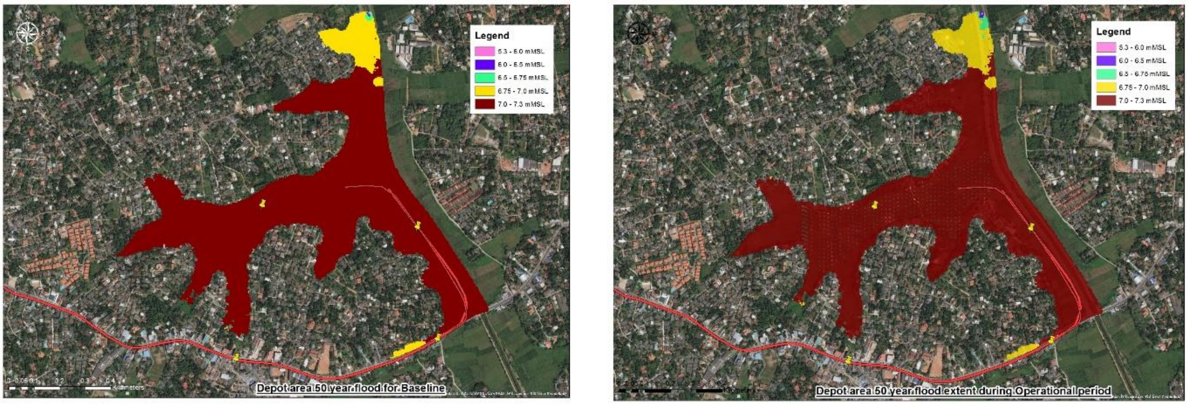
Flood extent maps for depot area for different scenarios are shown in the figures below.



10 Year Flood Extent (Baseline) 10 year flood extent construction period



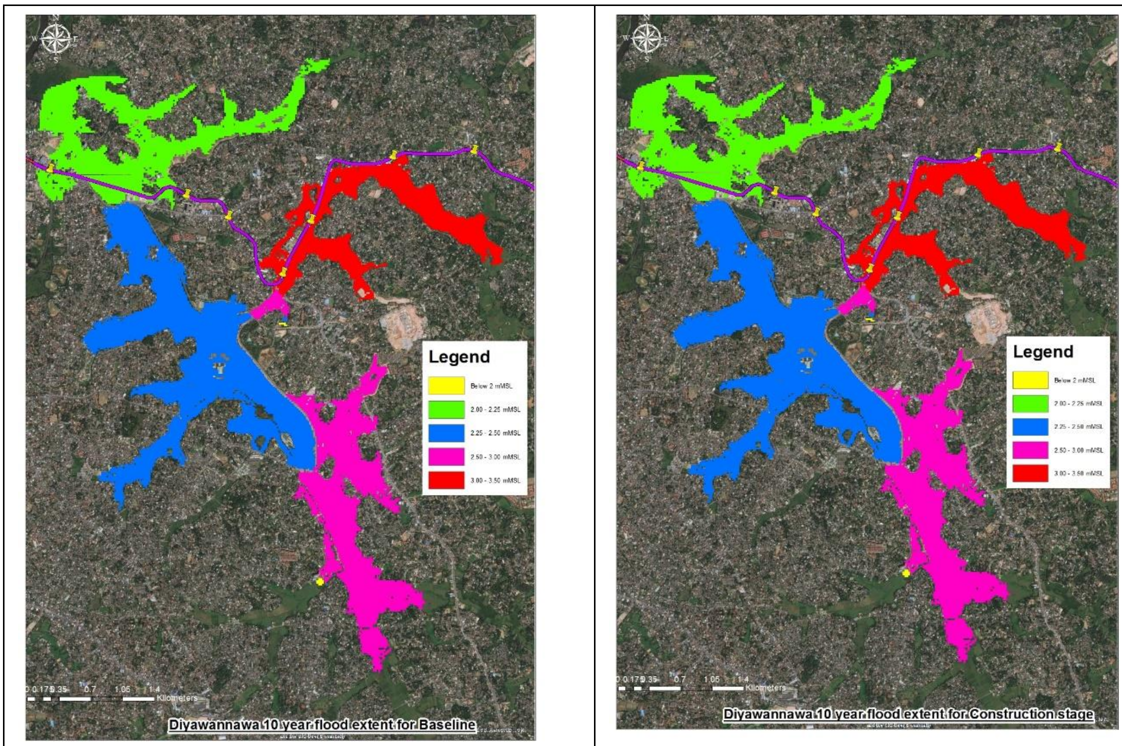
50 yr flood extent (operational project) 50 year Flood extent (Baseline)



100yr Flood Extent (Baseline) 100yr flood extent (operational period)

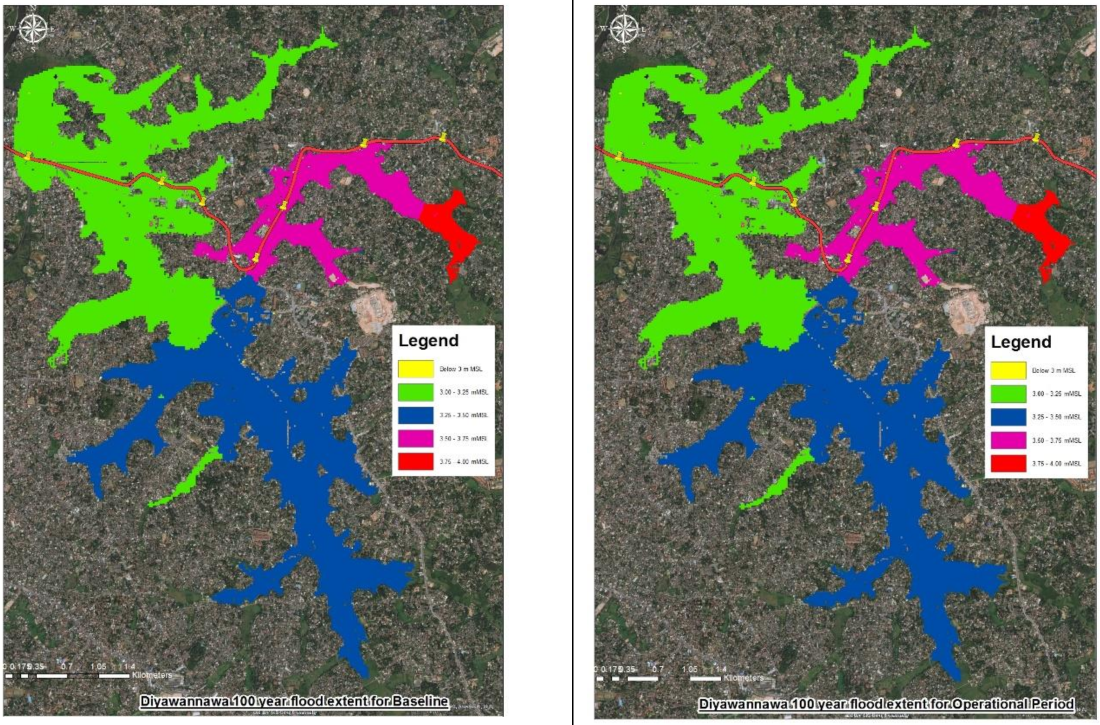
Figure 4.25 Flood Extent Maps for the Depot Area with and without LRT

Additional information on flood modelling is given in Annex L**.**



10 Year (Baseline)

10 Year (Construction)



100 Year (Baseline)

100 Year (Operational)

Figure 4.26 Flood Extent Maps for the Diyawanna Lake Area with and without LRT

(5) Determination of 100 Year Flood Level for the Depot

One hundred flood level for the depot site was independently obtained using the flood frequency analysis of Kelani River water levels at Ambatale which the closest river gauging station for the Depot is. The flood frequency curve Figure 4.27 and the flood frequency analysis Table 4-31 are given below. Depot elevation will be kept above 100-year flood level.

Table 4.31 Flood Frequency Details for Ambatale-Kelani River

Return Period	Frequency Factor	WL in m
2	-0.151	4.29
5	0.888	5.30
10	1.575	5.96
20	2.235	6.60
50	3.089	7.43
100	3.728	8.05

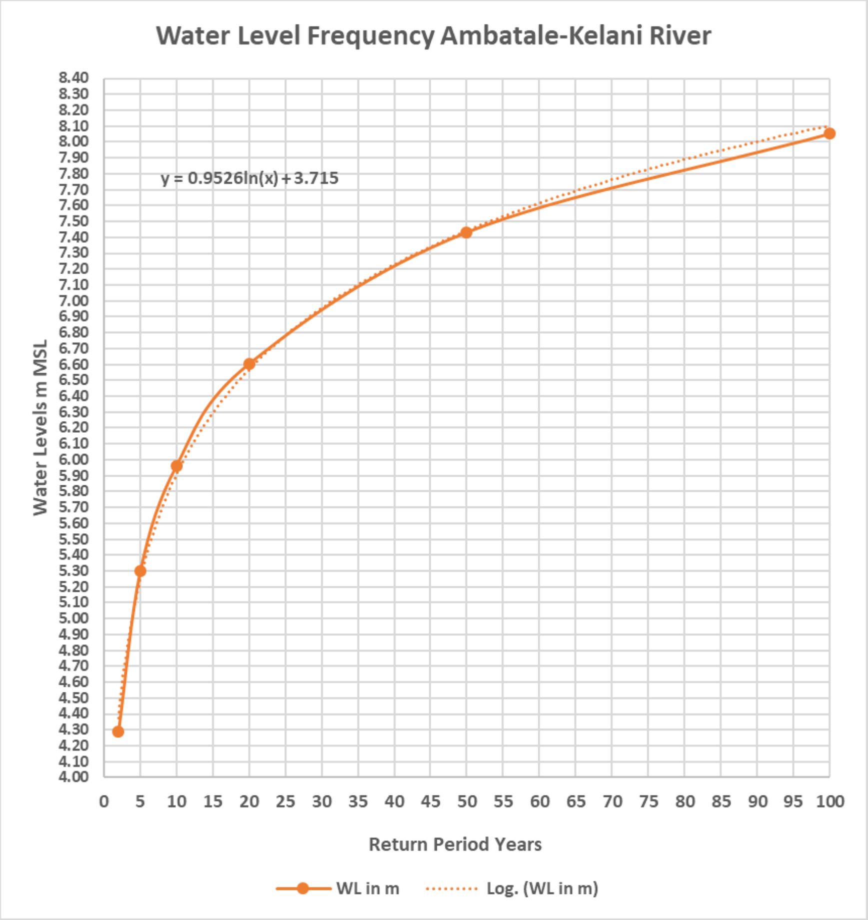


Figure 4.27 Flood Frequency Curve in Ambatale-Kelani River

A detailed description of the hydraulic modelling activities is presented in Annex L.

4.15 Air quality Impacts

4.15.1 Air Quality Degradation Construction stage

Although operation of the LRT itself has no impact on air quality, there is a possibility of impacts on air quality during the construction stage. This is mainly due to the impact of dust generated by the construction activities. However, in this type of construction dust generation could mainly come from the depot area. The fugitive emissions in form of dust are expected due to cut & fill of earth, loading, unloading and transport of fill material materials during the site development and construction of Depot. The potential for dust to be emitted during site preparation and construction activities is strongly dependent on the type of activities taking place, such as the movement of vehicles along the working width and their speed, soil stripping, cutting, back-filling and reinstatement. Wind speed and a particular wind direction may carry emitted particles towards receptors located in the adjacent residential area. Effects of dust emissions are heightened by dry weather and high wind speeds and effectively reduced to zero when soils and/or ambient conditions are wet. However, dust generated from the site development and construction activity will generally settles down on the adjacent areas within a short period due to its larger particle size. This temporary dust generation from the construction activities is not expected to significantly affect the ambient air quality of the study area

Heavy vehicles transporting construction materials are also potential sources of air pollution during the construction stage, as these vehicles could emit excessive amounts of pollutants such as Sulphur Dioxide, Oxides of Nitrogen, Carbon Monoxide and Particulates.

4.15.2 Air Quality Improvement in the Operation stage

The emissions from the LRT project during operation will be limited to operation of machinery for the maintenance of the rolling stocks at the depot area.

There is a possibility that the air quality might improve, since people using private vehicles may opt to use the LRT instead. It is, however, difficult to exactly predict improvement in air quality.

4.16 Urbanization Impacts

4.16.1 Increased urbanization During Operational Stage

The population of Colombo District continuously increased from 1,699,241 in 1981, to 2,251,274 in 2001, and 2,324,349 in 2011. Although the Average Annual Population Growth Rate (AAGR) has come down from 1.4 between 1981 – 2001 to 0.35 between 2011 – 2011, the population has increased even at a decreasing rate. Major capital investments in roads, water supply, health, education, irrigation, and industrial estates have resulted in curtailing migration of rural population to Colombo.

However, Colombo being the location for the administrative and commercial capital of Sri Lanka experiences high population density. Particularly, after the establishment of the peace in the country, Colombo started to regain its vibrant urban development process as demonstrated by large-scale urban regeneration projects taking place in both the City of Colombo and its suburban areas.

With regard to the sustainable urban development principles, Colombo Urban Area has been undergoing three serious issues namely;

- Spread of urban population along main roads in the form of low-density settlements
- Lack of high-quality public transportation resulting in environmental, economic, and social losses, and further encouraging outward bound development
- Colombo, losing its competitiveness in the region.

The LRT project will provide a positive impact, on resolving the above key issues, provided that the urban planning institutions will integrate future land use system with Transit Oriented Development, based on the proposed LRT. The expected results would be;

- Increasing the urbanisation process in the City of Colombo and suburban areas, in the form of concentrated development, creating a cost-effective, efficient, and market-driven urban economy.
- Increasing the competitiveness of the city due to the reduction in the level of pollution, traffic congestion, social and economic losses, and improving the aesthetic appearance of the cityscape.
- The reduction in the accidents. According to the information of the Ministry of Transport and Civil Aviation, in 2016, 53,118 accidents were recorded in Sri Lanka of which 3003 were deaths, and 2824 were fatal accidents. Of them, a large proportion consisted of Motor Bicycles and three Wheelers.

The phase one of the LRT covers Colombo – Malabe corridor, which will be extended to cover other corridors in the future, covering large population concentrated suburban areas (i.e. Kaduwela DS – 252,041 population, Homagama DS – 237,905, Seethawaka – 113,807, Maharagama – 196,423, Sri Jayawardhanepura Kotte – 95,506 in 2012). Thus, urbanisation of Kaduwela, Sri Jayawardhanapura Kotte, Colombo, and Thimbirigasyaya DS areas will be further strengthened during the phase one of the project and others during the next phases, making those areas attractive for urban investment.

On the other hand, there is a risk that with increased urbanization, conversion of paddy lands and green areas, particularly close to the train stations will also increase. These areas may be converted to park-and-ride facilities, commercial/residential buildings and/or developed into a multi-modal transport center or hub.

4.17 Contingency Impacts

4.17.1 Unexpected events (for both Construction and Operation Stages)

Accidents and natural hazards may impact the project and pose both environmental and social risks when not identified and addressed at an early stage. An emergency response plan will be prepared for both construction and operation phases.

- Failure of rail component and structure
- Fire due to extreme hot weather, equipment failure and accident
- Impact due to flooding

4.18 Impact Analysis using a Leopold Matrix

4.18.1 Project Activities vs. Induced Environmental Impacts

To assess the degree of environmental and social impacts of the project, the Leopold Matrix Impact Assessment Method was employed. In order to calculate the impact scores, physical, physiochemical, social and ecological impacts cause by project activities during the main stages of the project (i.e. construction stage and operational stage), were identified and evaluated. Positive scores were assigned for positive impacts while negative scores were assigned on negative impacts. The impacts scores were assigned on two major themes i.e. the **Magnitude [M]** and the **Significance[S]**. The scores were assigned based on the nature of the impacts identified during the EIA studies. The score ranges and the degree of the impact Magnitude [M] and Significance[S] are presented in the following table.

Table 4.32 Scoring Method for the Environmental Impact Magnitude [M] and Significance [S]

+ Positive	**- Negative**
Magnitude[M]/Significance[S]	
"Blank"	Not relevant
1-3	Insignificant
4-6	Significant
7-9	Very significant

4.18.2 Calculation of Impact Scores

Impact scores are calculated by multiplying assigned values for the Magnitude [M] and the Significance[S] of impacts. Negative values were used for negative impacts and positive values were used for positive impacts. The impact scores were illustrated using a colour code within the Leopold Matrix as indicated in the table below.

4.18.3 Sub Colour Coding Range for the Cumulative Scores

Table 4.33 Colour Coding for the Cumulative Effect of the Impact i.e. Magnitude[M]x Significance[S]

	Magnitude [M]									
Signinificance [S]	POSITIVE IMPACTS									
	Significance	1	2	3	4	5	6	7	8	9
	1	1	2	3	4	5	6	7	8	9
	2	2	4	6	8	10	12	14	16	18
	3	3	6	9	12	15	18	21	24	27
	4	4	8	12	16	20	24	28	32	36
	5	5	10	15	20	25	30	35	40	45
	6	6	12	18	24	30	36	42	48	54
	7	7	14	21	28	35	42	49	56	63
	8	8	16	24	32	40	48	56	64	72
	9	9	18	27	36	45	54	63	72	81
	NEGATIVE IMPACTS									
	Significance	-1	-2	-3	-4	-5	-6	-7	-8	-9
	1	-1	-2	-3	-4	-5	-6	-7	-8	-9
	2	-2	-4	-6	-8	-10	-12	-14	-16	-18
	3	-3	-6	-9	-12	-15	-18	-21	-24	-27
	4	-4	-8	-12	-16	-20	-24	-28	-32	-36
	5	-5	-10	-15	-20	-25	-30	-35	-40	-45
	6	-6	-12	-18	-24	-30	-36	-42	-48	-54
	7	-7	-14	-21	-28	-35	-42	-49	-56	-63
	8	-8	-16	-24	-32	-40	-48	-56	-64	-72
	9	-9	-18	-27	-36	-45	-54	-63	-72	-81

4.18.4 Score Assignments for the Environmental Impacts

Scores assignment for the environmental impact Magnitude [M] and Significance [S] was done based on the results of the environmental assessment. Judgement was exercised in assigning scores for each item. High negative scores were used to show most significant negative impacts (Scores -56 to -81) .

4.18.5 Leopold Matrix for the LRT's Environmental Impacts

The simplified version of the Leopold Matrix showing the impact scores, is given in Table 4.34 and the full version is given in Annex M. The degree of positivity and the negativity is illustrated for each impact through the colour coding process. Hence, the very significant negative impact items could be readily spotted in the Leopold Matrix from red colour coding range. Green colour coding shows the positive impacts. The impacts for both Construction Stage and the Operational Stage have been sorted according to the total impact score. Thus, the most significant negative impacts appear on the top of the matrix and the most significant positive impacts are at the bottom of the matrix.

4.18.6 Outcome of the Leopold Matrix

The impacts were accorded scores (based on the EIA study finding and the judgement of the expert team) and the impacts were sorted according to the total score. One of the main assumption when adducing scores is that there are no mitigation measures except for the mitigations-by-design. The reason is that by this exercise only the significance of impacts is determined to provide mitigation measures. After the screening process the identified most significant negative impacts in the order of priority are;

Construction Stage – Negative Impacts

1. Noise
2. Road link capacity reduction
3. Landscape/aesthetic degradation
4. Community health and safety Degradation
5. Occupational health and safety degradation
6. Vibration
7. Disruption of livelihood and economic activities
8. Fauna flora disturbance
9. Wetland degradation
10. Disruption to underground utilities
11. Land acquisition/Resettlement of people /structures
12. Neighbouring Land Users-Severance of light
13. Erosion of excavated material
14. Surface water quality degradation
15. Disruptions to Bo Trees and shrines
16. Construction disruption at pocket flooding locations
17. Spillage and accidental leakage
18. Disruption to overhead utilities
19. Backwater at lake/stream crossings
20. Wastewater from worker camps
21. Backwater at flood plains
22. Disruption to archaeological buildings
23. Ground water quality degradation
24. Air quality degradation

Construction Stage – Negative Impacts

1. Employment generation
2. Travel time saving

Operation Stage – Negative Impacts

1. Occupational health and safety degradation
2. Noise
3. Unexpected events -structure failure, equipment failure and flooding
4. Spillage and accidental leakage
5. Wetland degradation
6. Solid waste generated from Depot
7. Wastewater generated from depot
8. Surface water quality degradation
9. Vibration
10. Wastewater generated from stations
11. Road link capacity reduction
12. Solid waste generation from station
13. Ground water quality degradation
14. Disruption of livelihood and economic activities
15. Neighbouring Land Users-Severance of light
16. Fauna flora disturbance
17. Disruptions to Bo Trees and shrines
18. Landscape/aesthetic degradation

Operation Stage – Positive Impacts

1. Air quality improvement
2. Increased Urbanisation
3. Boost of Regional Economic Activities
4. Socio-economic benefits
5. Employment generation
6. Travel time saving

4.18.7 Application of Mitigation Measures for Impacts

The most significant impacts indicated above need careful and stringent mitigation measures. It is seen from the table above most negative impacts exist during the Construction Stage which require mitigation measures. Many positive impacts are seen during the Operational Stage. However, the positivity of the impacts during the operational stage is mainly based on the long term economic returns as indicated in the Extended Cost Benefit Analysis. The overall impact cannot be judged from the results of the Leopold Matrix alone for such indirect positive impacts on the economy. There are also negative impacts during the Operational Stage needing mitigation measures.

Table 4.34 Leopold Matrix (Summary)

Impact Causing Activities-Construction Stage																			Impact Causing Activities-Operational Stage									
Impact Themes	Structure demolition to clear trace bends	Excavation for foundations for LRT pillars	Utility diversion(Power lines, water supply, telecom cables)	Construction of light rail pillars	Traffic diversions(Human and vehicular)	Pilot Road construction with excavated material in low lying	Tree removal and tree branch pruning	Installation of construction rigs in Diyawanna Oya	Underwater concreting for pillars in streams ands lakes	Construction of elevated stations	Girder /Superstructure construction	Construction of the elevated depot on the low lying area	Installation of rolling stocks	Installation of the wastewater treatment plant for the depot site	Removal of the pilot road and construction waste disposal	Landscaping	Power supply installations	TOTAL SCORES	Impact Themes	Driving Train(including test runs)	Passenger services in stations	Emergency action	Regular Maintenance	Breakdown maintenance	waste disposal from depot and stations	Sludge disposal from depot	Wastewater disposal from depot from wash and clean process	TOTAL SCORES
Noise	-64	-36	-9	-49	-36	-36	-16	-49	-36	-42	-56	-81	-9		-16		-8	-543	Occupational health and safety degradation	-36	-24	-81	-36	-49	-24	-25	-36	-311
Road link capacity reduction	-49	-64	-64	-64	-72	-10	-9			-36	-63	-15	-54		-20	-2	-4	-526	Noise	-64	-24		-25	-16				-129
Landscape/aesthetic degradation	-24	-48	-36	-40	-16	-42	-40	-36	-24	-48	-40	-32	-32	-18	-20		-16	-512	Unexpected events -structure failure, equipment failure and flooding	-16	-16	-36	-16	-16	-8	-8	-8	-124
Community health and safety Degradation	-36	-36	-48	-36	-56	-25	-4	-16	-16	-48	-25	-64	-25		-36	-16	-25	-512	Spillage and accidental leakage				-16	-30	-16	-25	-30	-117
Occupational health and safety degradation	-25	-25	-36	-36	-20	-25	-16	-36	-36	-36	-36	-48	-36	-25	-25	-8	-36	-505	Wetland degradation						-36		-81	-117
Vibration	-9	-16	-9	-49	-4	-9	-3	-25	-49	-36	-49	-81	-25					-364	Solid waste generated from Depot						-64	-36		-100
Disruption of livelihood and economic activities	-36	-64	-64		-36					-72		-64		-9				-345	Wastewater generated from depot								-81	-81
Fauna flora disturbance		-16			-4	-36	-24	-16	-16	-16		-36		-36	-16		-4	-220	Surface water quality degradation	-4					-4	-36	-36	-80
Wetland degradation		-4		-4		-64		-36	-24			-64		-12	-9			-217	Vibration	-36		-16	-8	-16				-76
Disruption to underground utilities	-36	-81	-64			-16						-4						-201	Wastewater generated from stations						-64			-64
Land acquisition/Resettlement of people /structures	-9		-48			-21				-20		-81		-12				-191	Road link capacity reduction	-48								-48
Neighboring Land Users-Severance of light				-8						-25	-36	-48	-36			-16		-169	Solid waste generation from station		-36							-36
Erosion of excavated material	-4	-49	-20			-30	-12	-4				-4			-16	-16		-155	Ground water quality degradation							-16	-9	-25
Surface water quality degradation								-36	-48			-36						-120	Disruption of livelihood and economic activities			-16						-16
Disruptions to Bo Trees and shrines				-16			-36			-16	-16		-6					-90	Neighboring Land Users-Severance of light	-16								-16
Construction disruption at pocket flooding locations		-16	-16	-16		-24												-72	Fauna flora disturbance	-4		-4						-8
Spillage and accidental leakage	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-68	Disruptions to Bo Trees and shrines	-4								-4
Disruption to overhead utilities				-36			-16						-16					-68	Air quality degradation									0
Backwater at lake/stream crossings				-16				-16	-16									-48	Backwater at lake crossings									0
Wastewater from worker camps	-4	-4	-4					-4		-4	-4	-4	-4		-6		-4	-42	Backwater at flood plains									0
Backwater at flood plains				-8		-16						-48			36			-36	Community health and safety degradation									0
Disruptions to archaeological buildings		-9		-16														-25	Construction disruption at pocket flooding locations									0
Ground water quality degradation				-4			-4	-4										-12	Disruption to overhead utilities									0
Air quality degradation	-4			-6														-10	Disruption to underground utilities									0
Air quality improvement																		0	Disruptions to archaeological buildings									0
Boost of Regional Economic Activities																		0	Disturbance to protected areas									0
Disturbance to protected areas																		0	Erosion of excavated material									0
Increased Urbanization																		0	Land acquisition/Resettlement of people /structures									0
Socio-economic benefits																		0	Wastewater from worker camps									0
Solid waste generated from Depot																		0	Landscape/aesthetic degradation				81		-8	-8	-8	57
Solid waste generation from station																		0	Air quality improvement	81					-4			77
Unexpected events -structure failure, equipment failure and flooding																		0	Increased Urbanization	81								81
Wastewater generated from depot																		0	Boost of Regional Economic Activities	81	36		16					133
Wastewater generated from stations																		0	Socio-economic benefits	81	81							162
Employment generation		81	81	81		36	18	16	16	36	25	81	36	16	16	36	25	600	Employment generation	20	81	16	81	64	36	16	16	330
Travel time saving																			Travel time saving	81	81	81	81	81	81	81	81	648
TOTAL SCORE																		-4451	TOTAL SCORE									136

CHAPTER 5 Proposed Mitigation Measures

5.1 Mitigation Measures for Noise and Vibration

5.1.1 Mitigation measures due to Impacts on Noise

Construction stage

All construction equipment will be used in good service condition and low noise/vibration generating construction equipment will be used. Heavy noise/vibration generating construction work are not expected. There could be some noise during trench excavation for foundations and the placement of steel beams on columns etc. Such noise or vibration will be minimum and limited to the construction stage and such impacts are not continuous but sporadic. No noise generating night work will be allowed especially in the areas where there are residences (e.g. Ward Place etc.).

Noise and vibration nuisance would be significant only during the construction stage where a piling operations and structure construction works would commence. Therefore, noise levels will be well monitored during the construction stage. If ambient levels are far higher than the stipulated level of 75 dB (A) for daytime construction and 50 dB (A) for night time, mitigation measure given below will be implemented. The impact of noise and vibration nuisance could be minimized through the following measures;

1) Fitting of exhaust baffles and maintaining construction vehicle and machinery in a high operable condition,
2) Use the noise, low-vibration type machine and/or vehicles,
3) The construction site is separated with corrugated sheets or other suitable material especially at locations near noise sensitive receptors, particularly at National Hospital and school zone.
4) Scheduling of construction work that cause high noise and vibration must be within authorized construction embodiment times with the least inconvenience to the public,
5) Avoid construction work on Poya days and days of other religious and/ or cultural importance,
6) Avoid high noise construction activities during the night time.
7) Establishing a complaint mechanism and implementing a procedure to effectively deal with any issue raised by the community.
8) Inform surrounding community of the construction schedule and proposed activity in advance

For the construction activity at Depot, following mitigation measures will be implemented.

1) Conduct a test piling activity and check the noise level generated from the piling activity at Depot area.
2) Consider changing the height of hammer drop or weight of hammer to be used, depending on the result of test piling

3) Install a noise reduction equipment with piling hammer

Operational stage

During the operation of LRT project, noise level from LRT will meet the noise level standard for railway both Peak noise level (LAmax) and Equivalent noise level (LAeq) of Japanese/Australian standards. However, noise level would be gradually increased up to the 13m height. In addition, there would be a disturbance especially around noise sensitive areas as identified in Chapter 3.3.3, including hospitals such as General hospital and Ayurweda hospital, schools and education institutes. Therefore, following mitigation measure will be implemented.

1) For section along noise sensitive areas, implementation of noise mitigation measures such as noise barriers or double pane windows shall be considered during detail design stage as well as operational stage.
2) Carry out noise monitoring along LRT routes at the location conducted for noise measurement survey (total 7 locations). Additional monitoring point will be added based on comments raised from stakeholders along LRT route.
3) Standard maintenance of trains, structure and tracks
4) Regular reconditioning of train and its components, such as suspension system, brakes and wheels.
5) Establishing a complaint mechanism and implementing a procedure to effectively deal with any issue raised by the community.

5.1.2 Mitigation Measures for Vibration

Construction stage

Mitigation will include the following actions;

1) Identification of type of building structure (Type 3 and Type 4). For Type 4 structure, the consultation with Department of Archaeology is required.
2) Carry out a property condition survey (crack survey) of nearby structures and record the present condition of the structure, to accurately assess any damage to these structures during the construction stage.
3) Vibration monitoring at selected area around the construction activities.
4) Regularly communicate with surrounding communities to inform the construction schedule.
5) Use of lower vibration generating device/machinery.
6) Scheduling of construction work that cause high vibration must be within authorized construction embodiment times,
7) Minimization of piling energy (e.g. reduced hammer drop distance) as necessary depending on receptor distance.
8) Establishing a complaint mechanism and implementing a procedure to effectively deal with any issue raised by the community.

Operation stage

Although no significant vibration impact is expected, following mitigation measure will be implemented.

1) Design of rail tracks must incorporate measures to reduce level of vibration, such as use of long rail, sleeper with the anti-vibration mat.
2) Vibration monitoring at selected area along the LRT route.
3) Standard maintenance of trains, structure and tracks
4) Regular reconditioning of train and its components, such as suspension system, brakes and wheels.
5) Establishing a complaint mechanism and implementing a procedure to effectively deal with any issue raised by the community.

5.2 Mitigation Measures for Traffic Impacts

5.2.1 Road Link Capacity Reduction during Construction Stage

A comprehensive traffic study will be carried out during the detailed design stage to assess the different scenarios of stage-wise construction, traffic diversion options for each construction phase and its impact on the network traffic flow. This study will be accompanied by a traffic engineering model within the study area to assess possible changes that will be made in the future. A separate intersection wise analysis will be conducted at the key intersections affected by the study. Any changes made to the traffic management schemes in the area, such as bus lane implementation, traffic signal installation etc. will be incorporated in the model.

A stakeholder committee with the participation of project consultants, Colombo Municipal Council and the other relevant local government bodies, Road Development Authority and Traffic Police, will be appointed to give guidance on the developed traffic management plan as well as to continuously monitor its implementation during construction stage. The traffic management plan will be made available to the public and adequate time will be provided to allow familiarization of the new routes.

Based on the above, a traffic management scheme for each stage of construction and mechanism for monitoring will be set up to monitor the traffic flow characteristics during the construction stage.

1) Preparation of traffic management plan for each construction stage such as diversion, lane control, safety measures. The traffic management plan will also take into consideration mobility and safety of vulnerable groups (e.g. school children, elderly).

2) Carry out traffic simulation for above traffic management plan

3) Road Intersection wise traffic analysis for the key road intersections affected by the study (See Section 1.4 of the Traffic Impact Assessment Report in Annex C for the affected intersections)

4) A stakeholder committee with the participation of project consultants, Colombo Municipal Council and the other relevant local government bodies, Road Development Authority and Traffic Police, will be appointed to give guidance on the developed traffic management plan

5) Monitoring of traffic flow during construction stage

In addition to the mitigation measures described in above for traffic impact, following mitigation measures will be implemented to minimize the impact on existing road users, including pedestrian and bus user.

1) Ensuring the safety during the construction period using standard safety measures.
2) Adherence to the work zone management guidelines formulated by RDA.
3) Provide minimum 3m lane width for bus routes
4) Maintain walkable paths for pedestrian movement especially where high density pedestrian traffic flows exist (e.g. Malabe, Rajagiriya Road, Olcott Mawatha, Justice Akbar Mawatha and Malay Street, access roads in depot area)
5) Retain access roads in depot area (slightly diverted) and ensure that design and construction of depot civil structures will not hamper movement of people and vehicles in the area.

5.2.2 Road Link Capacity Reduction During Operation Stage

During the detailed design of the LRT structure, coordinate closely with RDA in determining how to integrate the LRT structure and future road development (e.g. number of lanes, road width).

5.2.3 Mitigation Measures for Improvement of Traffic Condition in off LRT Routes during Operational Stage

This is a positive impact for which no mitigation measures are necessary.

5.3 Mitigation Measures for Landscape Impacts

5.3.1 Mitigation Measures for Landscape and Aesthetic Degradation

The LRT road trace falls largely on built up areas. The road trace is very diverse in both its natural and built environment, thus its impacts vary from section to section. Further, other than the most critical areas, the impacts on the other areas can be mitigated through good design intervention. Such design intervention will be comprehensive to treat the whole LRT trace as an integral part of the urban corridor, as to make it an interesting element of the trace.

1) The major sensitive areas will be thoroughly studied in terms of landscape impact during detailed design stage through the consultation with concerned agencies. After detailed assessment of landscape impact, if it is found that alternative route is suitable, it will be a subject for supplementary EIA.
2) Micro level detailing, structures, colors, lighting, planting, trains designs and colors, stations, interactions will be part of the overall design depending on each section.
3) In order to realize the overall objectives, in the design team in addition to the design and structural engineers it will include; Tow Planners, Urban Designers, Architects, Landscape Architects, and Lighting Experts.

5.4 Mitigation measures due to impacts on Health and safety

5.4.1 Mitigation measure for community health and safety during construction stage

Mitigation measures are required to protect people and work force from accidents in the work sites. The construction activities will be performed on existing roads and on elevated structures. The project will take optimum measures to assure the protection of people living, working and moving in the project areas.

In order to mitigate the impact on health and safety risk of surrounding communities, following mitigation measures will be considered.

1) The project site should be fully fenced and access points should not be available for the public.
2) Temporary sanitary facilities should be provided at all construction sites, especially for the Depot site.
3) Environmental pollution control measures, including watering standard maintenance of machinery will be implemented.
4) Arrange construction activities and schedule to minimize the impact on surrounding communities (e.g. prohibit high noise generating activity on night time)

5.4.2 Occupational Health and safety during Construction stage

Adoption of standard worker safety methods such as provision of helmets, earplugs, dust masks, warning signs, safety display posters and safety gear. Suitable advice will be obtained from the District Factory Inspection Engineer –Department of Labour and action will be taken to conform to his requirements.

These safety arrangements will be examined periodically by the officers of PMU. Adhering to safety measures will be made compulsory and needs for such safety precautions will be specified in the EMP and in the contract documents. Contractors shall submit an Occupational Health and Safety Management Plan in accordance with the guidelines set by the Labour Department, prior to commencement of work.

Workers Health will be impacted from dust and noise. However, dust stir is minimum as there will be only very little excavation work which will only be needed for foundation trenches. Workers will be instructed to wear dust masks as a mitigation measure. Dust stir will also be minimized using dust curtains, water sprinkling etc. No serious health impacts are expected from the construction work as there will not be any works with hazardous chemicals (except for paints) and obnoxious gases.

Power transmission lines are the objects causing most harmful accidents with lethal impacts on drivers and machine operators unless they work with proper precautionary measures. Hence awareness programs for the machine operators will be held to educate them with this aspect. Engineers from Ceylon Electricity Board have been seconded to the PMU and they will provide necessary advice to the Contractor. Power lines will have to be temporarily switched of for critical construction work with adequate notice to the affected public.

5.4.3 Mitigation Measures for Occupational health and safety during Operational stage

There may be risk of accidents due to improper work practice, which would be a threat to health and safety of workers at the station, Depot and LRT structure. Health and Safety Management Plan for operational stage will be developed and implemented by the O&M Company which will be created for the operation of the LRT. All workers undertaking maintenance work will be provided with appropriate personal protective equipment (PPE). Security guards will be deployed in Depot and all stations. Emergency Response Plan will be established by the Project Proponent.

5.5 Mitigation Measures for Socio-economic Impacts

5.5.1 Mitigation measures due to Disruption to Livelihood and economic activities during Construction Stage

The proposed LRT project has significant impact on livelihood and economic activities of commercial property owners, residential property owners and paddy land owners. Special attention will be paid to these affected people to mitigate the impacts on them.

Compensation will be paid to the affected parties according to the stipulations of the Land Acquisition Act (LAA) and Land Acquisition and Resettlement Committee (LARC). Payments for loss of business (temporary or permanent), loss of livelihood, loss of wages employment will be provided to affected parties, as compensation. Further, there are stipulations in the LARC on an ex gratia payment for paddy lands to be acquired.

The livelihood of the persons occupying in business premises and residences will be temporarily disturbed by the construction of the LRT and following mitigation measures in summary will be implemented.

1) Provision of compensation to the Project Affected Parties (PAPs) using the compensation package decided for LRT Project based on LARC stipulations on assessing the financial and

other losses of PAPs.

2) Provision of alternative access to their premises as far as possible outside the construction sites to carry out their usual business activities and other domestic or related employment activities.
3) Develop a Livelihood Restoration Plan
4) Continual liaising with the Project Affected Parties (PAPs) will be undertaken to decide on the site-specific mitigation measures.
5) Consultation with people whose livelihood depend on modes of transportation that may be affected by the Project (e.g. 3-wheelers and bus operators). They will be included in the development of the traffic management plan.

5.5.2 Impact on livelihood during Operational stage

Positive impact is expected since the LRT project would boost regional economic activities along the route and presence of stations will attract future commercial development. No mitigation measure is required.

For PAPs whose livelihood had been affected during construction stage, monitoring of the implementation of the Livelihood Restoration Plan will be conducted. The Cabinet Memorandum on the application of LARC to the LRT project is given in Annex I.

For bus operators and 3-wheel drivers whose livelihood may be affected by the operation of the LRT (a potential competitor in terms servicing passengers/commuters), continued consultation together with relevant agencies will be conducted to seek optimum solutions. In addition, developing terminals for 3-wheelers close to the trains stations will be proposed.

5.5.3 Travel Time Saving during Operation

This is a positive impact for which no mitigation measures are necessary.

5.5.4 Employment Generation

This impact is a positive impact for both stages and no mitigation measures are necessary.

5.6 Mitigation Measures for Impacts on the Biological Environment

5.6.1 Mitigation Measures for the Disturbance on Protected Areas

The proposed project will have no direct impact on the two protected areas, Sri Jawardenapura-Kotte Bird Sanctuary and Thalangama EPA found in the project area as they were avoided by the design. However, there may be possibilities of indirect impacts. Thus, in order to identify any potential indirect impact, monitoring of bird species, which could be an indicator species of these areas, will be conducted.

5.6.2 Mitigation Measures for impacts on flora and fauna (aquatic/ terrestrial habitats).

No significant impacts are anticipated with respect to aquatic and terrestrial habitats except at the LRT depot site where a low land (agricultural land) with an extent of about 15 ha will be affected. However, since the depot will be established as an elevated platform the low land will not be filled except temporary filling that may take place during construction stage in order to gain access for construction work. However, after the construction work is completed, all the fill material will be removed, and the low land will be restored to its original physical condition.

As mitigation measure, restoration program will be planned which will be a creation of wetland and green buffer at open area and surrounding of depot Restoration program will be developed during the detailed design stage and the budget of 20,000,000Rs will be secured for the restoration program. Also, off set of losing 89 trees along Denzil Kobbekaduwua Mawatha will be part of restoration program.

The restoration plan will include following concepts;

- Offset trees of 10 times of that is cut down by the project
- Enhancement of biodiversity through creation of various type of habitat such as wetland, forest zone and open area.
- Use the native species which will enhance the value of ecosystem in the area
- Creation of green buffer zone around the Depot by selection of tree species which grows high to mitigate the landscape impact

5.6.3 Mitigation Measures for Wetland Degradation

During the operational stage some sections will be subjected to increased shade due to the overhead structures. However, there still will be light penetration in to the wetland. This aspect will be taken into consideration when selecting plant species for restoration of the wetland during the post construction period.

Other than this, special mitigation measures are not required in the other sections of the LRT trace with respect to habitats and species. However, removal or pruning of trees will be kept to a minimum level during construction.

Wetland degradation in the form of water quality degradation will be mitigated by the introduction of the wastewater treatment plant and collection of scheduled waste for the “Ecocycle” process.

5.7 Mitigation Measures for utilities such as Water, Electricity and Communication

5.7.1 Disruption to Underground Utilities

Utility details such as wastewater sewer lines, have already been obtained from the relevant line agencies. Hence there is a rough idea about the utility relocation. However, the detailed information about these utilities (exact location and depth) has not been recorded well.

Therefore, working group for utility relocations will be appointed to address utilities relocation in advance of construction stage. During the construction, the Contractor will be directed by the Engineer to identify the utilities in more detail with the help of the area officers (e.g. Technical Officers) of the relevant line agencies. Immediate action will be taken during construction to provide the usual utility services such as electricity, water supply and telecommunication uninterrupted as much as possible.

Disturbance to water lines is a very common impact and such impact will be mitigated by the provision of water supply bypass lines to maintain an uninterrupted water supply. Suitable liaising arrangement with the line agencies such as, NWS&DB and SLT will be maintained with the support of the area offices and the PMU. Some agencies such as NWS&DB and CMC have provided the existing utility plan. Some of the available and presentable utility plans are given in **Annex G**.

The project requires temporary adjustments in the infrastructure facilities to proceed with its construction work as scheduled. The transmission lines, telecommunication and water supply lines may be temporarily closed and shifted as a result. Such activities would be carried out with the following mitigation measures.

1) Any change in the infrastructure facilities will be done with the co-ordination of the authorities responsible for the installation and maintenance of utilities.
2) Adoption of schedules for the shifting and temporary termination of infrastructure service supply and making the public aware of them in advance to prevent ad hoc activities and the resulting negative impact on people and the work force.
3) Making all the payments timely, as agreed upon at the beginning of the project to enhance the efficiency of shifting of infrastructure facilities. The delay of payment tends to prolong the period of restoring the disturbed infrastructure facilities and such disturbances will affect the day to day activities of the people. The Project Proponent being alive to such issues will avoid the delay of the completion of the shifting of infrastructure facilities.
4) The Project Proponent will assist the service provider to complete the shifting of such facilities and it will not allow any informal or unauthorized shifting of any infrastructure facility, which would be harmful to the work force and the people in the area.
5) Although utility plans are available there could be unexpected situations when the ground is opened. Such situations will be anticipated, and necessary advices will be obtained from other ongoing projects (e.g. Colombo sewerage project).

5.7.2 Disruption to Overhead Utilities

The common overheads utilities are telephone lines and electricity lines. The Project Proponent will liaise with CEB and SLT to make the necessary changes to utilities as outlined under Underground Utilities.

5.8 Mitigation Measures for Land Acquisition Impacts

5.8.1 Mitigation measures due to impacts on land acquisition and resettlement of people and / or relocation of structures/buildings etc. (if any)

The proposed LRT trace was planned to traverse along existing roads to minimize land acquisition. Further, the design alternatives also have been considered to avoid residential and commercial places. These are mitigation-by-design actions. However, the project would still need to acquire land, residential and commercial structures to a limited extent.

A Resettlement Action Plan (RAP) is ongoing to identify these affected places exactly and to carry out consultation with owners of these affected properties to decide on the compensation that will be provided. The RAP will provide guidance to relocate affected people with compensation and required support and assistance to reestablish the affected income and livelihood.

The Project Proponent has already taken cabinet approval for Land Acquisition and Resettlement Committee (LARC) system to be used to pay compensation for the affected parties. The relevant Gazette is attached in **Annex I.** The LAA system was abolished after introducing 2008 regulations for payment of compensation. However, the Ministry of Land reintroduced the LARC system to 18 projects through gazette notification no. 1837/47 dated 22nd of November 2013. LARC is used to compliment undervalued properties through a consultative process with the participation of affected persons at community level and at national level, if the concerned affected person is not satisfied with the decision at community level LARC, the person can appeal for Super LARC.

5.8.2 Mitigating impacts to Government Institutions and properties

The Project proponent will discuss with relevant government organizations and will provide necessary assistance to relocate the affected parties. The Project Proponent has already started discussions with relevant ministries in this regard.

5.8.3 Socio Economic Benefits During Operation

This is a positive impact for which mitigation measures are not necessary.

5.9 Mitigation Measures for Neighboring Land Users Related Impacts

5.9.1 Mitigation Measures for impact on neighboring land uses

No significant impact is expected since LRT route goes at the center of the existing road, while providing roadside buildings with adequate space for light and ventilation. Therefore, no mitigation measure is required.

5.10 Mitigation Measures for Impacts due to Solid Waste

5.10.1 Mitigation measure for erosion of excavated materials, spoil and other waste construction materials etc.

Following objects which consist of construction material will be subject to erosion;

1) Temporary non-compacted soil mounds formed from excavated earth of foundation trenches ready to be transported for pilot road construction in flood plains as it is prudent to use such material for the pilot roads on the flood plains which have a limited length.
2) Sand stockpiles used for concrete in the batching plant site

To mitigate the erosion impacts following mitigation measures will be adopted.

1) Loose earth will not be kept by the road side even within the construction site for a long time without transportation to the pilot road. If such soil is kept temporarily such soil mounds will be covered by a polythene sheet and weights will be placed on sides to avoid the cover getting off soil mound.
2) Sand stockpiles will be haunched and compacted slightly to avoid ready erosion from rain.
3) Temporary drainage provisions will be provided around the sand stockpiles.

As only excavations are limited to 6mx6m trenches for column foundations not much spoil will be generated. Such spoil after checking the suitability will be used for the pilot road construction on the flood plain.

Temporary storage areas will be identified prior to construction. Sensitive areas such the protected areas (e.g. Thalangama EPA, Sri Jawardenapura Bird Sanctuary, wetlands) will be avoided. Wastes will be segregated and disposed accordingly.

Building rubble, excavated soil, and construction wastes will be used for necessary pilot roads and temporary filling. Once construction is over, these will be disposed at the Waste Management Park development area at Kerawalapitiya, located approximately 15km north from the LRT route. The consent letter on the disposal of construction waste at the above disposal site is obtained from SLLRDC (See Annex B).

Recyclable materials (e.g. paper, glass) will be handed to registered recyclers. Non-hazardous waste (Non-Scheduled Waste) will be disposed to in accordance with relevant local regulations (e.g. disposal to designated disposal sites through the Local Authority). Wastes will be collected and disposed regularly to prevent accumulation, which may cause pollution and safety risks.

Scheduled wastes (e.g. oil) will be collected and carefully stored. Treatment and disposal of these wastes will be contracted out to a registered industrial waste company.

Any metal solid waste generated from construction activities will be handed over for recycling. Any other waste such as chemicals residues or any other Scheduled Waste will be handed over to the Lafrage Hocim Geocycle process for burning in the cement manufacturing plant Puttlam.

5.10.2 Mitigation measure for waste generated from Depot during the Operation Stage

During operational stage, lubricant oil, sludge, brake shoe, metal scraps and rubber tube will be generated as waste from the Depot. Metal scraps can be recycled. If available, these will be handed to a registered recycling company. On the other hand, hazardous wastes (e.g. lubricant oil, sludge) and other industrial wastes (e.g. rubber tube, brake shoe) will be collected and stored at designated area. Treatment and disposal of these wastes will be contracted out to a registered industrial waste company. With implementation of proper waste management practice, the likelihood of an accident such as spillage and leakage of wastes streams will be minimal. Currently, Ecocycle (waste management company) is identified as candidate company in charge of the disposal of these wastes. (See Annex B).

5.10.3 Mitigation measure for waste generated from Stations during the Operation Stage

Domestic solid waste will be generated from the stations and from the depot during the operational stage. Such solid waste will be separated to bins for bio degradable and non-degradable waste and such waste will be handed over to Colombo Municipal Council and relevant Pradesheeya Sabhas for disposal.

Any wastes generated will be collected according to the type of waste by registered waste contractor and treated through a registered waste disposal facility such as the “Ecocycle” facility in Puttlam Cement Factory. Recyclable waste will be handed over for recycling.

5.11 Mitigation Measures for Impacts on Surface and Groundwater Quality

5.11.1 Mitigation Measures for Surface Water Quality Degradation during Construction

There are possibilities of surface water quality degradation during the construction of piers for Diyawanna Lake crossing and the depot. Water turbidity and alkalinity could increase. This impact is temporary and limited to the construction stage. As Diyawanna Lake is a large waterbody the increase of alkalinity will not be significantly felt. Water quality in Diyawanna Lake near the construction site will be monitored to detect abnormal water quality changes.

5.11.2 Groundwater Quality Degradation during Construction

The potential impact on groundwater is very limited because alkaline substances will not dissolve in the water. Once built, the foundation structures will have negligible impact on groundwater quality. Hence no special mitigation measures are necessary. However, the groundwater monitoring will be conducted near the Depot area to confirm the potential contamination.

5.12 Mitigation measures due to impacts on culturally and Historically Important aspects during Construction

5.12.1 Mitigation measure for Bo trees and shrines

There are total 14 Bo trees (with and without shrine) along the LRT route. Careful consideration has been taken to avoid and minimize the impact on Bo trees since the initial stage of feasibility study. The route will be further adjusted to minimize the impact on Bo trees during detailed design stage.

In case trimming or cutting down of branches is required, religious rituals and communication with relevant stakeholders (Monks and devotees) will be carried out before the commencement of construction activities.

Access to religious and culturally important sites may be impaired temporarily. Therefore, a traffic management plan will be developed considering alternative access roads to religious and culturally important sites.

5.12.2 Mitigation measure for Archeological buildings

Based on the preliminary archaeological survey conducted by the Department of Archeology, there are two buildings along the trace that are potentially significant, but these are not designated as archeologically important. However, there are listed archeologically important buildings close to Lipton Circle (eg: Hospital Building).

The LRT route was designed to avoid the direct impact on these buildings. Also, “archeological effect evaluation application” was submitted to the Department of Archeology and further study may be conducted as per the guidance from the Department. Refer to **Annex B** for the submitted application form.

5.13 Mitigation Measures for Wastewater Impacts

5.13.1 Disposal of waste/waste water generated from workers camp (depot area) and Construction Site during Construction Stage

Since no workers camp is needed for the construction activity, there will be no domestic waste or sewage generated during this period. However, limited number of construction workers may live on the Depot site, therefore, adequate facilities will be provided, such as sanitary latrines.

In addition, at construction sites, cylindrical septic tank or temporary toilet**Error! Reference source not found.** Will be installed. Septage will be collected by authorized sewage waste management company.

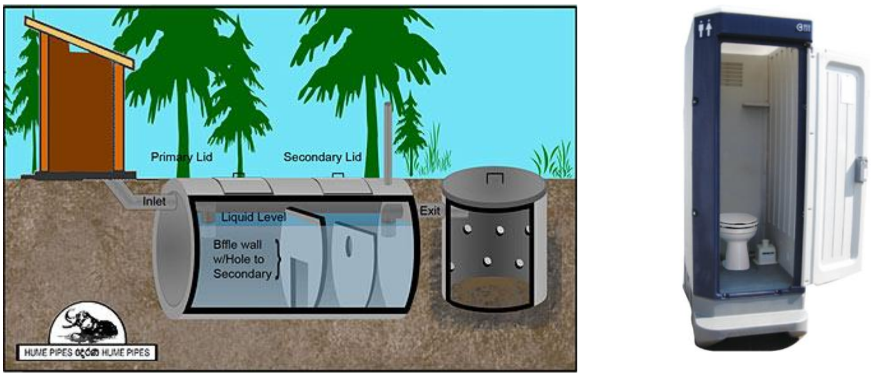


Figure 5.1 Example of Cylindrical Septic Tank (Left) and Temporary Toilet (Right)

5.13.2 Mitigation Measures for Spillage, Leak and Accidental Discharge of Fossil Oil Generated from Construction and operation stages

Construction Stage

The risk of spillage, leak and accidental discharge of fuels from construction equipment can be reduced and manage with proper spill prevention measures. Following mitigation measures will be implemented during construction stage.

1) Good use and maintenance of construction machines and heavy vehicles
2) Install oil and grease traps in the drainage system
3) Establish and implement emergency and contingency plan in case of spills

Operational Stage

LRT is an electrically operated transport mode and fossil fuel will not be used for train operation. However, fuel oil or lubricant oil will be stored and handled at Depot area. In order to prevent leakages/spillage, the following mitigation measures will be conducted:

1) Secondary containers will be placed in storage areas
2) Spill kits will be provided
3) Areas which have risks to spill/leakage will be provided with a drainage that is directed to the oil separator (particularly for the depot area)

5.13.3 Mitigation Measures for Disposal of Wastewater Generated from Depot (Terminal Buildings, Rolling Stocks, Maintenance, Washing, serving etc.) during the Operation

Wastewater from Depot

Wastewater from maintenance yard

Wastewater generated from maintenance yard for LRT system will be treated in series of wastewater treatment system to treat the wastewater to meet required standard It is expected that type of wastewater treatment system to be installed includes Holding tank, Oil Separator, Dissolved air floatation, dehydrator and filtration as shown in Figure 5.2. Treated wastewater will be discharged to the public sewage system.

Wastewater from administration building

In addition, wastewater will be generated from administration building, such as from toilet and kitchen. These wastewaters will be treated through Oil Separator as minimum treatment process, then discharged to the public sewage system as shown in Figure 5.2.

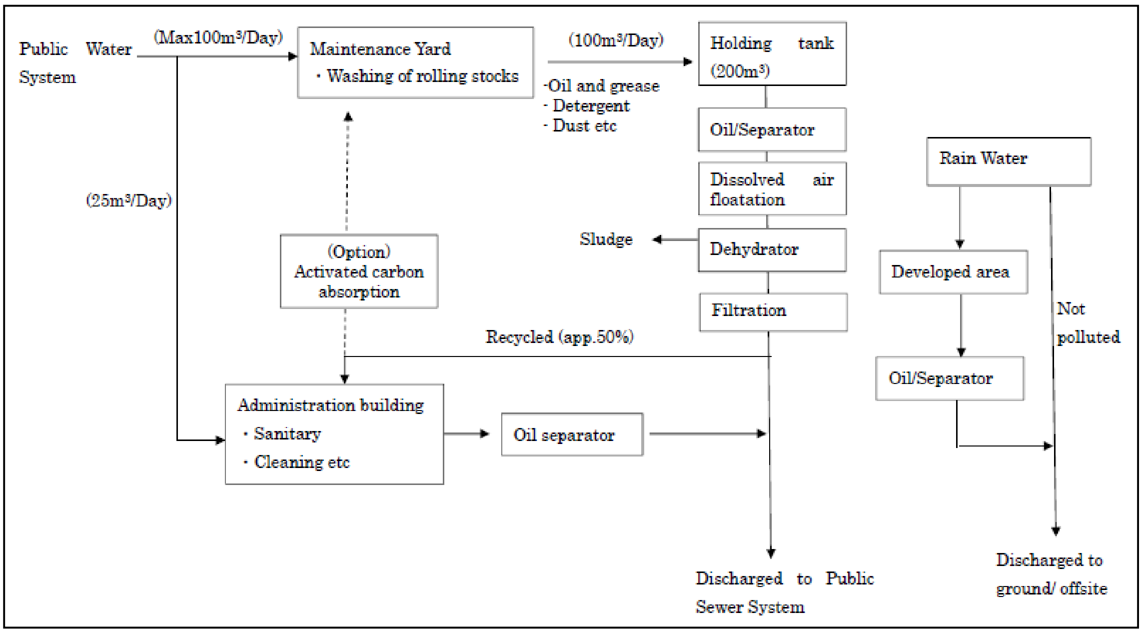


Figure 5.2 Proposed Wastewater Treatment System for Depot

It is intended that the treated wastewater from maintenance yard will be reused in administrative building as well as maintenance yard as reasonable as possible. The necessity of implementation of activated carbon absorption will be considered during the detailed design stage once the characteristic of wastewater quality as well as requirement of water quality for maintenance yard is confirmed.

It is noted that no public sewage system is currently developed around the proposed Depot location. However, there is a plan of the sewage system development around Si Jayawardanapura Kotte area. The study of this project has been conducted by National Water Supply and Drainage Board, supported by JICA. Under the current proposal, the public sewage system is planned to be extended up to the area of Koswatta Junction, which is approximately 3km from the proposed Depot area. The wastewater pipeline from the Depot will be connected to the proposed public sewage system. (See Annex B). The wastewater can be transported through the pipeline (diameter could be around 20cm) which would be hooked along the elevated structure and connected to their proposed treatment plant, located in Battaramulla. The consent letter from NWS&DB regarding to the acceptance of the wastewater generated from the LRT project has been obtained and attached in Annex B.

In case that the implementation of the proposed public sewage system is delayed, the following temporary mitigation measures will be implemented until the proposed sewage system is implemented.

1. Wastewater generated from the maintenance yard.

Mediwela canal is running west of proposed depot adjacent to the road, which connects Thalangama Tank and Kelani River. Total length of the canal is approximately 7km and proposed discharge point is located about half point. Main source of the water in the canal is Thalangama tanks. In case wastewater is discharged to Madiwela canal, the wastewater will be treated to the meet CEA standard (SCHEDULE 1, LIST1, General standards and criteria for the discharge of industrial effluents into inland surface waters).

2. Wastewater generated from the administrative building.

The wastewater from administrative building will be collected in Septic Tank, then the sewage will be collected by gully sucker by licensed contractor or local authority for final disposal.

5.13.4 Mitigation Measures for Disposal of Wastewater Generated from Stations during the Operational Stage

The wastewater generated from the station is sewage from the toilet facility. Sewage will be sent to public sewage system. The stations located within CMC area (6 stations) will be connected to the existing public sewage network system. For remaining stations, the sewage pipeline will be connected to the proposed public sewage system as described in above.

In case that the implementation of the proposed public sewage system is delayed, the sewage will be collected in Septic Tank which will be installed within the elevated station structure or underground under the station structure, then collected by gully sucker by licensed contractor or local authority for final disposal.

5.14 Mitigation Measures for Impacts on Water Courses

5.14.1 Mitigation Measures for Backwater at Lake Crossings during Construction and Operation

Construction Stage

1) Using a two-dimensional flood model with a possible tentative blocking arrangement for construction rigs within the Diyawanna Lake possible backwater from 100 year will be controlled to an insignificant level. The entire cross section of the lake across the LRT trace will not be blocked substantially for construction work. Blocking of the lake cross section will be done part by part.
2) Construction of the foundation of LRT structure within the lake will be strictly limited to dry season and critical monsoon periods such as April- June and September to November will be avoided using the rain forecasts from the Department of Meteorology and other international

weather information sources.

3) Temporary blocking of the lake section will be carried out according to the instructions of SLLRDC and the model will be re-run depending on the site-specific construction arrangements.

4) In case of a flood a suitable pumping arrangement will be made to speed up the flow through the blocked sections to minimize backwater and such pumps will be kept in reserve at the construction site.

5) If in the opinion of the Engineer that flooding is aggravated because of temporary construction blocks such blocks will be temporarily removed until the flood subsides.

Operational Stage

The model studies show that the backwater impact because of LRT piers is not significant and no mitigation measures are needed as the mitigation by design has been effected.

5.14.2 Mitigation for Pocket Flooding Locations

The contractor will be cautioned about the pocket flooding places. Drainage paths over the road will be kept undisturbed as far as possible. During construction if necessary temporary drainage paths will be created from the construction sites to the nearest drain. Construction equipment will be removed from site if inundation occurs.

5.14.3 Mitigation Measure for Backwater on Flood Plains

Mitigation Measures for Flood Aggravation in Depot Area

It was inferred that the flood impact will be around 6cm because of the temporary filling for the depot and the low-lying area from Chandrika Kumarathunga Mawatha to depot. The flood level rise for a construction stage flood of 10-year return period will be 12 cm. To mitigate the flood impact the following mitigation measures will be adopted.

<u>Depot Area</u>

1) Provide a 3m wide canal right round the fill area to reduce the net water level rise to 5cm and this result was confirmed through model studies conducted by SLLRDC.

2) The entire area demarcated for the depot will not be filled at once even temporarily. Filling and construction will be in parts. Once the construction of a part of the depot is over the temporary filling will be removed and temporary filling in another sub area could be started.

3) Height of fill will be controlled and water overtopping over the fill will be allowed.

4) It is also proposed to improve the existing drainage canals in the low-lying paddy by desilting them. The desilting of the drainage canals will be undertaken under the supervision of SLLRDC and Provincial Irrigation Department, Western Province.

5) Direct drainage connection will be established between these canals and main canal.

6) Culverts connecting paddy area and Madiwela canal are closed by gates and these gates are not

functional. During a flood, these culvert gates will be opened.

7) Existing drainages will not be blocked by temporary fillings.

8) The overall model will be refined adding the sub streams of the sub catchment on which the proposed depot will be constructed. Lower part (part occupied by the proposed depot) of this sub catchment will be modelled as a hydro dynamic model to represent the existing drainages and internal road culverts.

9) Filling will be breached at strategic locations in case of a flood if there is a backwater build up.

Pilot Road in the Low-Lying Areas Adjacent to Chandrika Bandaranayaka Kumaranathunga Mawatha

1) Height and width of the pilot road will be minimized to a height of 0.6m to allow floods of higher (greater than 10 years) return periods to overtop the pilot road.

2) Temporary culverts will be provided to all drainage paths and at places of the flood plain (where flow balancing is required) crossing the pilot road.

3) Filling will be breached at strategic locations in case of a flood if there is a backwater build up.

4) Pilot road will be again tested using the flood model of SLLRDC to represent site specific conditions accurately with openings.

Bridge crossing

In case of heavy floods, if necessary if there are coffer dam, they will be breached. Approval from SLLRDC will be obtained for the coffer dam

5.15 Mitigation Measures for Impacts on Air Quality

5.15.1 Air Quality Degradation During Construction Stage

Usually air quality could be impacted by dust as well as vehicular emissions. Several mitigation measures will require to be adopted during the construction phase to reduce dust generation. This includes the water spraying of surfaces which are prone to dust emission. It is also important to ensure that vehicles transporting construction material such as sand, metal and cement are covered adequately to reduce dust generation. The dust levels will be monitored periodically to ensure that the levels are not too high. To prevent adverse impacts on air quality from heavy vehicles these vehicles will be maintained in optimum condition always.

Dust-Wetting and water spraying of exposed surfaces to control dust. Soil compaction and timely debris removal. Cover exposed earth with gunny bags, black polythene etc. Covering of material transport vehicles. Limiting speed of construction vehicles to 10km/h. erect speed limiting sign boards. Careful stockpiling of cement and even spoil away from sensitive receptors (temples, schools etc.) and wind vulnerable areas. Road usage for material transport to be meticulous and will be free from spills from vehicles or tires. Assembling, dismantling of machines or other construction components will be carried out with minimum dust emission. Siting of crushing plans away from schools, temples etc. - upwind 500m and downwind 100m. Dust generation from crusher plants will be controlled by covering using wetted fabrics. Wetting the materials (e.g. aggregate) earmarked to be loaded, to avoid dust stir.

Emissions – Keep all vehicles and equipment in good service (with emission certificates). Siting cement mixing places and batching plants away from sensitive receptors and avoid operations during windy conditions. Provide quarry, batching plant and construction workers with dust masks and safety goggles. Wetting of quarry site before blasting without causing misfires.

Dust and emissions will be prevented, suppressed and contain exposure of workers, public or sensitive receptors. Prepare of a schedule for dust/emission generation activities and inform public in the environs regarding such activities.

Dust barriers will be installed near sensitive receptors or residential areas if the need arise. Site wetting will be continually carried out and dust monitoring will be an inherent activity of the Contractor's /Consultant's Environmental Officers.

5.15.2 Air Quality Improvement during Operational Stage

LRT will be electrically driven, and it is an emission free operation and the impact on emissions has already mitigated by the design itself. No further mitigation measures are warranted.

5.16 Mitigation Measures for Urbanization Impacts

5.16.1 Mitigation measures for impacts of increased urbanization

The LRT project will provide a positive impact, on resolving the issues which Colombo Urban Area has been undergoing, including spread of urban population, lack of high-quality public transport system and losing competitiveness in the region. No mitigation measure is required.

For the conversion of green areas and paddy fields to expansion of train station facilities and residential/commercial buildings, PMU will coordinate with relevant agencies regarding possible alternatives.

5.17 Mitigation Measures for Contingency Impacts

5.17.1 Mitigation Measures for Unexpected Events such as accidents, fire, natural hazards

Mitigation Measures Implemented

In order to address risks of unexpected events such as accidents and natural hazards, the following mitigation measures will be implemented.

1) Compliance with applicable performance specification, design standards and codes, health and safety regulations
2) Provision of firefighting system (firewater retention pond, fire hydrants, fire extinguishers) will be implemented as per applicable industrial standard
3) Development of an emergency response plan for both construction and operation phases.

Emergency Response Plan Policy

An emergency is an unplanned event when a project operation loses control, or could lose control, of a situation that may result in risks to human health, property, or the environment, either within the facility or in the local community. Emergencies do not normally include safe work practices for frequent upsets or events that are covered by occupational health and safety.

During the detailed design stage, PMU and EPC contractor will develop an emergency response plan for construction stage. During operational stage, O&M company will also prepare a specific emergency response plan for operational stage. The emergency response plan will be developed to address, as a minimum, the following categories:

- Fire due to extreme hot weather, equipment failure and accident
- Impact due to flooding
- Failure of rail component and structure/train accident

Emergency response plan will include following elements;

- Administration (policy, purpose, distribution, definitions, etc.)
- Organization of emergency areas (command centers, medical stations, etc.)
- Roles and responsibilities
- Communication and reporting systems
- Emergency response procedures
- Emergency resources

- Training and updating
- Checklists (role and action list and equipment checklist)
- Business Continuity and Contingency

Emergency Response Procedures

Emergency response procedure for each potential hazard will be prepared. A simplified set of emergency procedures for each potential hazard is presented below. There is a need to develop in situ specific response strategies once project details and corresponding hazards and risks have been identified.

1) Fire

- The Emergency Response Coordinator must be notified.
- Personnel in the immediate vicinity of the fire, including the designated Evacuation personnel must be immediately notified.
- All persons located in the area where fire is located must be evacuated. Evacuation must be carried out as per the Evacuation Procedure.
- All doors and windows of buildings and vehicles that are in the immediate vicinity of the fire must be closed.
- The fire must be contained with the correct extinguisher only by trained staff.
- Those requiring assistance must be assisted and first aid must be rendered only by trained staff.
- Those confined to an area where there is smoke, must move under the level of the smoke and cover their nose/mouth.

2) Flood

- Identify flood hazards of project components located in low-lying areas.
- The weather forecast in flood-prone areas must be constantly monitored, especially during the rainy season.
- All key equipment must be raised above (or away) expected flood levels.
- Construction of bund and water channels to divert flood water to safe areas.

3) Failure of rail component and structure/train accident

- Operational control center shall play important role in initial stage of emergency response. Following shall be included in the plan.
  - ✓ The general roles and responsibilities of key personnel during emergencies
  - ✓ The roles and responsibilities of the control centre in the incident notification,

  evaluation and documentation processes
  - ✓ The location of emergency plans and procedures
  - ✓ The policies for coordinating with incident command
- Procedure for notifying key parties of emergency situations and incidents must be developed. Following shall be included.
  - ✓ Guidelines on what information to obtain from employees, passengers or other individuals first reporting emergencies to the RTS
  - ✓ Guidelines for what people/departments are to be contacted at what stage of the process
  - ✓ Policy for reporting emergencies within the RTS
  - ✓ Guidelines for disseminating appropriate information to customers
  - ✓ Inter-agency policy for broadcasting system status information to the public
  - ✓ Instructions and policy for contacting outside agencies
  - ✓ Instructions and policy for media notification.
- Training for emergency response crew for the operation stage will be programmed. This would include training programs:
  - ✓ Evacuation of passengers from train, to a point of safety
  - ✓ Evacuation of passengers from stations (surface and underground)
  - ✓ Emergency procedures to be controlled from the Depot control center, including co-ordination of participating agencies such as fire service, police, ambulance, public works and utility companies, etc.
- Coordination with other agencies shall be arranged for emergency situation, including
  - ✓ Medical services
  - ✓ Building department
  - ✓ Fire department
  - ✓ Police department
  - ✓ Utility companies
  - ✓ Other transportation agencies

CHAPTER 6 Extended Cost and Benefit Analysis

6.1 Introduction

6.1.1 Background

This chapter presents the extended cost-benefit analysis (ECBA) of the proposed LRT Project. The purpose of the ECBA is to assess the economic viability of the project once the environmental and social costs and benefits reported in the EIA of the project had been incorporated into the analysis. The EIA of the project has identified environmental and social impacts that could lead to benefits and costs—i.e. positive or negative effects—to the economy. The ECBA is based on the principles of discounted cash flow analysis. The standard investment assessment criteria of net present value (NPV), cost-benefit ratio (CBR) and internal rates of return (IRR) were used as decision rules of the analysis.

6.1.2 Nature of the Investment and Economic Contribution of the Project

The project involves investments leading to establishment of new mode of transport currently not available in the multi-modal transport network in the Colombo Metropolitan Area. The necessity of LRT network has been identified in the Megapolis Transport Master Plan (MTMP) published in 2016 as a rapid transit system (RTS) to ease the peak hour traffic congestion and resultant passenger difficulties, especially in Central Business District (CBD) areas. The MTMP proposed a network of seven RTS routes (RTS1-RTS7) that connects CBD as well as suburban areas based on a comprehensive methodology that has taken major trip generation points, major trip attraction points and minimum spanning tree into consideration. The project involves substantial cost of capital investments on civil works for construction of the line including stations and depot area, cost of acquiring rolling stocks as well as operational costs of running the system.

The MTMP has carried out a detailed economic evaluation for the entire Plan based on output parameters of comprehensive demand forecast modelling exercise that covered the whole system of multi-modal transport network using a scenario based approach. However, the MTMP recommended undertaking detailed economic analysis in project feasibility studies to ascertain true economic value of each individual project implemented under it.

The proposed LRT line for Malabe traffic corridor from the Fort station to Depot station combines certain sections of RTS 1 and RTS 4 thereby connecting CBD with suburban areas. Out of seven major traffic corridors that enter the Colombo city, Malabe corridor has the largest volume of traffic and the lowest travel speed at peak hours which was estimated at 13.8 km/h. Shifting and expansion of government office complexes in Battaramulla, Malabe and Akuregoda areas are further increasing the demand for transport facilities in this corridor at a rapid rate. Currently, there is no rail-based public transport connection available for this traffic corridor.

The LRT Project opens a new mode of transport for passengers in this corridor in an elevated track that can operate on regular basis without being obstructed by traffic conditions in the existing road transport facilities. It will increase the capacity of total transit system while simultaneously reducing the burden of overloading the existing transit facilities by attracting passengers especially from modes of private transport such as cars, motorcycles and three wheelers. Hence, the project offers a modal choice for passengers with faster connectivity, low travel time, increased safety and comfort to their destinations.

The LRT was selected as a mode of environmental sustainable transport, one of the four major principles considered in the preparation of WRMTMP. The LRT is an electric-powered system with no or minimum emissions during its operations. Simultaneously, reduced use of emissionintensive private transport modes and decreased traffic congestions can be expected to generate further reductions in emissions that can be considered as a major environmental benefit of the project.

6.2 Methodology of the ECBA

This section describes the general methodology adopted in undertaking the ECBA. It discusses data sources used, key steps of evaluation, standards and assumptions and decision criteria used for evaluation.

6.2.1 Data Sources of ECBA

The key data sources used for the ECBA are draft final report of the Feasibility Study[1] prepared by the expert team of Oriental Consultants Global Co., Japan, draft final report of EIA Study[1] and Resettlement Action Plan (RAP)[2] prepared by the Consulting Engineers and Architects Associated (Pvt) Ltd., Sri Lanka. The feasibility study team has undertaken an economic evaluation of the project using output parameters of the demand forecast modelling study and other relevant economic data from secondary sources. Even though this evaluation has not considered all environmental and social impacts identified in the EIA, the experts have also estimated emission reduction benefits of the project. The EIA and RAP studies have identified environmental and social impacts of the project during construction and implementation phases. The ECBA is mainly based on information from these study reports. In addition, key members of expert teams were consulted time-to-time for clarifications and further information.

6.2.2 Key Steps

Key steps of the ECBA of KHRP included the following steps:

- Extracting the required base data on project costs and benefits from the demand forecast analysis and the feasibility study
- Identifying environmental social impacts reported from the current EIA and SIA and determining whether they represent cost (negative impacts) or benefits (positive impacts)
- Acquiring required information on economically measurable impacts (costs and benefits) from experts of EIA and SIA teams and evaluating costs and benefits of environmental and social impacts using appropriate methods
- Carrying out ECBA, incorporating extended cost and benefits identified in EIA and SIA to estimate standard project evaluation parameters —i.e. NPV, CBR and IRR
- Undertaking sensitivity analysis of CBA taking alternative scenarios of benefits and costs in to consideration

6.3 Standards and Assumptions used in ECBA

The list of assumptions and standards adopted in the ECBA is given in the Table 6.1.

Table 6.1 Major Assumptions and Standards for ECBA

Parameter	Standard/Assumption	Remarks
Discount rate	12%	This is the standard rate used in CBA of the project feasibility study and ECBA of many similar projects and is based on the historical movement of the interest rates in the country.
Evaluation period	2018-2024 for construction and 30 years (2025-2054) for operations	Cost estimates for the construction were available for given number of years and consistent with the usual standards applied for similar projects.
Price year	2017 constant prices	This is a new trace and EIA for it will be completed in early 2018
Prices	Shadow prices were used.	Standard practice adopted in economic analysis. Shadow conversion factors used in the CBA of the project feasibility study were applied
Numeraire currency	LKR	Standard used in the CBA and ECBA of previous traces
Treatment of inflation	Constant prices excluding inflation was used	Standard practice adopted in economic analysis

6.4 Decision Criteria

The three decision criteria considered in the ECBA are:

- Net Present Value (NPV)
- Benefit Cost Ratio (BCR)
- Internal Rate of Return (IRR)

6.4.1 Net Present Value

The Net Present Value (NPV) measures the actual or real net economic benefit of the project. The NPV is calculated by subtracting the discounted costs from the discounted benefits. All projects with a positive NPV provide a net economic benefit and are economically justified. The NPV should be used when comparing mutually exclusive project options. The option with the highest NPV is the economically preferred option.

The formula applied for calculating NPV is as follows:

$$NPV = \sum_{i=1}^{n} \frac{(B_i - C_i)}{(1+r)^i}$$

Wherein,

B= Net annual benefits

C = Net annual costs

r = discount rate

6.4.2 Benefit Cost Ratio (BCR)

The Benefit Cost Ratio (BCR) is the ratio of the present value of benefits to the present value of costs and measures the relative net gain of the proposed expenditure. The BCR will be greater than 1 whenever discounted benefits exceed discounted costs. A project with a BCR above 1, provides a net economic gain and is therefore it is economically justified. In a budget constrained environment, projects should be prioritized according to their BCRs. The project with the higher BCR is expected to provide the greatest benefit per dollar invested and hence it should receive priority in the allocation of funding. This will ensure the efficient allocation of scarce resources.

The formula applied for computing BCR is as follows:

$$BCR = \sum_{i=1}^{n} \frac{B_i}{(1+r)^i} \Big/ \sum_{i=1}^{n} \frac{C_i}{(1+r)^i}$$

6.4.3 Internal Rate of Return (IRR)

Internal Rate of Return (IRR) is the discount rate at which the present value of benefits equals the present value of costs (where NPV equals zero). It measures the rate of return of benefits to costs. If the IRR is greater than the interest rate that would otherwise be the rate of return for the funds invested in the project concerned and it is considered as a sound investment.

6.5 Costs of the Project

6.5.1 Construction and Operational Costs of the Project

In the feasibility study, major components of the project costs and benefits have been identified and estimated. The project cost estimates were prepared according to the final trace and engineering design of the project. Key project benefits were estimated using information generated in demand forecast study and other secondary information.

Preliminary cost estimates of the project have been prepared in the feasibility study. Cost items have been identified under the following major categories:

- **Cost of construction:** This includes all estimated capital cost items of construction phase of the LRT project including pre-construction costs. Pre-construction costs include cost of feasibility, detailed design and land acquisition. Engineering construction and project management costs are to be expended within the first eight years (2017-2024) of the project life and the LRT will be commissioned in 2025.
- **Operating costs and replacement costs:** Operating costs of LRT system were estimated for a period of 30 years after commissioning of the LRT line from 2025 to 2054. Estimates cover costs concerning operation of train services and maintenance and rehabilitation of the line for the period concerned. Details about construction and operational costs are given in the Tables 6.2 and 6.3.
- **Replacement costs:** Costs of replacement identified for every five year after commencing operations. The cumulative total for the 30 years was estimated at 83.7 billion LKR.

The original estimates of the project costs were financial estimates and they were converted to economic costs by using standard conversion factor that has been calculated as 0.92 by the feasibility study team.

Table 6.2 Costs of Operation and Maintenance Activities

Description		Cost (million LKR)	
		2025	2035
Human Cost		953.94	953.94
Outsourcing & Parts Cost	Operation	637.21	955.82
	Maintenance of Rolling stocks	404.52	606.78
	Maintenance of Infrastructure & Tracks	415.92	415.92
	Maintenance of Electrical Equipment	499.11	499.11
Power Cost		573.64	860.46
Admission cost		95.40	95.40
Total		3,579.74	4,387.42

Source: JICA Study Team

Table 6.3 Costs of Pre-construction and Construction Activities

Item		Total Value of Foreign Currency component	Local currency	Total financial Cost	Total Economic Cost
		(million LKR)	(million LKR)	(million LKR)	(million LKR)
ELIGIBLE PORTION					
Procurement/Construction		144,591	111,894	256,485	212,449
	Base Cost	124,123	88,573	21,2697	195,681
	Price Escalation	11,338	14,223	25,562	0
	Physical Contingency	9,129	9097	18,226	16,768
Consulting Services		17,361	5,321	22,682	19,158
	Base Cost	15,314	4,429	19,743	18,164
	Price Escalation	1,221	639	1,859	0
	Physical Contingency	827	253	1,080	994
Total (I+II)		161,953	117,215	279,167	231,607
NON ELIGIBLE PORTION					
a	Land Acquisition	0	5,929	5,929	190
B	Administration Cost	0	14,255	14,255	13,115
C	VAT	0	42,764	42,764	0
Total (a+b+c+d)		0	62949	62949	18,507
TOTAL (A+B)		161,953	180,164	342,116	250,177
Interests during Construction		1,530	0	1,531	0
Front End Fee		562	0	561	0
GRAND TOTAL (A+B+C+D)		164,045	180,164	344,208	250,177

Source: JICA Study Team

6.5.2 Environmental and Social Costs of the Project

Besides the above-mentioned project related costs, the EIA study has identified a number of negative environmental and socio-economic impacts that can be considered as environmental costs of the projects. The summary of these environmental and socio-economic impacts are given Table 6.4. These include impacts during the construction stage and operation stage of the project.

Majority of impacts are connected to construction phase and therefore they can be considered as temporary. Impacts relating to noise, vibration, water quality and safety are likely to persist during the operation phase. Also, the Project requires removal of some number of trees along the Denzil Kobbekaduwa Road (Palan Thuna Junction area). Details given in the EIA study report suggest that the impacts identified are scattered and can largely be managed using appropriate mitigation and monitoring measures.

Some significant impacts will be caused by the construction of and operation at the depot area. The proposed depot is located in a flood prone area and therefore it has been designed as elevated structure supported by pillars. This can disturb the wetland environment in the depot area. Significant amount of waste generated in the depot during operation stage has to be managed to avoid pollution of water sources.

On the other hand, some environmental conditions are likely to be improved due to the Project after construction phase. An example is improvement of air quality due to reduction of emissions from vehicles. (Economic benefits of emission reductions are discussed in Section on 'Environmental Benefits of the Project').

Given the scattered nature of impacts, limited availability of data and time constraints, estimation of the value of these environmental costs was not practical. However, the EIA team has identified mitigation measures to minimize all these impacts. These mitigation measures have been taken into consideration in the preparation of the project costs. Experts of project feasibility team confirmed that number of mitigation measures have already been included in the project costs as shown in the final column of Table 6..

They can be considered as proxy values of environmental costs of the project estimated through 'preventive expenditure' approach. For instance project cost covers the cost of installing the wastewater treatment plant of LKR 68 million.

The RAP has identified quantitative details of certain socio-economic impacts together with compensation schemes and income restoration measures. A summary of the impacts identified in RAP is given in Annex P Table 3.

Table 6.4 Environmental and Socio-economic Impacts of the Project

Area of Impact	Stage	Key impacts	Cost of mitigation
Environmental Impacts			
Traffic	construction	Traffic congestion	Included in EPC Contractor's service fee
Noise	construction	Noise pollution	Included in EPC Contractor's service fee
	Implementation	Noise pollution from the operation of LRT	To be included in the project cost at the detailed design stage
Vibration	construction	Damage to adjacent buildings	Included in EPC Contractor's service fee
	Implementation	Vibration impact from the operation of LRT	Included in the project cost
Air quality	construction	Dust and emissions	Included in EPC Contractor's service fee
Water course	construction	Bridge crossing and impacts on flood plains	Included in EPC Contractor's service fee
Water and soil quality	construction	Soil erosion, improper discharge of sewage from depots and sites and discharge of oil from vehicles	Included in EPC Contractor's service fee
	Implementation	Spillage, leakage and accidental leakage	Included in the project cost
		Waste water from depots	To be included in the project cost at the detailed design stage
		Waste water from stations	Included in the project cost
Solid waste	construction	Nuisance to pedestrians and road users	Included in EPC Contractor's service fee
	Implementation	Waste from depots	Included in the project cost
		Waste from stations	Included in the project cost
Flora and Fauna	construction	Removal of trees and trimming of branches	Included in EPC Contractor's service fee
		Loss of green area (appox. 1 ha)	20 million
Landscape	construction	Impact on aesthetic view of sensitive areas	To be included in the project cost at the detailed design stage
Socio-economic impacts			
land	construction	Land acquisition and resettlement	Included in the project cost
Livelihood	construction	Disturbances to livelihood and economic Activities	Included in the project cost
	Implementation	Disturbances to livelihood and economic Activities	
Safety	construction	Occupational Health and safety	Included in EPC Contractor's service fee
	Implementation	Occupational Health and safety	Included in the project cost
Religious & culture	construction	Impacts on religious & Culturally important locations	Included in EPC Contractor's service fee
Government properties	construction	Impacts on Government properties	Management cost
Utilities	construction	Disturbances to utility supply lines	Included in the project cost

6.6 Benefits of the Project

The project generates both transport and environmental benefits to the national economy. The LRT project being a transport sector project, transport benefits can naturally be considered as the most important category of the benefits.

6.6.1 Transport-related Benefits of the Project

In the Project Feasibility Study, the following transport system benefits have been identified as the key benefits of the project.

- Vehicle operation cost savings
- Travel time cost savings
- Savings of accident costs

(1) Vehicle Operations Cost Savings

Vehicle operating costs (VOC) are the costs associated with the running of a motor vehicle such as fuel, oil, tires, repair and maintenance and depreciation costs. Smooth vehicle running conditions created due to operation of LRT against the base case situation of the existing road network can be expected generate VOC savings as main economic benefit. General formula for estimating Vehicle Operating Cost Savings can be given as follows.

$$VOC\ savings\ = Total\ VKT\ by\ vehicle\ class\ \times\ \Delta\ unit\ OC\ per\ vehicle\ km\ by\ vehicle\ class$$

Wherein,
VKT = Vehicle km travelled
Δ Unit OC = Difference in unit operating cost between base case and LRT

The unit vehicle operating costs (VOC) were derived based on 'Assessing Public Investment in the Transport Sector 2001' by the Department of National Planning, Ministry of Finance and Planning, Sri Lanka. The price was converted to 2017 price based on the Colombo Consumer Price Index (CPI) of the transport sector. Unit vehicle operating cost estimated by the representative vehicles and operating speed in 2017 prices is shown in Annex P Table 6.

(2) Travel Time Savings

Savings in travel time is a primary economic benefit sought from many transport sector projects. These savings are enjoyed by passengers as well as freight consignees. A main benefit predicted by traffic demand models for users of LRT is travel time savings. The general formula used for estimating travel time savings is as follows.

$$TT\ savings\ = \Delta\ VHT\ by\ vehicle\ class\ \times\ \ VT\ per\ vehicle\ hour\ by\ vehicle\ class$$

ΔVHT = Difference in vehicle hours travelled between the base case and KHRP
VT = Value of time per vehicle hour by vehicle class

Hourly travel time value of passengers was estimated for three income groups based on the results of the Home Visit Survey (HVS 2013) conducted in 2013 by the CoMTrans Project and the

Household Income and Expenditure Survey 2012 (HIES 2012) by the Department of Census and Statistics. Income categories were identified by the HVS considering vehicle ownership and mode choice characteristics. The mean household income was estimated by the HIES 2012. It is assumed that the future value of time by income class is consistent throughout the analysis period. The following table presents the time value of workers average trip for three income categories in 2017 prices.

Table 6.5 Hourly Value of Time by Income Group

Income Level (LKR)	Mean Household Monthly Income	Avg. No. of Workers in household	Time Value of Work Trip (LKR/h)	Work Trip Ratio	Avg. Time Value (LKR/h)
>80,000	231076	1.9	1129	23%	572
40,000-79,999	70516	1.72	381	16%	169
<40,000	29802	1.2	231	15%	100
All	87343	1.36	596	16%	265

(3) Savings of Accident Costs

Compared with situation of the existing road network (base case), reduced number of accidents is another advantage of the LRT. This results in the economic benefit of accident cost savings. The accident loss was estimated by the method proposed in 'Assessing Public Investment in the Transport Sector 2001' by the Ministry of Finance and Planning. Assumptions on the accident loss estimation are shown in Annex P Table 7. The unit accident cost per vehicle-kilometre in 1999 was converted to the 2017 value. It is assumed that traffic accidents will decline 4% every year.

6.6.2 Environmental Benefits of the Project

The major environmental benefit that can be expected from the LRT project is reduction of emissions due to modal shift from private vehicles to LRT and low traffic congestion. This could lead to improved public health and climate change mitigation due to reduction of GHG emissions.

(1) Reduction of CO_2 Emissions

For the analysis, assessment year was set at 2035 to evaluate the potential GHG emission reduction, covering both construction and operation phases. Project activities considered in the analysis and the corresponding quantification methods employed are summarized in Table 6.6

Table 6.6 Analysis Scope and Quantification Methods

Project Phase	Activities	Quantification Method
Construction	Carbon loss from disturbance on grassland by construction of depot area	Estimated by multiplying total biomass (including above- and belowground biomass in Depot construction site) and carbon fraction value to convert dry matter to carbon
Operation	Decrease of fossil fuel consumption by modal shift of passenger from existing transportation modes (e.g. buses, private car, taxi, motorbike) to LRT (Light Rail Transit)	Determined as the difference between the GHG emission of baseline activity (existing mode of transportation, e.g. buses, private car, taxi, motorbike) and project activity (e.g. LRT.).
	Increase of electricity consumption in the operation of LRT	Estimated by multiplying annual electricity consumption associated with the operation of the LRT and CO_2 emission factor of the grid electricity.

Source: JICA Study Team

Parameters considered, and conversion factors used for the analysis are summarized in Annex P Tables 2, 4 and 5. Results indicate that during construction phase, carbon loss from disturbance on grassland by depot construction is estimated to be 436.8 t-CO2e. On the other hand, during operation phase, CO2 reduction in year 2035 is estimated to be 77,184 t-CO2e/y. In order to convert the estimated GHG emission data into monetary value, carbon emission reduction credit value under the Clean Development Mechanism (CDM) has been adopted. As of October 20, 2018, the credit value is 0.19 Euro/t -CO2e. Therefore, the Project will incur cost of approximately 83EUR (approximately LKR 14,850[1]) due to GHG emission during construction; and will yield savings (positive) equivalent to approximately 14,665 EUR (approximately LKR Million 2.768) in 2035 due to GHG emission reduction. These values were incorporated in the Project's Cost and Benefit Analysis.

6.6.3 Summary of Project Benefits

According to the above estimates, the LRT project can be expected to generate LKR Billion 3,920.51 of total undiscounted benefits over 30 years period (Table 6.7) The highest share of benefits is due to travel time savings which amounts to 67% of the total benefits. The lowest share of benefits is due to reduction of emissions.

Table 6.7 Summary of Benefits of the LRT Project

Benefits	Total undiscounted value for the project evaluation period (LKR Billion)
Travel time savings	2,617.1
Vehicle operating cost savings	1,290.4
Saving of accident costs	12.9
Emission reduction benefits	0.1136
Total	3,920.51

6.6.4 Other Unquantified Benefits

In addition, following benefits can be expected due to establishment of LRT. However, they were not included in the cost benefit analysis due to lack of data for making reliable estimates.

Table 6.8 Unquantified Benefits Expected from the Project

Benefits	Remarks
Benefits during construction period	
Employment (direct + indirect) Direct Indirect	LRT project is a large scale construction project and during the construction period it is expected that a significant number of employment opportunities (direct + indirect) will be created.
Benefits after implementation of the project	
Real estate market value gains	It is expected that commissioning of LRT will bring in an upward push to real estate prices located along the route and surrounding areas.
Employment benefits Direct Indirect	LRT will generate additional employment opportunities after commissioning of the road for management and maintenance of the system

6.7 Calculation of Benefit Cost Ratios (BCR), NPV, and IRR

BCR, ENPV and EIRR were calculated applying the assumptions mentioned in Table 6.1. The Discount Rate used in the analysis was 12%. As in the usual case of large-scale infrastructure projects, capital investment of the LRT project is high at the initial stage (construction period 2017-2024). Thereafter, the project starts generating transport and environmental benefits to the national economy. The estimated BCR, ENPV and EIRR values are given in Table 6.9.

Table 6.9 ECBA Results

Decision Criteria	
BCR	**2.15**
ENPV (Billion LKR)	**169.0**
EIRR (%)	**20.2 %**

Note: E-Denotes "Environmental"

Estimated ENPV was 169.0 billion LKR. The values of EIRR and BCR were 20.2% and 2.15, respectively. Since the project records a positive ENPV together with EIRR exceeding the discount rate of 12% and BCR over 1, the project can be identified as an economically viable project.

6.7.1 Sensitivity Testing

A sensitivity testing was carried out under three adverse scenarios.

- Scenario 1: Benefits are reduced by 10%
- Scenario 2: Costs are increased by 10%
- Scenario 3: Costs are increased by 10% and benefits are reduced by 10%

The estimated BCR, ENPV and EIRR values are given in Table 6.10. It indicates economic feasibility under selected scenarios thereby confirming the resilience of the project under adverse economic conditions.

Table 6.10 Sensitivity Analysis Results

Parameter	**Base Case**	**Benefit -10%**	**Cost +10%**	**Benefit -10% Cost +10%**
EIRR	20.2%	18.9%	19.1%	17.8%
ENPV (Billion LKR)	169.0	137.4	154.3	122.7
BCR	2.15	1.93	1.95	1.75

6.8 Conclusion

The results of the ECBA (refer to Table 6.9 and Table 6.10) show the ENPV, EIRR and BCR values of the project under the base case and three selected adverse scenarios. It indicates that even under the worst scenario of 10 % cost escalation plus 10% benefit reductions; the BCR values are greater than 1.75. The EIRR value (17.8%) is higher than the discount rate and the project reports a positive ENPV of LKR Billion 122.7. Therefore, the proposed LRT project in Colombo can be considered as an economically viable project that can be recommended for implementation.

CHAPTER 7 Environmental Management and Monitoring Plan

7.1 General

The Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP) (EMMP) are developed to avoid and/or minimize the adverse impacts to the physical, biological and social environments during construction and operational stages of the project. The EMMP presented in Annex Q has been prepared taking into account the adverse impacts and the proposed respective mitigation measures to minimize such impacts.

The EMMP will form part of the respective bid documents and it will be a part and parcel of the contract after contract award. The implementation of the EMMP will be the responsibility of the contractor/s and the executing agency (The Project Proponent) through the PMU will oversee the effectiveness of the implementation of the EMMP in collaboration with other agencies.

7.2 Institutional Responsibilities

The Environmental Monitoring Plan will be executed under the following institutional arrangement.

The implementation of mitigation actions lies with the EPC contractor during construction stage and the O&M Company during operational stage under the supervision of the Project Proponent, the Ministry of Megapolis and Western Development (MMWD)

The main responsibility for monitoring the project activities will lie with the Project Proponent (MMWD) assisted by the Project Management Unit (PMU) of LRT Project, under the appointed “Engineer” – Resident Engineer (or Resident Project Manager) and the Environmental Manager working under the above setup. The PMU will facilitate the contractors in carrying out the required work.

An Inter-Agency Committee comprising the following line agencies will be appointed for the monitoring of project activities. This may include the following – Urban Development Authority (UDA), Colombo Municipal Council (CMC), Kotte Municipal Council, Kaduwela Municipal Council, Central Environmental Authority(CEA), Divisional Secretaries (DSs) of the 4 DS Divisions (Colombo, Thimbirigasyaya, Kotte and Kaduwela), National Water Supply and Drainage Board (NWS&DB), Ceylon Electricity Board (CEB), Sri Lanka Telecom(SLT), Sri Lanka Railway (SLR), Sri Lanka Land Reclamation and Development Corporation and Department of Agrarian Development.

7.3 Contractual Requirements

The EMP and EMoP will be included in the Bid Documents, as part of the Project Requirements. The Bidders will be advised to carefully consider the EMP and EMoP requirements when preparing the bid and pricing the items of work.

In case, the Contractor or his Sub Contractors fails to implement the said requirements after informing in writing, the PMU will take whatever actions it is deemed necessary to ensure that the EMP is properly implemented. If the Contractor/Sub-contractor still fails to comply with these requirements, the PMU may levy a penalty based on the level of non-compliance, cost incurred to rectify the damages caused by such negligence and/or recover the cost from Contractor's payments.

7.4 Refinement of the EMMP

The EMMP will be further refined after the contract award based on the "Method Statement" of the Contractor, while considering the specific contract execution methods and the results of the Detailed Design.

7.5 Reporting Procedure

During the construction stage, the Contractor is responsible to report the progress of Environmental Compliance to the MMWD (PMU) on monthly basis and MMWD (PMU) will submit progress report on Environmental Compliance to JICA and CEA on quarterly basis.

During the operational stage, O&M Company is responsible to report the progress of Environmental Compliance and will submit progress report on Environmental Compliance to JICA and CEA on twice a year.

7.6 Environmental Management Plan and Environment Monitoring Plan

The EMMP consists of two parts the Environmental Management Plan and the Environmental Monitoring Plan. The Management Plan for pre-construction /construction stage and operation stage are shown in Annex Q – Table 1 and Annex Q – Table 2 respectively. The Monitoring Plan for pre-construction /contraction stage and operation stage are shown in Annex Q – Table 3 and Annex Q – Table 4 respectively.

CHAPTER 8 Conclusion and Recommendations

8.1 Conclusion

The Environmental Impact Assessment for the proposed project has revealed that the potential impacts of the project take place mainly during the construction phase, and that the possible environmental impacts during the operational stage is minimal. However, there are landscape impacts due to the presence of LRT system such as on ceremonial access to Parliament (from Rajagiriya to Diyatha), Diyatha Uyana area and Depot Malabe.

The number of houses and commercial establishments to be relocated due to the proposed project is relatively low, since a major portion of the LRT route traverses in the middle of the already existing road network. Such building demolition is mainly needed in the bends of the LRT at road intersections. Most of the affected structures are commercial in nature and livelihood of owners, tenants and employees in those structures will be affected.

On the other hand, the LRT project could have positive impacts on ambient air quality due to the reduction in the number of vehicles on the road. The LRT is a low-emission solution by itself compared to even a usual fossil fuel driven train. The environmental impact of the LRT during the operational period will be minimal except for the noise and vibration which too could be mitigated.

The Extended Cost Benefit Analysis of the project indicated that the proposed LRT project for Malabe traffic corridor can be considered as an economically viable project suitable for implementation.

It could be concluded that the project will have some mitigable impacts during construction and mitigable low impacts during the operational stage.

8.2 Recommendations

It is recommended that the proposed LRT project from Colombo Fort to Malabe is implemented as a solution to the traffic congestion of Borella Malabe corridor, to provide passengers with a safe comfortable quick mode of transport, which has the added benefit of being environmentally friendly.

The EIA report’s mitigation measures and EMMP will be made part and parcel of the tender documents for the construction work and in turn of the construction contract. The responsibility of environmental impact mitigation will be borne by the Project Proponent while the implementation of such mitigation measures will be carried by the Contractor (through contractual arrangements) under the supervision of PMU and CEA’s monitoring mechanisms.

LIST OF REFERANCES

Chapter 1

[1] Colombo Metropolitan Area is defined as area covered by the following Municipal Councils: Colombo, Thimbirigasyaya, Sri Jayawardenapura Kotte, Kaduwela, Dehiwala-Mount Lavinia and Moratuwa, and surrounding suburbs.

Chapter 3

[1] Wijesundara S. (2010) Invasive Alien Flora of Sri Lanka. In Invasive Alien Species - Strengthening Capacity to Control Introduction and Spread in Sri Lanka. Marambe, B., Silva, P., Wijesundara, S., and Atapattu N. (eds.) Biodiversity Secretariat of the Ministry of Environment. Sri Lanka.

[2] Conservation Status of a sanctuary: A sanctuary is declared to ensure the protection of wildlife in private lands which are outside the state claim. Therefore sanctuaries may include private lands and permits are not required to enter) According to the IUCN system of classifying protected areas, a Sanctuary is a Category VI protected area.

[3] An Environmental Protection Area [EPA], is declared to regulate activities in private lands which are outside the state claim where the enforcing agency, the Central Environmental Authority shall exercise, perform and discharge any powers, duties, functions related to planning and development, within such protection areas.

Chapter 4

[1] Investigation on characteristics of noise generated by pilling activity, K.M. Lisan (ICSBE 2016)

[2] California Department of Transportation 2013, Transportation and Construction Vibration Guidance Manual, Sacramento, CA, p. 17. Referring to: Hendriks, R 2002. *Transportation related earthborne vibration (Caltrans experience)*. California Department of Transportation. Sacramento, CA.

[3] This vibration level is set at a higher value compared to 81dB, in order to take a conservative approach in the calculations.

[4] Conversion was calculated by using the acceleration of vibration [$L=20\log(a/a_o)$] (unit in dB), converting this into velocity [$V=(GA)/(2\pi F)$] (unit in mm/s), and correcting the value by multiplying RMS (root mean square) for waveforms.

[5] California Department of Transportation 2013, Transportation and Construction Vibration Guidance Manual, Sacramento, CA, p. 17. Referring to: Hendriks, R 2002. *Transportation related earthborne vibration (Caltrans experience)*. California Department of Transportation. Sacramento, CA.

Chapter 6

[1] *Preparatory Study on the Project for Establishment of New Rail Transit System in Colombo* submitted for approval of the JICA
[2] *Environmental Impact Assessment for Colombo Light Rail Transit (LRT) Project* prepared for submission of CEA.
[3] *Resettlement Action Plan for Colombo Light Rail Transit (LRT) Project* (unpublished)

[4] Conversion rate for Euro to Sri Lankan Rupee is 178.89, according to the Central Bank of Sri Lanka (as of 1 December 2017).

MCA	Multi Criteria Analysis
MOT	Ministry of Transport
MRT	Mass Rapid Transit
MmTH	Multimodal Transport Hub
MMWD	Ministry of Megapolis and Western Development
MSL	Mean Sea Level
MW	Mawatha
NEA	National Environmental Act
NO_2	Nitrogen Dioxide
NPV	Net Present Value
NSW EPA	New South Wales - Environmental Protection Agency
NT	Near Threatened
NWSDB	National Water Supply and Drainage Board
O&M	Operation and Maintenance
OCC	Operation Control Centre
ODA	Official Development Assistance
O/L	Ordinary Level
PAA	Project Approving Agencies
PAP	Project Affected People
P&R	Park and Ride
PC	Pre-stressed Concrete
PHC	Pre-Tensioned Spun High Strength Concrete
PIWQS	Proposed Inland Water Quality Standards
PM10	Particulate Matter (10 micrometers or less in diameter)
PMU	Project Management Unit
PSD	Platform Screen Door
PP	Project Proponent
PPE	Personal Protective Equipment
PPHPD	Passenger Per Hour, Per Direction
PPP	Public-Private Partnership
RAP	Resettlement Action Plan
RBL	Rating background level
RC	Reinforced Concrete
RDA	Road Development Authority

ROW	Right of Way
RRI	Route Relay Interlocking System
RSS	Receiving Substation
RTS	Rapid Transit System
RTU	Remote Terminal Unit
SJKMC	Sri Jayawardhanapura Kotte Municipal Council
SLLRDC	Sri Lanka Land Reclamation and Development Corporation
SLR	Sri Lanka Railway
SLS	Sri Lankan Standard
SLT	Sri Lanka Telecom
SO2	Sulphur Dioxide
SRM	Standard Reken Method
SSS	Service Substation
STEP	Special Term for Economic Partnership
TEC	Technical Evaluation Committee
TOD	Transit Oriented Development
TOR	Terms of Reference
TSS	Total Suspended Solids
TSS	Traction Substation
UDA	Urban Development Authority
UITP	International Organisation for Public Transport
VVVF	Variable Voltage Variable Frequency
VU	Vulnerable
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

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මහා නගර හා බස්නාහිර සංවර්ධන අමාත්‍යාංශය (MMWD)
இலங்கை ஜனநாயக சோசலிச குடியரசின் அரசாங்கம்
மாநகர மற்றும் மேல்மாகாண அபிவிருத்தி அமைச்சு (MMWD)
Government of the Democratic Socialist Republic of Sri Lanka
Ministry of Megapolis and Western Development (MMWD)

කොළඹ සැහැල්ලු දුම්රිය සංක්‍රමණ ව්‍යාපෘතිය සඳහා වූ පාරිසරික බලපෑම් ඇගයීම් වාර්තාව

கொழும்பு இலகு புகையிரத ட்ரான்ஸிட் (LRT) செயற்திட்டத்துக்கான சுற்றாடல் தாக்க மதிப்பீட்டு அறிக்கை

ENVIRONMENTAL IMPACT ASSESSMENT FOR COLOMBO LIGHT RAIL TRANSIT(LRT) PROJECT

ඇමුණුම් / ANNEXURES / பின்னிணைப்புகள்

April 2018

Submitted to;
Central Environmental Authority

Submitted By;
Ministry of Megapolis and Western Development

Prepared By:
Oriental Consultants Global Co., Ltd, Japan
Consulting Engineers and Architects Associated (Pvt.) Ltd., Sri Lanka

List of Annexures:

Annex A

TOR for EIA study

TERMS OF REFERENCE

(This ToR is valid only for one and half years from the date of issue)

This ToR has been issued by the Central Environmental Authority (CEA) only as a means of providing guidance for preparation of the Environmental Impact Assessment (EIA) report for the proposed project. Required information on impacts, mitigation measures etc. which will be useful in decision making should be incorporated in the EIA report based on the findings of the EIA study.

Issuance of the ToR does not in any way reflect an agreement on the part of the CEA regarding the granting of approval for the project. It is the responsibility of the project proponent to clear any issues regarding land ownership and to obtain approvals required from agencies other than the CEA. In the case where the project is to be sited on state land we recommend obtaining "in principle" approval of the land owner, prior to embarking on the EIA report preparation. The CEA will not be responsible for any costs incurred by the project proponent in EIA report preparation in case the project is rejected.

Project Name : COLOMBO LIGHT RAIL TRANSIT PROJECT

Project Proponent : Ministry of Megapolis and Western Development

Project Approving Agency : Central Environmental Authority

Report requirement : Environmental Impact Assessment (EIA) report

Date of issue of the ToR : 23.05.2017

Report format :

Executive Summary

1. Introduction
2. Description of the Project and reasonable alternatives
3. Description of the existing environment
4. Anticipated environmental impacts of proposed project
5. Proposed mitigatory measures
6. Extended Cost - Benefit Analysis
7. Environmental Management Plan
8. Conclusion and Recommendation

Annexure

I	Terms of Reference
II	References
III	Sources of data & information
IV	List of preparers including their work allocation (Report should be authenticated by the preparers.)
V	Comments made by the public, NGOs and other agencies during formal and informal scoping meetings held by the EIA study team
VI	Complete set of relevant maps, tables, charts, layout plans and other details.

Executive Summary

The summary should be a brief, non-technical summary of the justification of the proposed project, description of the salient features of the project, the existing environment of the project sites and its environs, key environmental impacts, the measures proposed to mitigate the environmental impacts, extended cost benefit analysis monitoring programme and conclusion.

A one page summary table indicating the significant impacts and proposed mitigatory measures should be presented.

1. INTRODUCTION

- Background of the project (Brief history of the project, its current status, implementing agency including an organization chart and its operation mechanism etc.)

- Objective of the proposed project and justification of the project (Summarize the need or problem being addressed by the project and how the proposed project is expected to resolve the problem).

- Objective of the EIA report (Specify the objectives of the assessment and the relationship of the results to project design and implementation).

- Methodologies and technologies adopted in EIA report preparation.

- Conformity with Government policies and plans.

- Preliminary approvals needed for the project and any conditions laid down by state agencies in granting preliminary clearance for the project

2. DESCRIPTION OF THE PROPOSED PROJECT AND REASONABLE ALTERNATIVES

2.1 Description of the proposed project

Following details should be given in order to get a clear picture of the project.

i. Location, indicating the Divisional Secretariat Division(s) and the Local Authority area(s) within which the Light Rail Transit System (project) site falls.

ii. Location map of appropriate scale indicating the project site. Clear coloured and readable maps together with diagrams and photographs to be provided for the reviewer to get a clear understanding of the project area. (The location map should include general location of the project site and exact location with clear coordinates.)

iii. State the present ownership of the project site. If state owned, please submit a letter of consent from the relevant state agency/agencies.
(If any activity of the project falls within a protected area declared under the Forest Ordinance/Flora and Fauna Protection Act, consent of the Forest Department/Department of Wildlife Conservation should be obtained on release of land prior to embarking on the EIA study).

iv. Description of all components relevant to the project.

(a) Description of project components such as extent (both width and length) of Right of Way of the project, rail track (railroad), U turn space, Terminal Buildings, Station Plazas (if any), light train (rolling stocks) parking (Depot) and servicing/repairing facilities, signal control and signaling system passenger vehicles parking facilities and other relevant structures (temporary and permanent) etc.

(b) The layout plan(s) of the project at appropriate scale. This should indicate all the project components mentioned in above (a) and reservation/s to be maintained.

v. The details on pre-construction and construction activities, phased implementation schedule, staffing/workforce, future development/expansion etc.

vi. Method/s of construction, raw materials requirement including quantities and sustainable sources etc. (If any filling of lowlands is envisaged in permanent and/or temporary basis, the location/s of such filling together with the extent, method of filing and level in terms of MSL should be given).

vii. Methodology of operation and maintenance of project including institutional arrangements.

viii. Type of energy to be used to power the light rails; either fossil fuel or electricity.

ix. Anticipated types and source/s of wastewater generation and pollution load (Quality of raw wastewater) together with the details of the wastewater collection, treatment and final disposal. Conceptual plans on the wastewater treatment plants, expected quality of treated wastewater etc. should be given.

x. Details of generation of sludge from wastewater treatment, other wastes such as waste oil and solid wastes including municipal solid wastes, plastics, iron etc. their quantities and management including final disposal.

xi. Any infrastructure facilities required by the project.
  - Energy including fossil fuel/electricity and source/s
  - Water and source/s
  - Access roads
  - Parking, service, maintenance facilities for constructions equipment/vehicles

xii. Project cost, investment and funding sources.

2.2 Evaluation of Alternatives

- Describe reasonable alternatives considered in the course of developing the project (e.g. alternative transport modes, siting, design, technology selection, construction methods etc.) including no action alternative.

- Compare alternatives in terms of potential environmental impacts, mitigation of environmental impacts, capital and operating costs, reliability etc.

- Give the reasons for why such alternatives were rejected.

3. DESCRIPTION OF THE EXISTING ENVIRONMENT

Study Area

The study area for the assessment shall include the following;

i) Project site (area within proposed Right of Way)

ii) The area beyond the Right of Way that has a likelihood of being significantly impacted ("influenced area"). (The limits of "influenced area" should be identified by the study team with clear justification).

iii) Off site locations which will be affected due to activities of the project.

Assemble, evaluate and present baseline data on the relevant environmental characteristics of the study area.

This chapter should provide information on physical, biological and socio cultural aspects of the environment likely to be affected by any activity of the project during and after the project construction period. Information should be presented using photographs, tables, maps and diagrams where appropriate. The maps provided must be clear, readable and at appropriate scale. The methods used to collect data should be clearly stated under each category.

The existing environment should be described under following;

3.1 Physical environment

i. Existing land use
ii. Ambient air quality (*The ambient air quality parameters to be covered shall include PM10, PM 2.5, SO_2, NO_x, CO, and other applicable parameters to be determined depending on the project.*
iii. Noise levels (both day and night)
iv. Surface and ground water quality (*The water quality parameters to be covered shall include Total Suspended Solids, pH, Bio-chemical Oxygen Demand, Chemical Oxygen Demand, Temperature, Oil and grease, e-coli and other applicable parameters to be determined depending on the project*).
v. Wetlands and streams encountered by the project.

3.2 Socio-cultural Environment

- Existing houses, government/commercial/non-commercial/buildings etc.
- Noise sensitive receptors.
- Culturally, historically and archaeologically important objects/places.
- Existing transport network, public transport services, traffic levels on the existing roads (the road sections proposed to be used for the project and all the roads connected thereto within the Colombo Metropolitan Region within the study area) preferable with a modal split.
- Planned development activities.

3.3 Biological Environment

i. Presence of protected areas (extent, conservation status etc.) and other sensitive habitats such as wetlands and their importance
ii. Rare, threatened and endemic species (if any) within these habitats

4. ANTICIPATED ENVIRONMENTAL IMPACTS OF PROPOSED PROJECT

This chapter should show the overall effects of the project on the individual environmental components both during construction and operations phases of the project. Impacts should include the direct and indirect, long and short-term, positive and negative effects.

Significance of impacts should be assessed using appropriate techniques.
When describing the impacts indicate which are irreversible or unavoidable and which can be mitigated to the extent possible. Wherever possible describe impacts quantitatively.

Impacts should be discussed in the order of severity.

Special attention should be paid to;

i. Socio-cultural and socio-economic impacts during construction and operation phases giving special reference to impacts on the following.

   - Existing road users due to escalation of traffic congestion on such roads
   - Livelihood and economic activities
   - Health and safety impacts
   - Increased urbanization
   - Resettlement of people and/or relocation of structures/buildings etc. (if any)
   - Relocation of the utilities such as water, electricity, telecommunication (if any)
   - Socio-cultural and socio-economic benefits.

ii. Noise and vibration impacts during construction and operation phases giving special reference to noise and vibration impacts on the land uses at the boundary of the right of way of the project, users of the existing roads etc.. Vertical and horizontal distribution of noise levels at expected different operation levels should be predicted using a validated mathematical model and results should be presented to identify the impact area, land use of the impact area, affected population etc.

iii. Air quality impacts during construction and operation phases giving special reference to impacts on the land uses at the boundary of the right of way of the project, users of the existing roads due to emission construction vehicles and light rails, fugitive emission due to construction etc.

iv. Impacts on the water courses that cross by the rail track including the impacts on the drainage pattern, current uses of such water courses etc. during construction and operation phases.

v. Impacts on surface water, groundwater, soil quality due to;
   - erosion of excavated materials, construction materials etc. and spoil and other waste generated from construction activities.

- spillage, leak and accidental discharge of fossil oil, waste oil generated from rolling stocks maintenance, washing, serving etc.
- disposal of wastewater generated from workers camps, offices, station plazas, terminal buildings, rolling stocks maintenance, washing, serving etc.
- unusual occurrences such as accidents, fire, natural hazards etc..
- disposal of other liquid/solid wastes generated from workers camps, offices, station plazas, terminal buildings etc.

vi. Impacts on neighboring land uses at the Right of Way of the project due to severance of light, ventilation etc. (if any).

vii. Impacts on aquatic/ terrestrial habitats and wildlife therein.

5. PROPOSED MITIGATORY MEASURES

This chapter should set out the proposed measures to minimize the impacts identified in Chapter 4 to acceptable levels including conformity to regulations and national standards. Alternative methods of mitigation should be discussed and effectiveness of the proposed measures that are to be provided should be stated. Mitigation methods should be defined in specific practical terms. A rationale should also be presented for selection of chosen mitigatory measures.

6. EXTENDED COST BENEFIT ANALYSIS

Total environmental cost (the cost of direct and indirect negative impacts, proposed mitigation cost, administration and monitoring costs etc.) and benefits arising out of the project should be incorporated and discussed. Findings should reflect the benefits arising out of the project.

7. ENVIRONMENTAL MANAGEMENT PLAN

An Environmental Management Plan (EMP) should be submitted including the followings;

- A summary of anticipated significant adverse environmental impacts together with the mitigation measures with technical details for each anticipated significant environmental impact.

- Monitoring plan including;
  - Parameters/ Indicators/Criteria/to be monitored
  - Proposed locations of sampling points
  - Frequency of monitoring

- Implementation arrangement including;
  - Responsibility and Implementation schedule for mitigation, monitoring and reporting along with specifying the exact parties responsible for these actions and the schedule for these tasks.
  - Institutional framework, namely who is responsible for carrying out the mitigation and monitoring.
  - Costs of implementation of mitigation and monitoring measures described above. Identify the availability and source of funds to implement the measures.

8. CONCLUSION AND RECOMMENDATION

The environmental acceptability of the proposed project and key findings and recommendations of the assessment should be clearly stated.

TP D/:EIA/Rail/CLRT/ Scoping /7 LRT final ToR for EIA 23.05.2017 ver. 06

Annex B

Correspondence with relevant agencies

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வீதி அபிவிருத்தி அதிகாரசபை
Road Development Authority

"මගනැගුම මහමැදුර" ඩෙන්සිල් කොබ්බෑකඩුව මාවත,
කොස්වත්ත, බත්තරමුල්ල, ශ්‍රී ලංකාව.
"மகநெகும மஹமெதுர", டென்சில் கொப்பேகடுவ மாவத்தை,
கொஸ்வத்தை, பத்தரமுல்லை, இலங்கை.
"Maganeguma Mahamedura",Denzil Kobbekaduwa Mawatha,
Koswatta, Battaramulla, Sri Lanka.

මගේ අංකය / எனது இல. / My No. RDA/P/NPRS/RS/GEN

ඔබේ අංකය / உமது இல. / Your No. ……………

දිනය / திகதி / Date 09.01.2018

Light Rail Transit Project-JICA
RECEIVED
10 JAN 2018
Ministry of Megapolis & Western Development

Secretary
Ministry of Megapolis and Western Development
Suhurupaya
Battaramulla

CLEARENCE FOR THE STUDY ROUTE

LIGHT RAIL TRANSIT PROJECT - JICA

This refers to your letter No LRT/JICA/PLN/05 dated 09.08.2017 regarding the above matter.

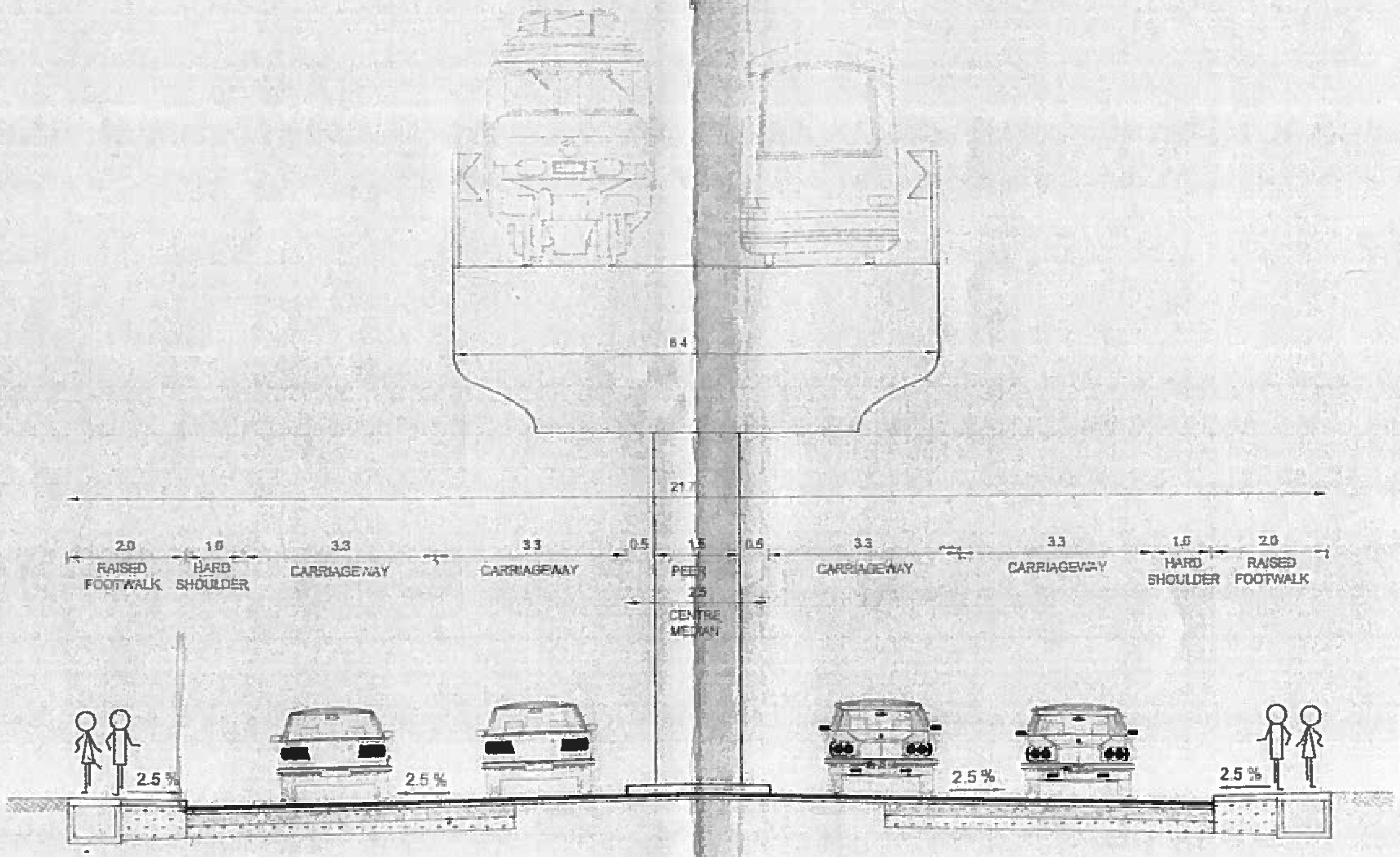
Road Development Authority hereby grants clearance to the proposed Light Rail Transit (LRT) Project under the following conditions.

1. As the existing center median width is 1.2m, width of the center median should be widened according to the width of the column which are going to position along the center median.
2. Traffic management plan for the construction period to be addressed clearly and get the approval from RDA before commencing the work.
3. No of lanes and width of traffic lane, width of walkways and center median should be according to the design drawing submitted by the RDA as discussed in the Technical Committee Meeting.
4. Additional acquisition is to be done according to the letter No RDA/CH/HYD/MEGAPOLIS dated 20.12.2017 signed by the Chairman Road Development Authority.

The above factors are clearly addressed in the final design and the approval to be sought from the RDA.

Director General
Road Development Authority

2



NOT TO SCALE

WIDENING & IMPROVEMENTS TO COTTA ROAD WITH LRT

TYPICAL CROSS SECTION

REV	DESCRIPTION	DATE	DO	D(H/D)

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF HIGHWAYS

HIGHWAY DESIGNS DIVISION
ROAD DEVELOPMENT AUTHORITY
"MAGANEGUMA MAHAMEDURA"
BATTARAMULLA.

SURVEYED & PLOTTED - Licensed Surveyor	DESIGNED - S A S T Salawavidana	CHECKED - R A S K Kaluarachchi	DRAWN - J A R Sembukuttiarachchi	CHECKED - K.K.C Perera
DEPUTY DIRECTOR	DIRECTOR	ADDITIONAL DIRECTOR GENERAL (CD) for DIRECTOR GENERAL		DATE - 11.10.2017 DRG.No. W/B435/R/1/TCS-2

182

(39)

මාර්ග සංවර්ධන අධිකාරිය
வீதி அபிவிருத்தி அதிகாரசபை
Road Development Authority

"මගනැගුම මහමැදුර", ඩෙන්සිල් කොබ්බෑකඩුව මාවත,
කොස්වත්ත, බත්තරමුල්ල, ශ්‍රී ලංකාව.
"மகநெகும மஹாமதுர", டென்சில் கொப்பேகடுவ மாவத்தை,
கொஸ்வத்தை, பத்தரமுல்லை, இலங்கை.
"Maganeguma Mahamedura", Denzil Kobbekaduwa Mawatha,
Koswatta, Battaramulla, Sri Lanka.

5610

මගේ අංකය / எனது இல / My No. } RDA/CH/HYD/MEGAPOLIS

ඔබේ අංකය / உமது இல / Your No. }

දිනය / திகதி / Date } 20th December 2017

Light Rail Transit Project
RECEIVED
22 DEC 2017

මහානගර හා බස්නාහිර සංවර්ධන අමාත්‍යාංශය
21 DEC 2017
ලේකම් කාර්යාලය
සුහුරුපාය, 17 වන මහල, සුභූතිපුර පාර,
බත්තරමුල්ල.

PD (LRT, JICA)

Eng. Nihal Rupasinghe
Secretary
Ministry of Megapolis & Western Development

<u>ROAD WIDENING & LAND ACQUISITION</u>
<u>LIGHT RAIL TRANSIT (LRT) PROJECT - JICA</u>

This has the reference to your letter numbered LRT-J/16/UTI/01/RDA dated 26.10.2017 regarding the above matter.

We have already forwarded our proposal regarding the required road widening to Project Director (LRT) of Ministry of Megapolis & Western Development by our Director (Highway Design). (Letter attached for your reference please).

While we RDA, can handle the land acquisition process for this project, kindly be informed that following costs should be borne by your project for this endeavor;

- Land acquisition cost for the required corridor
- 6% administration cost

This is for your information and necessary actions please.

Chairman
Road Development Authority

cc : Mr. R. Paskralingam
Senior Advisor to the Ministry of National Policies & Economic Affairs - f.i.pl.

Director General, Road Development Authority - f.i.pl.

Director (Highway Design) - f.i.pl.

ප්‍රවාහන හා සිවිල් ගුවන්සේවා අමාත්‍යාංශය
போக்குவரத்து மற்றும் சிவில் விமானசேவைகள் அமைச்சு
MINISTRY OF TRANSPORT & CIVIL AVIATION

07 වෙනි මහල, සෙත්සිරිපාය, අදියර II, බත්තරමුල්ල
07 ஆவது மாடி, செத்சிறிபாய, II ஆம்கட்டம், பத்தரமுல்லை
7th Floor, Sethsiripaya, Stage II, Battaramulla

වෙබ් අඩවිය / இணையத்தளம் / Website: www.transport.gov.lk

දුරකථන தொலைபேசி Telephone

අමාත්‍ය அமைச்சர் Minister	2187225
ලේකම් செயலாளர் Secretary	2187233
කාර්යාලය அலுவலகம் Office	2187200 2187201
ෆැක්ස් பெக்ஸ் Fax	2865093 2187226
විද්‍යුත් තැපැල් மின்னஞ்சல் E-Mail	mintransport@sltnet.lk

මගේ අංකය எனது இல. My No.	MT/06/244
ඔබේ අංකය உமது இல. Your No.	
දිනය திகதி Date	2017.12.12

Light Rail Transit Project-JICA
RECEIVED
20 DEC 2017
Ministry of Megapolis & Western

The General Manager

Sri Lanka Railways

Project: Light Rail Transit (JICA Funded) project

Subject: Concurrence for Proposed Route and Integration at Multi Modal Transport Hub (MMTH)

Reference: T.02/21308/CAPC of 27.11.2017

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1. Maradana

Reference above, attached herewith is the Aerial Map (Auto CAD Enabled) of Maradana Area applicable to LRT Route.

The LRT Project may be requested to clearly draw the Route on this diagram.

Location marked as (6) is needed for construction of 12 storied building for Railway (Specially, the New Colombo Train Control Center). Based on the outcome of the feasibility study (AFD Funded) of PMMTH, the location for Colombo Central Railway (CCR)station will be decided and with that, there will be eight Railway Lines between Colombo Fort -Maradana-Loco Junction section. Those additional Lines will pass through Item (3) of the drawing and an additional opening (to construct two Lines) on both bridges at Maradana (on Elphinstone Theater Side) will be provided.

However, the space for piers of LRT elevated track can be decided during the PMMTH Feasibility Study. The Design Consultants of CSRP will be available from January 2018.During the design stage, the location of piers of LRT elevated track can be decided.

In addition, the proposal for Maradana Multi Modal Center will also be forwarded by Ministry of Megapolis and Western Development, to ERD soon.

Hence, the LRT Project is requested to explore the possibility for designing LRT traces at Maradana along the new bridge (near item 7 at Maradana).

2. Cotta Road

The Railway Track of in KV Line will be an elevated Structure (Possibly 5.5 m above ground level). For construction of LRT route (if it runs above elevated railway), then a clearance of (minimum) 8.0 meters from railway tracks will be required.

Therefore, Railway cum LRT Station needs to be designed at Cotta Road. This can be decided jointly by CSRP Designers and LRT Designers.

Palitha Samarasinghe

Addl.Secretary (Technical)

Ministry of Transport & Civil Aviation

Copy: The Secretary -Ministry of Transport & Civil Aviation

The Secretary - Ministry of Megapolis & Western Development

The Project Director, Light Rail Transit (JICA Funded) Project.

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை
National Water Supply & Drainage Board

ප්‍රාදේශීය සහාය සේවා මධ්‍යස්ථානය - (බටහිර-මධ්‍යම)
பிரதேச ஆதார நிலையம் - (மேற்கு-மத்தி)
Regional Support Center - (Western Central)

නියෝජ්‍ය සාමාන්‍යාධිකාරී / பிரதிப் பொது முகாமையாளர் / Deputy General Manager : 2812671

පොදු කාර්යාලය / பொது அலுவலகம் / General Office : 2856420, 2856421, 2856422

ෆැක්ස් / பெக்ஸ் / Fax : 2812672

175 A, කළුතොට ගොඩනැගිල්ල, නාවල පාර, නුගේගොඩ.
175 A, களுத்தோட்டை கட்டிடம், நாவல வீதி, நுகேகொட.
175 A, Kalutota Building, Nawala Road, Nugegoda.

මගේ අංකය / எனது இல. / My No. : DGM/WC/P&D/Proj. (Ext. /04)

ඔබේ අංකය / உமது இல. / Your No. :

දිනය / திகதி / Date : 19th December 2017

Light Rail Transit Project-JICA
RECEIVED
20 DEC 2017
Ministry of Megapolis & Western Development

Eng. Nihal Rupasinghe,
Secretary,
Ministry of Megapolis and Western Development,
8th Floor, Sri Subuthipura Road,
Suhurupaya,
Battaramulla.

PROJECT: LIGHT RAIL TRANSIT - JICA

SUBJECT: CLEARANCE OF THE LRT ROUTE AND WATER SUPPLY TO STATIONS AND DEPOT AT MALAMBE

This refers your letter dated 30th November 2017 regarding the above subject.

If any existing water pipe lines have to shift due to the above project, you should shift those water pipe lines through your contractor in your cost.

NWSDB will assist to you in designing, documentation and supervision work of the shifting of the existing water pipe lines.

Please note that NWSDB shall not take any responsibility for any losses or damages that may caused by you or third party to the unforeseen properties of NWSDB in the above areas. It is recommended to carryout trial pits/trenches before the commencement of the construction work to identify the exact locations of underground water pipe lines.

In addition to above, please be good enough to provide following details to check the feasibility of providing water supply to stations and depot at Malambe with application.

1. Survey Plan.
2. One set of architectural drawings attested by Architect of proposed site (in A3 Size).
3. Water demand per day for proposed buildings with necessary calculations.
4. Ground sump capacity including fire requirement and the location should be marked in drawing.
5. Entrance location to the stations and depot to be marked in the site layout plan.

"Water - Every Drop is Precious"

The application form is enclosed herewith.

You are required to pay an amount of Rs. 12,500.00 + applicable VAT in order to process your request for development clearance of the above project.

The payment can be made in cash to the Cashier Counter of Regional Support Centre (Western –Central) at Ground Floor, Kalutota Building, No. 175 A, Nawala Road, Nugegoda or as a cheque written in favour of "General Manager" National Water Supply & Drainage Board. Please arrange to send the original receipt (if payment is in cash) or submit the cheque to Planning & Design section at 6th Floor of the same building.

Further, please contact Eng. W. D. L. Chandrasiri, Assistant General Manager (Greater Colombo Sewerage), NWSDB on 0777356643 regarding the sewerage lines under NWSDB.

Eng. T. W. S. Perera
Deputy General Manager (WC)

ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය
தேசிய நீர் வழங்கல் வடிகாலமைப்புச் சபை
National Water Supply & Drainage Board

සභාපති / தலைவர் / Chairman — Tel : **2634488** Fax : **2611234**
උප සභාපති / உப தலைவர் / Vice Chairman — Tel : 2635883 Fax : 2610034
ප්‍රධාන කාර්යාලය / தலைமை அலுவலகம் / Head Office — Tel : 2638246, 2638256, 2638259, 2638260, 2621621
තැ.පෙ. / த.பெ.இல. / P.O. Box — **14,** ගල්කිස්ස / கல்கிசை / Mt. Lavinia
සාමාන්‍යාධිකාරී / பொது முகாமையாளர் / General Manager — Tel/Fax 2636449
ක්‍රියාකාරී අධ්‍යක්ෂ / தொழிற்பாட்டுப் பணிப்பாளர் / Working Director — Tel : 2636901 Fax : 2611590
Hunting No : 2638999
Fax : 2636449
E-mail : nwsdbch@sltnet.lk
ගාලු පාර / காலி வீதி / Galle Road — රත්මලාන / இரத்மலானை / Ratmalana, Sri Lanka.

මගේ අංකය / எமது இல / My No. Addl.GM/S/P/SJK
ඔබේ අංකය / உமது இல / Your No.
දිනය / திகதி / Date 03.04.2018

Eng. Chaminda Ariyadasa,
Project Director
Light Rail Transit Project_JICA
Ministry of Megapolis and Western Development
8th Floor, Suhurupaya, Battaramulla

Dear sir,

<u>Request to Obtain Information of the Proposed Sewer Network in Sri Jayawardanapura Kotte and Kaduwela Municipal Council Area</u>

Reference is made to your letter number LRT-J/07/ENV/2018/07 dated 20th March 2018 and the subsequent discussion we had with your staff along with JICA Consultants appointed to carryout Feasibility Study for Sri Jayawardanepura Kotte Sewerage Project (SJPKSP) on 29th March 2018 we would like to inform you that NWSDB could accept sewage emanation from Light Rail project upon implementation of the SJPKSP as follows;

- Direct sewer connection to the Light Rail Stations proposed at Walikada, Rajagiriya, Sethsiripaya, Battaramulla, Palamthuna and Robert Gunawardane as they are situated within the sewerage reticulation system of proposed SJKSP. Therefore direct sewer connection could be provided for the 6 stations. Final connection point will be decided during detailed design stage.
- Other stations situated outside sewer network area towards depot direction can be dispose in one of the following ways
  - Single pumping main supported on light rail elevated supporting structure with synchronized pumping from 4 stations and the depot located outside SJKSP
  - Implementing Jhokasou or any other independent treatment and disposal system at each train station
  - Keeping holding tank at each rail station and utilize gully sucker to collect and transport to proposed sewage treatment plant or or as a interim measure to existing septage disposal facility operated by NWSDB. This will create traffic congestion ,overflow situation if not managed properly.
- **NWSDB accept only wastewater of domestic nature**. Therefore waste oil and grease from the depot should be separated in concentrated form and dispose appropriately
- Light rail project should incorporate capital cost of the sewer connection/independent treatment based on the preferred option as SJPKSP will not be accommodating these disposal arrangements in the project cost.

MINISTRY OF CITY PLANNING AND WATER SUPPLY
"Water - Every Drop is Precious"

- O&M cost when connected to sewer system will be charged based on wastewater flow as per the National Sewerage Tariff

- Light rail stations situated towards CMC area should be connected in consultation with CMC

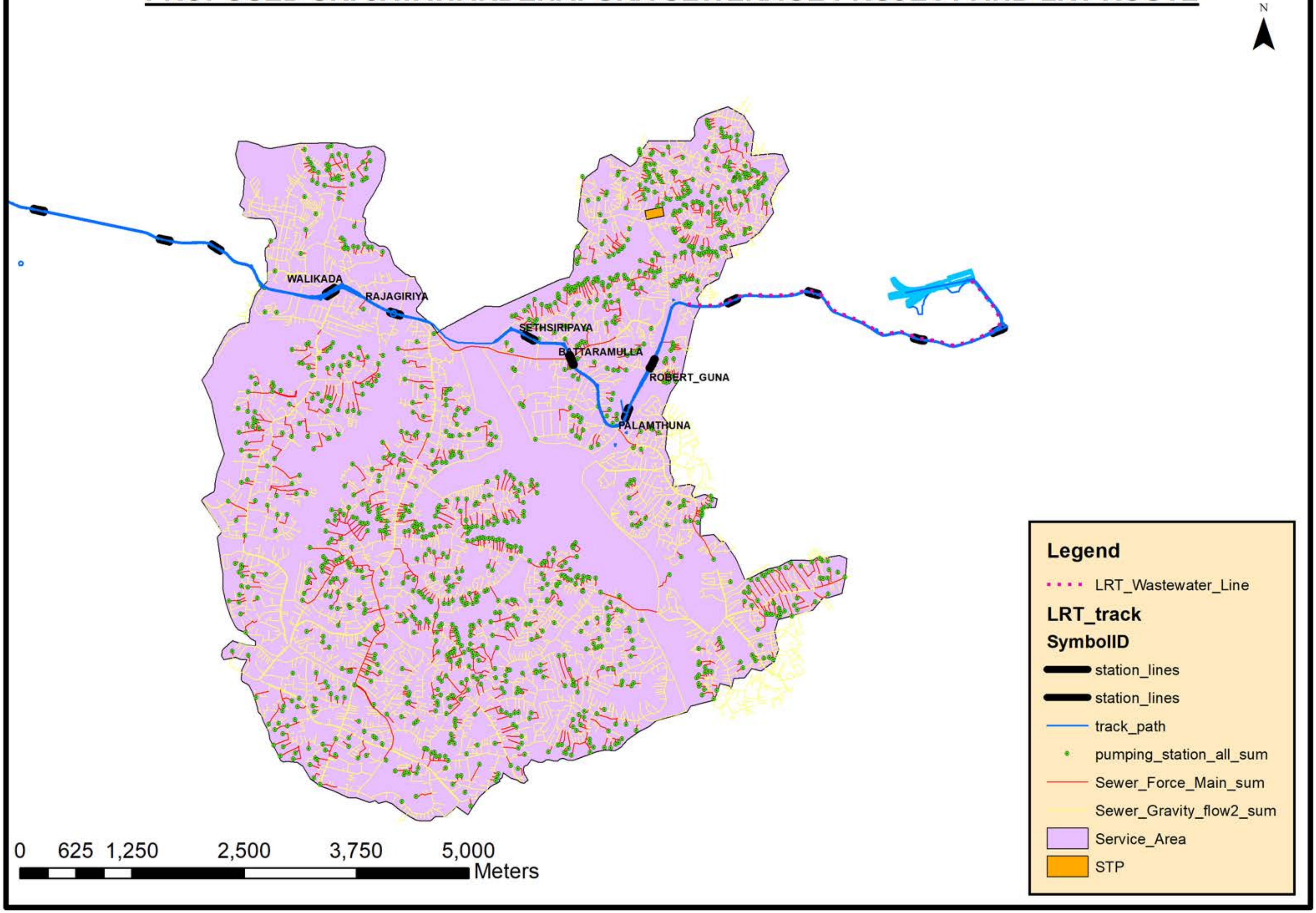
Yours faithfully,

Addl.GM (Sewerage)

Encl: LRT Track and reticulation area map

CC : Secretary , Ministry of Megapolis – f.y.i.pl
Team leader , JET – f.y.i.&.n.a.pl

PROPOSED SRI JAYAWARDENAPURA SEWERAGE PROJECT AND LRT ROUTE



Attention :- Mr. Ravi RD/PROJ/35

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ශ්‍රී ලංකා ඉඩම් ගොඩකිරීමේ සහ සංවර්ධනය කිරීමේ සංස්ථාව

மாநகர மற்றும் மேல் மாகாண
அபிவிருத்தி அமைச்சு
இலங்கை காணி மீட்பு மற்றும்
அபிவிருத்திக் கூட்டுத்தாபனம்

MINISTRY OF MEGAPOLIS &
WESTERN DEVELOPMENT
SRI LANKA LAND RECLAMATION
AND DEVELOPMENT CORPORATION

த.பெ.56, இல.03, ஸ்ரீ ஜயவர்த்தனபுர மாவத்தை,
வெலிகட, ராஜகிரிய.

තැ.පෙ.56, අංක 03, ශ්‍රී ජයවර්ධනපුර මාවත,
වැලිකඩ, රාජගිරිය.

P.O. Box 56, No. 03, Sri Jayawardenapura Mawatha,
Welikada, Rajagiriya.

Our Ref: RD/PROJ/35

18/12/2017

Eng. Nihal Rupasinghe,
Secretary,
Ministry of Megapolis and Western Development,
Suhurupaya,
17th Floor,
Battaramulla.

Clearance for the study route

Light Rail Transit Project – JICA

This has reference to your letter LRT/JIENV/08 dated 20/10/2017 regarding above.

Sri Lanka Land Reclamation & Development Corporation hereby grants clearance to the proposed LRT (Light Rail Transit), under the condition that a detailed drainage study to be carried out during the detailed design stage and final approval to be sought from the corporation.

Eng. Srimathi Senadheera
General Manager
Sri Lanka Land Reclamation & Development Corporation.

0001
20/12 2017 3:53 PM FAX

මහානගර හා බස්නාහිර සංවර්ධන අමාත්‍යාංශය
ශ්‍රී ලංකා ඉඩම් ගොඩකිරීමේ සහ සංවර්ධනය කිරීමේ සංස්ථාව

மாநகர மற்றும் மேல் மாகாண
அபிவிருத்தி அமைச்சு
இலங்கை காணி மீட்பு மற்றும்
அபிவிருத்திக் கூட்டுத்தாபனம்

**MINISTRY OF MEGAPOLIS &
WESTERN DEVELOPMENT**
SRI LANKA LAND RECLAMATION
AND DEVELOPMENT CORPORATION

த.பொ.56, இல.03, ஸ்ரீ ஜயவர்தனபுர மாவத்தை,
வெலிகட, ராஜகிரிய.

තැ.පෙ.56, අංක 03, ශ්‍රී ජයවර්ධනපුර මාවත,
වැලිකඩ, රාජගිරිය.

P.O. Box 56, No. 03, Sri Jayawardenepura Mawatha,
Welikada, Rajagiriya.

Ref: WM/WWPM/185/Gov16 2018-01-24

Eng. Nihal Rupasinghe,
Secretary,
Ministry of Megapolis and Western Development,
"Suhurupaya",
Battaramulla.

Dear Sir,

Approval for the Waste delivering to Waste Management Park at Kerawalapitiya

This has reference to the letter dated 8th January 2018 on above. The permission has been granted to deliver Construction and Demolition waste generated through the Light Rail Transit Project – JICA to the Waste Management Park development area at Kerawalapitiya.

It has to be noted that, the following conditions to be applied;

- Construction and Demolition waste and Excavated material will be accepted at Free of Charge and following conditions to be satisfied.
    - No contamination with the fresh Municipal Solid Waste (MSW), Hazardous wastes, wood or plant debris
    - Attention to maintain a better environment during the transportation and dumping operation (Specially in Dust Controlling)
- To be transported via approval vehicles only. It is necessary to take approval for the waste transporting vehicles in writing prior to the delivering.
- Name of the Authority and the Waste type need to be displayed at the front of the vehicles.
- Before the commencement of the project, this approval needs to be renewed.

Forwarded for our attention please.

Thank You.
Yours Sincerely,

Eng. K. Rajapakse
Actg. General Manager
Sri Land Reclamation and Development Corporation

දුරකථනය
தொலைபேசி
Telephone
2867369, 2889485
2863705, 2889486
2867533, 2889487

සභාපති
தலைவர்
Chairman
2863696

ෆැක්ස්
பெக்ஸ்
Fax
2862457
2868001

Website : www.landreclamation.lk
E-mail: sllrdc@sltnet.lk

142

(16)

නාගරික කොමසාරිස්
වී. කේ. ඒ. අනුර
மாநகர ஆணையாளர்
வி. கே. ஏ. அனுர
MUNICIPAL COMMISSIONER
V. K. A. ANURA

කොළඹ මහා නගර සභාව
නගර ශාලාව, කොළඹ 07.
கொழும்பு மாநகர சபை
நகர மண்டபம், கொழும்பு 07.
Colombo Municipal Council,
Town Hall - Colombo 07.

දුරකථනය / தொலைபேசி / Telephone — කාර්යාලය / காரியாலயம் / Office — 011-2695121, 011-2678425
ෆැක්ස් / தொலைநகல் / Fax — 011-2694640
විද්‍යුත් තැපෑල / மின்னஞ்சல் / E.Mail : munici@slt.lk

Light Rail Project-JICA
RECEIVED
29 NOV 2017
Ministry of Megapolis & Western Development

මගේ අංකය / எனது இல. / My No. ME/ME/ML/43/2017

ඔබේ අංකය / உமது இல. / Your No

දිනය / திகதி / Date 23 11/2017

PD (LRT, JICA)

මහානගර හා බස්නාහිර සංවර්ධන
අමාත්‍යාංශය
R 6845
28 NOV 2017
ලේකම් කාර්යාලය
සුහුරුපාය, 17 වන මහල, සුභූතිපුර පාර,
බත්තරමුල්ල.

Eng. Nihal Rupasinghe,
Secretary,
Ministry of Megapolis and Western Development,
Suhurupaya,
17th Floor,
Battaramulla.

<u>Clearance for the study route</u>

<u>Light Rail Transit Project – JICA</u>

This has reference to your letter dated 09.08.2017 regarding above.

Colombo Municipal Council hereby grants clearance to the proposed LRT (Light Rail Transit) route in the center median of the roads within the Colombo City subjected to the condition that the land acquisition has to be done by the Ministry of Megapolis in cases where the existing width of Thoroughfare is reduced due to the proposed structure.

....
Municipal Commissioner

කොළඹ මහා නගර සභාව
கொழும்பு மாநகர சபை
COLOMBO MUNICIPAL COUNCIL

නාගරික ඉංජිනේරු දෙපාර්තමේන්තුව
පුරහල, කොළඹ 07.
மாநகர பொறியியலாளர் திணைக்களம்
நகர மண்டபம், கொழும்பு 07.
MUNICIPAL ENGINEER'S DEPARTMENT
Town Hall, Colombo 07.

මගේ අංකය
எனது இல
My No.

දුරකථනය
தொலைபேசி
Telephone **2691191, 2693437**

ඔබේ අංකය
உங்கள் இல
Your No.

.................................02..04.2018....

Eng. Nihal Rupasinghe,
Secretary,
Ministry of Megapolis and Western Development,
"Suhurupaya",
17th Floor,
Baththaramulla.

Disposing Solid Waste Water / Sewer Generated from Proposed Stations in LRT system from Fort to Malabe within Colombo City Limit.

This is response to your letter under reference LRT-J/07ENV/2018/04 dated 20.03.2018.

1. Colombo Municipal Council confirms that the sewerage connection can be facilitated provided that all related costs are met.

2. Colombo Municipal Council confirms that solid waste could be collected provided that the facilities are furnished at the road level for collection.

....

Eng. K. A. D. N. Wickramaratne,
Actg. Deputy Municipal Commissioner,
Municipal Engineer's Department.
29th March 2018.

Eng. K.A.D.N. WICKRAMARATNE
Director Engineering
Traffic, Design & Road Safety Division
Colombo Municipal Council

නාගරික කොමසාරිස්
மாநகர ஆணையாளர்
MUNICIPAL COMMISSIONER

තැ.පෙ. අංක. 6, ශ්‍රී ජයවර්ධනපුර
த.பெ. இல. 6, ஸ்ரீ ஜயவர்தனபுர
P.O. BOX. NO.6, SRI JAYAWARDENAPURA

දුරකථන / தொலைபேசி / Telephone } 2877518, 2862941
ෆැක්ස් / தொலை நகல் / Fax } 2874703
කාර්යාලය / காரியாலயம் / Office } 2862555, 2874701, 2874702

ශ්‍රී ජයවර්ධනපුර කෝට්ටේ මහ නගර සභාව
ஸ்ரீ ஜயவர்த்தனபுர கோட்டை மாநகர சபை
SRI JAYAWARDENAPURA KOTTE MUNICIPAL COUNCIL

මගේ අංකය / எனது இல / My No. } JKMC/W6/සැ.දු.සං.ව්‍යා./2017
ඔබේ අංකය / உமது இல / Your No. } LRT-J/07/ENV/17/01
දිනය / திகதி / Date } 2018.01.24

ලේකම්,
ව්‍යාපෘති කළමණාකරන ඒකකය,
මහ නගර හා බස්නාහිර සංවර්ධන අමාත්‍යාංශය,
8 වන මහල,
"සුහුරු පාය" ශ්‍රී සුභූති පාර,
බත්තරමුල්ල.

<u>සැහැල්ලු දුම්රිය සංක්‍රමණ ව්‍යාපෘතිය (JICA)</u>

උක්ත කාරණය සම්බන්ධයෙන් ඔබගේ සමාංක හා 2017/11/30 දිනැති ලිපිය හා බැඳේ,

02. මාලබේ සිට කොළඹ කොටුව දක්වා දිවෙන සැහැල්ලු දුම්රිය සංක්‍රමණ ව්‍යාපෘතිය යටතේ අප මහ නගර සභා සීමාවේ මෙම ව්‍යාපෘතියට යොදා ගැනෙන ඉඩම් හා ගොඩනැගිලි සම්බන්ධයෙන් රජයේ තක්සේරුව මත අදාල පාර්ශවයන්ට වන්දි ගෙවීමේ එකගතාවය මත ව්‍යාපෘතිය ක්‍රියාත්මක කිරිමට 2018.01.11 දින පැවති කළමණාකරන කමිටුවේ අනුමැතිය ලබා දී ඇති බව කරුණිකව දන්වා සිටිමි.

නාගරික ඉංජිනේරු,
ශ්‍රී ජයවර්ධනපුර කෝට්ටේ මහ නගර සභාව.

ජේ. නිවාහර්
නාගරික ඉංජිනේරු
ශ්‍රී ජයවර්ධනපුර කෝට්ටේ මහ නගර සභාව

නාගරික ලේකම්	மாநகர செயலாளர்	Municipal Secretary	: 2888098
සහකාර නාගරික ලේකම්	பிரதி மாநகர செயலாளர்	Assistant Municipal Secretary	: 2862615
ප්‍රධාන නාගරික ගණකාධිකාරී	மாநகர பிரதம கணக்காளர்	Chief Municipal Accountant	: 2862839
ප්‍රධාන නාගරික ඉංජිනේරු	மாநகர பிரதம பொறியியலாளர்	Chief Municipal Engineer	: 2862173
සෞඛ්‍ය වෛද්‍ය නිලධාරි	சுகாதார மருத்துவ அதிகாரி	Medical Officer of Health	: 2888097
නාගරික පශු වෛද්‍ය නිලධාරි	மாநகர மிருக வைத்திய நிபுணர்	Municipal Veterinary Surgeon	: 2876012
ගිනි නිවීමේ ඒකකය	தீயணைப்புப் படை நிலையம்	Fire Brigade Center	: 2879444

නාගරික කොමසාරිස්
மாநகர ஆணையாளர்
MUNICIPAL COMMISSIONER

තැ.පෙ. අංක. 6. ශ්‍රී ජයවර්ධනපුර
த.பெ. இல. 6, ஸ்ரீ ஜயவர்தனபுர
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දුරකථන / தொலைபேசி / Telephone: 2877518, 2862941
ෆැක්ස් / தொலை நகல் / Fax: 2874703
කාර්යාලය / காரியாலயம் / Office: 2862555, 2874701, 2874702

ශ්‍රී ජයවර්ධනපුර කෝට්ටේ මහ නගර සභාව
ஸ்ரீ ஜயவர்த்தனபுர கோட்டை மாநகர சபை
SRI JAYAWARDENAPURA KOTTE MUNICIPAL COUNCIL

මගේ අංකය / எனது இல / My No.
ඔබේ අංකය / உமது இல / Your No. LRT-J/07/ENV/2018/05
දිනය / திகதி / Date 2018.03.29

ලේකම්,
මහානගර හා බස්නාහිර සංවර්ධන අමාත්‍යාංශය,
17 වන මහල,
'සුහුරුපාය',
බත්තරමුල්ල.

<u>ඝන අපද්‍රව්‍ය කලමනාකරණය සහ මල අපද්‍රව්‍ය බැහැර කිරීම සඳහා එකඟතාවය ලබා දීම සැහැල්ලු දුම්රිය සංක්‍රමණ ව්‍යාපෘතිය (ජයිකා)</u>

උක්ත කාරණය සම්බන්ධයෙන් ඔබගේ සමාංක 2018.03.20 දිනැති ලිපිය හා බැඳේ.

උක්ත යෝජිත ව්‍යාපෘතියෙහි වැලිකඩ හා රාජගිරිය ප්‍රදේශවල ඉදි කිරීමට යෝජිත දුම්රිය නැවතුම් ස්ථානවලින් දුම්රිය ක්‍රියාත්මක වීම ආරම්භයත් සමඟ ජනනය වන ඝන අපද්‍රව්‍ය (ආහාර කොටස්, ප්ලාස්ටික් සහ කඩදාසි) අප මහනගර සභාව මගින් ඉවත් කිරීමට එකඟතාවය පල කරන බව කාරුණිකව දැනුම් දෙමු.

තව ද උක්ත දුම්රිය ස්ථානවලින් ජනනය වන මල අපද්‍රව්‍ය ඉවත් කිරීම සඳහා මල අපද්‍රව්‍ය බැහැරලීමේ පද්ධතියක් අප බල ප්‍රදේශ තුල නොමැති අතර, ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය මගින් JICA ආධාර සහිතව මල අපද්‍රව්‍ය බැහැරලීම් පද්ධතියක් ඉදිකිරීමට යෝජිත ය. එබැවින් ඒ පිළිබඳව ජාතික ජල සම්පාදන හා ජලාපවහන මණ්ඩලය සමඟ සාකච්ඡා කොට එකඟතාවය ලබා ගන්නා මෙන් කාරුණිකව ඉල්ලා සිටිමි.

නාගරික ඉංජිනේරු
ශ්‍රී ජයවර්ධනපුර - කෝට්ටෙ මහනගර සභාව

[illegible] එෆ්. සී. ජේ. වන්නිනායක
[illegible] සෞඛ්‍ය වෛද්‍ය නිලධාරි
[illegible] පුර කෝට්ටේ මහ නගර සභාව
රාජගිරිය.

නාගරික ලේකම්	மாநகர செயலாளர்	Municipal Secretary	: 2888098
සහකාර නාගරික ලේකම්	பிரதி மாநகர செயலாளர்	Assistant Municipal Secretary	: 2862615
ප්‍රධාන නාගරික ගණකාධිකාරී	மாநகர பிரதம கணக்காளர்	Chief Municipal Accountant	: 2862839
ප්‍රධාන නාගරික ඉංජිනේරු	மாநகர பிரதம பொறியியலாளர்	Chief Municipal Engineer	: 2862173
සෞඛ්‍ය වෛද්‍ය නිලධාරී	சுகாதார மருத்துவ அதிகாரி	Medical Officer of Health	: 2888097
නාගරික පශු වෛද්‍ය නිලධාරී	மாநகர மிருக வைத்திய நிபுணர்	Municipal Veterinary Surgeon	: 2876012
ගිනි නිවීමේ ඒකකය	தீயணைப்புப் படை நிலையம்	Fire Brigade Center	: 2879444

දේශයේ ප්‍රතාපවත් පුරවරය/ நாட்டின் உன்னதமான நகரம் / Dignified City of the Nation

කඩුවෙල මහා නගර සභාව
கடுவெல மாநகர சபை
KADUWELA MUNICIPAL COUNCIL

මගේ අංකය / எனது இலக்கம் / My Number: KMC/05/E1
ඔබේ අංකය / உங்கள் இலக்கம் / Your Number: ....
දිනය / திகதி / Date: 2018. 01.

Light Rail Transit Project-JICA
RECEIVED
03 JAN 2017
Ministry of Megapolis & Western Development

Eng. Nihal Rupasinghe,
Secretary,
Ministry of Megapolis and Western Development,
8th Floor,
Suhurupaya,
Battaramulla.

CONCURRENCE OF PROJECT IMPLEMENTION
LIGHT RAIL TRANSIT (LRT) PROJECT - JICA

This has reference to your letter no. LRT-J/07/ENV/17/01 and dated 30.11.2017 Regrading above.

Kaduwela Municipal Council hereby gives consent on the proposed LRT (Light Rail Transits) route in the center median of the roads within the Kaduwela Municipal Council area subjected to grants necessary recommendation / approval from relevant institution.

S.M.M. Vijitha Mayadunne
Municipal Commissioner

S. M. M. Wijitha Mayadunna
Municipal Commissioner
Kaduwela Municipal Council

දේශයේ ප්‍රතාපවත් පුරවරය/ நாட்டின் உன்னதமான நகரம் / Dignified City of the Nation

කඩුවෙල මහා නගර සභාව
கடுவெல மாநகர சபை
KADUWELA MUNICIPAL COUNCIL

මගේ අංකය / எனது இலக்கம் / My Number } KMC/05/05/E15/03/02
ඔබේ අංකය / உங்கள் இலக்கம் / Your Number } ....
දිනය / திகதி / Date } 2018. 04. 02

මහානගර හා බස්නාහිර සංවර්ධන අමාත්‍යාංශය
03 APR 2018
ලේකම් කාර්යාලය
සුහුරුපාය, 17 වන මහල, සුභූතිපුර පාර,
බත්තරමුල්ල.

Eng. Nihal Rupasinghe,
Secretary,
Ministry of Megapolis and Western Development,
8th Floor,
Suhurupaya,
Battaramulla.

CONCURRENCE FOR SOLID WASTE AND SEWER DISPOSAL LIGHT RAIL TRANSIT PROJECT – JICA

This has reference to your letter no. LRT-J/07/2018/06 and dated 20.03.2018 regarding above.

Kaduwela Municipal Council hereby gives consent for the collection of solid waste with condition and charges stipulated by the council, which will be generated from the stations and depot under our jurisdiction coverage. Further, currently we have no public sewer facility, however some area would be covered by the proposed piped sewer project under National Water Supply and Drainage Board.

S.M.M. Vijitha Mayadunne
Municipal Commissioner

	නගරාධිපති மாநகர முதல்வர் Mayor	නාගරික කොමසාරිස් மாநகர ஆணையாளர் Commissioner	නාගරික ලේකම් மாநகர செயலாளர் Secretary	ප්‍රධාන කාර්යාලය பிரதான அலுவலகம் Head Office
දුරකථන தொலைபேசி Telephone	0112 539 832	0112 548 491	0112 539 831	0112 571200
ෆැක්ස් தொலைநகல் Fax	0112 548 493	0112 548 492	0112 539 831/011 2548996	0112 539839
	mayourkmc@sltnet.lk	mcomkadu@sltnet.lk	ms.kadumc@gmail.com	kadumc@sltnet.lk

30/11 2017 1:05 PM FAX +94 11 2696250 DEPT. OF ARCHAEOLOGY 144 ☑0001

Attention: Eng Chaminda Ariyadasa

අධ්‍යක්ෂ ජනරාල්
பணிப்பாளர் நாயகம்
Director-General

දුරකථන අංක
தொலைபேசி இல.
Telephone Nos. 011-2695255

ෆැක්ස්
பெக்ஸ்
Fax 011-2696250

E mail : info@archaeology.gov.lk
Web site : www.archaeology.gov.lk

විදුලි පණිවුඩ
தந்தி
Telegrams
පුරාවිද්.
புராவித்
Puravid.

පුරාවිද්‍යා දෙපාර්තමේන්තුව
தொல்லியல் திணைக்களம்
DEPARTMENT OF ARCHAEOLOGY
ශ්‍රී ලංකා ප්‍රජාතාන්ත්‍රික සමාජවාදී ජනරජය
இலங்கை சனநாயக சோசலிசக் குடியரசு
Government of the Democratic Socialist Republic

ශ්‍රීමත් මාකස් ප්‍රනාන්දු මාවත, කොළඹ 7.
சேர் மாக்கஸ் பர்னாந்து மாவத்தை,
கொழும்பு 7.
Sir Marcus Fernando Mawatha,
Colombo 7.

මගේ අංකය
எனது இல.
My No. H/ExP/ADA/WP/2017

ඔබේ අංකය
உமது இல.
Your No.

දිනය 2017.11.30

Light Rail Transit Project-JICA
RECEIVED
30 NOV 2017
Ministry of Megapolis & Western Development

Eng. Chaminda Ariyadasa
Project Director
Light Rail Transit Project-JICA
Ministry of Megapolis and western Development

Concurrence of Project implementation light Rail Transit (LRT) Project

This is in response to your application dated 02.11.2017 and letter numbered LRT-J/07/ENV and dated 23.11.2017.

02 I wish to inform you that your new project plan avoiding the two buildings mentioned in our previous report is approved and it should be carried out under following conditions. The two buildings are, Railway Museum and peoples Bank.

Conditions

1. If any antiquity is found during the construction, should report to the Director General of Archaeology or Assistant Director of Archaeology (Western Province)
2. This permission is granted considering only the Archaeological aspects that related to the project area and the Department of Archaeology is not responsible for the environmental impact and public protests if any.

Prassana B Rathnayake
Actg. Additional Director General (Academic)
For Director General of Archaeology

Archt. PRASANNA BANDARA RATNAYAKE
Chartered Architect
Additional Director General (Arch)
Director Architectural Conservation
Sri Lanka Architects' Service II
Department of Archaeology
Colombo 07.

Copy
Secretary, Ministry of Education -For kind Attention
Divisional Secretariat (Colombo)- For kind Attention
Divisional Secretariat (Thimbirigasyaya)- For kind Attention
Divisional Secretariat (Sri Jayawardanapura Kotte) - For kind Attention
Divisional Secretariat (Kaduwela) - For kind Attention
Assistant Director (western Province) - For kind Attention

Ravi – Pls inform relevant officials accordingly.
30/11

ගොවිජන සංවර්ධන දෙපාර්තමේන්තුව
கமநல அபிவிருத்தித் திணைக்களம்
DEPARTMENT OF AGRARIAN DEVELOPMENT

මගේ අංකය / எனது இல. / My No. 7/11/17/CO/Dev-94
ඔබේ අංකය / உமது இல. / Your No.
දිනය / திகதி / Date 2018.01.12

ලේකම්,
මහානගර හා බස්නාහිර සංවර්ධන අමාත්‍යාංශය,
සුහුරුපාය, 08 වන මහළ,
බත්තරමුල්ල.

2011 අංක 46 දරණ ගොවිජන සංවර්ධන (සංශෝධන) පනතින් සංශෝධිත 2000 අංක 46 දරණ ගොවිජන සංවර්ධන පනත - කුඹුරු ඉඩම් ප්‍රමාණයක් වී වගා කිරීමක් හැර වෙනත් කාර්යයක් සඳහා භාවිතා කිරීමට අවසර ලබාදීම.

උක්ත කරුණ සම්බන්ධයෙන් ඔබගේ අංකLRT/J/ENV/08 සහ 2017.10.20 දාතමින් ඉදිරිපත් කර ඇති ඉල්ලීම් ලිපිය හා බැදේ.එකී ලිපියට අදාලව මාළඹේ ගොවිජන සේවා බල ප්‍රදේශයේ ක්‍රියාත්මක කිරීමට සැලසුම් කර ඇති බස්නාහිර කලාපීය සැහැල්ලු දුම්රිය සංක්‍රමණික පද්ධති ව්‍යාපෘතියේ ප්‍රධාන මෙහෙයුම් ඒකකය ඉදි කිරිම සඳහා කුඹුරු ඉඩම් යොදා ගැනීම සම්බන්ධයෙන් ගොවිජන සංවර්ධන දෙපාර්තමේන්තුවේ විරෝධතාවයක් නොමැති බව කාරුණිකව දන්වා සිටිමි.

ඩී. වී. බන්දුලසේන
ගොවිජන සංවර්ධන කොමසාරිස් ජනරාල් (වැ.බ.)
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අංක. 42, ශ්‍රීමත් මාකස් ප්‍රනාන්දු මාවත
කොළඹ 07.

ඩී.වී.බන්දුලසේන
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1. දිස්ත්‍රික් ලේකම්,කොළඹ — කාරුණික දැන ගැනීම සඳහා
2. ප්‍රාදේශීය ලේකම්,කඩුවෙල — කාරුණික දැන ගැනීම සඳහා
3. ගොවිජන සංවර්ධන සහකාර කොමසාරිස්,කොළඹ — කාරුණික දැන ගැනීම සඳහා
4. සාමාන්‍යාධිකාරි, ශ්‍රී ලංකා ඉඩම් ගොඩකිරීමේ හා සංවර්ධනය කිරීමේ සංස්ථාව
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5. අධ්‍යක්ෂ(බස්නාහිර පළාත), නාගරික සංවර්ධන අධිකාරිය — කාරුණික දැන ගැනීම සඳහා
6. නාගරික කොමසාරිස්,මහ නගර සභාව,කඩුවෙල — කාරුණික දැන ගැනීම සඳහා
7. අධ්‍යක්ෂ, මධ්‍යම පරිසර අධිකාරිය(බස්නාහිර පළාත) — කාරුණික දැන ගැනීම සඳහා
8. ගොවිජන සංවර්ධන ප්‍රාදේශීය නිලධාරි,මාළඹේ — කාරුණික දැන ගැනීම සඳහා
9. පොලිස් ස්ථානාධිපති, අතුරුගිරිය — කාරුණික දැන ගැනීම සඳහා
10. කෘෂිකර්ම පර්යේෂණ නිෂ්පාදන සහකාර — කාරුණික දැන ගැනීම සඳහා

ගොවිජන සංවර්ධන දෙපාර්තමේන්තුව, අංක 42, ශ්‍රීමත් මාර්කස් ප්‍රනාන්දු මාවත, තැ. පෙ. 537, කොළඹ 07.
கமநல அபிவிருத்தித் திணைக்களம், இல. 42, சேர் மார்கஸ் பெர்னாந்து மாவத்தை, அ. பெ. 537, கொழும்பு 07.
DEPARTMENT OF AGRARIAN DEVELOPMENT, NO. 42, SIR MARCUS FERNANDO MAWATHA, P. O. BOX 537, COLOMBO 07.

8ු 1-1

දුරකථන/தொலைபேசிகள்/Telephones :
පොදු කාර්යාලය / பொது அலுவலகம் / General Office 2694231, 2694232, 2694233, 2694234
ගොවිජන සංවර්ධන කොමසාරිස් ජනරාල් / கமநல அபிவிருத்தி ஆணையாளர் நாயகம் / Commissioner General of Agrarian Development 2691060
ෆැක්ස් / தொலை நகல் / Fax 2693572, 2691843, 2674481
E-mail : commissionerdad@yahoo.com
විදුලි පණිවුඩ / தந்தி / Telegram ගොවිජනසේවා / கொவிசேவா / Agraservis

වනජීවී සංරක්ෂණ දෙපාර්තමේන්තුව
வனசீவராசிகள் பாதுகாப்புத் திணைக்களம்
DEPARTMENT OF WILDLIFE CONSERVATION

ප්‍රධාන කාර්යාලය - අංක 811/ඒ, ජයන්තිපුර පාර, බත්තරමුල්ල
பிரதான அலுவலகம், இல. 811/ஏ, ஜயந்திபுர வீதி, பத்தரமுல்லை
Head Office - No. 811/A, Jayanthipura Road, Battaramulla

මගේ අංකය / எனது இல. / My No. WL/6/1/1/298

ඔබේ අංකය / உமது இல. / Your No.

දිනය / திகதி / Date 15.01.2018

Light Rail Transit Project-JICA
RECEIVED
16 JAN 2018
Ministry of Megapolis & Western Development

Through
Secretary,
Ministry of Sustainable Development and Wildlife

Secretary,
Ministry of Megapolis and Western Development,
Battaramulla.

Dear Sir,

Concurrence for Project Implementation Light Rail Transit (LRT) –JICA Project

This refers to your letter numbered LRT-J/07/ENV/2017/1 and dated 23.11.2018 regarding the above subject.

02. According to the map that you have submitted to this department, proposed light rail transit (LRT) project falls outside of the Sri Jayawardhanapura Sanctuary declared under the Fauna and Flora Protection Ordinance. LRT goes through the sanctuary buffer zone (100 m) in two locations.

03. Therefore we have no objection to carry out this project under the stipulated conditions recommended by Environmental Impact Assessment (EIA)/Initial Environmental Examination (IEE) and the provisions of Flora and Fauna Protection Ordinance.

04. Please be kind enough to nominate Department of Wildlife Conservation (DWC) as a TEC member for the TEC committee.

Yours Faithfully,

Manjula Amararathne
Director (Operations)

Sgd/M.G.C.Sooriyabandara
Director General

Copy: Secretary,
Ministry of Megapolis and Western Development, - For Your Kind Information
Battaramulla.

Assistant Director (Western) - -do-

දුරකථන / தொலைபேசி / Telephone
අධ්‍යක්ෂ ජනරාල් - 011 2888581
අධ්‍යක්ෂ (පාලන) - 011 2888583
අධ්‍යක්ෂ (මෙහෙයුම්) - 011 2888582
අධ්‍යක්ෂ (මුදල්) - 011 2888584

ප්‍රධාන කාර්යාලය / அலுவலகம் / Head Office: 011 2888585
ෆැක්ස් / தொலைநகல் / Fax: 011 2883355
ඊ-මේල් / மின்னஞ்சல் / E-mail: director@dwc.gov.lk
වෙබ් අඩවිය / வலைப்பின்னல் / Website: www.dwc.gov.lk

(169)

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කාර්යාලය/ அலுவலகம் / **Office**
දුරකථනය / **Telephone** / தொலைபேசி: **011-2887421**
ෆැක්ස් / தொலை நகல / **Fax**: **011-2887481**

තිරසර සංවර්ධන හා වනජීවී අමාත්‍යාංශය
வலுவாதார அபிவிருத்தி மற்றும் வன ஜீவரசிகள் அமைச்சு
Ministry of Sustainable Development and Wildlife
9 වන මහල, පළමු අදියර, "සෙත්සිරිපාය", බත්තරමුල්ල.
9 ஆம் மாடி, முதலாம் கட்டம், "செத்சிறிபாய", பத்தரமுல்லை.
9th Floor, Stage I, "Sethsiripaya", Battaramulla.

ලේකම්/ செயலாளர்/ **Secretary**
දුරකථනය / தொலைபேசி / **Telephone**: **011-2885841**
ෆැක්ස් / தொலை நகல / **Fax**: **011-2885492**

3 0 JAN 2018
තැපැල් අංශය

මගේ අංකය / எனது இல / My No: SDW/5/4/2/iv
ඔබේ අංකය / உமது இல / Your No:
දිනය / திகத / Date: 29.01.2018

Light Rail Transit
RECEIVED
02 FEB 2018
Ministry of Megapolis & Western Development

SR
2018/01/30

PD (LRT, JICA)

Secretary
Ministry of Megapolis and Western Development
Batteramulla

Concurrence for Project Implementation Light Rail Transit (LRT) –JICA project

Herewith I am forwarding the letter dated 15th January 2018 sent by the Director General of Department of Wildlife Conservation regarding the above subject for your necessary action please.

A.K.K.M.R.W. Kumaragama
Additional Secretary (Development)
For Secretary
Ministry of Sustainable Development and Wildlife

RS – For NAP
1/2

Copy:
Director General, Department of Wildlife Conservation - i.f.pl.

ලංකා විදුලිබල මණ්ඩලය
இலங்கை மின்சார சபை
CEYLON ELECTRICITY BOARD

Your Ref: PMU/JICA/ULT/04 My Ref: LRT --Project/Gen.Correspondance Date: 08th November 2017

Project Director,
Light rail Transit Project (JICA),
Ministry of Megapolis and Western Development.

Dear Sir,

Consent for the Re-Routing of All Affected Transmission & Distribution Lines – JICA funded Light Rail Transit Project

---

This refers to your letter no PMU/JICA/ULT/04 dated 31.10.2017 regarding above.

As requested therein, the consent is hereby granted subject to the re-routing of all affected Transmission & Distribution Lines designed by CEB for the proposed LRT route.

This shall be carried out according to the system procedures and guidelines of Ceylon Electricity Board.

General Manager
Ceylon Electricity Board.

Copy to:

1. Addl.GM (DD1) – f.i.p.l.
2. Addl.GM (Tr) - f.i.pl
3. Addl.GM (DD3) – f.i.p.l.

OFFICE OF THE GENERAL MANAGER
3rd Floor, Chittampalam A Gardiner Mawatha, Colombo 00200, Sri Lanka.
Tel: +94 11 23 20 953 / 23 25 340 | Fax: +94 11 23 23 935 | e-mail: gm@ceb.lk| www.ceb.lk |

My No DIAM/AM/W/CMB/General
Assets Management Branch
Irrigation Department
Colombo07
16.12.2017

Light Rail Transit Project-JICA
RECEIVED
21 DEC 2017
Ministry of Megapolis & Western Development

Eng. Nihal Rupasinghe
Secretary
Ministry of Megapolis and Western Development

DPD – Pl collect all these Clearance letters in view of sending to JICA.

Mr. Ravi
Pl take action to collect all clearance letters from respective organizations.
26/12

Concurrence for Project Implementation
Light Rail Transit (LRT) Project.

(109)

This refers to your letter no LRT/J/ENV/08 dated 19.10.2017

This proposal was inspected at the site by Colombo Division Irrigation Engineer and found that 100 m^3 of water to be discharge daily to the canal along the Chandrika Kumarathunga Mawatha in Malabe and convey to the Kalani river through Malabe Minor Flood protection scheme belong to Irrigation Department.

Eventhough Irrigation Department has no objection for this proposal you may need the approval of SLRDC and Enviornment Authority due to reason mentioned in the above para.

Eng H.M.Junaid
Director of Irrigation (Assets Management)
O/C

Copy

1. Director of Irrigation (Colombo) - f.i. & n.a pl

KUMARASINGHE SIRISENA
Chairman
Sri Lanka Telecom PLC
1st Floor, CTO Building
Lotus Road, Colombo 01, Sri Lanka.
Company Reg. No. PQ7
Voice : +94- 11-2323434 / +94-11-2433337
Fax : +94-11-2449999
E-mail : sltchairman@slt.com.lk
Website : www.slt.lk

Sri Lanka Telecom

CH-L/GCEWO-LRT/04/01/2018

4th January, 2018

The Secretary
Ministry of Megapolis & Western Development
17th & 18th Floors
Suhurupaya, Subhuthipura Road,
Battaramulla

Dear Secretary

CONCURRENCE OF PROJECT IMPLEMENTATION
LIGHT RAIL TRANSIT (LRT) PROJECT – JICA

With reference to your letter LRT-J/16/UTI/07/SLT dated 15/12/2017 on the above subject, we wish to inform you that Sri Lanka Telecom PLC (SLT) has no objection in principle for your proposed trace to construct LRT structures on the center median of existing roads that may require to adjust/divert existing SLT owned Outside Plant network, if any, subject to the following:

1. Before commissioning the work, Ministry of Megapolis and Western Development and/or LRT Project-JICA shall make arrangements for joint site inspections with SLT with the relevant authorities/organizations to identify the existing SLT plants along the proposed trace and plan for appropriate diversions/relocations of SLT Out Side Plant network, where applicable. This will enable SLT to prepare the required removal and relocation plan and submit a cost estimate to your office.

2. Ministry of Megapolis and Western Development and/or LRT Project-JICA shall agree to bear the total cost of such diversions/relocations and service cut-overs based on the estimates made by SLT for such requirement. Upon the receipt of payment SLT will carry out necessary shifting work.

Thank you.

Yours sincerely

Kumarasinghe Sirisena
Chairman

Copy: Actg. CCO

Board of Directors: Mr. P.G. Kumarasinghe Sirisena (Chairman), Mr. Chan Chee Beng, Mr. Lawrence Paratz, Ms.Lai Choon Foong, Ms.Nilanthi Pieris, Mr.W.K.H.Wegapitiya, Mr.J.R.U.De Silva, Mr.A.R.Desapriya

Dialog

December 27, 2017

Mr. Nihal Rupasinghe,
Secretary,
Ministry of Megapolis and Western Development.

Dear Sir,

CONCURANCE OF PROJECT IMPLEMENTATION
LIGHT RAIL TRANSIT (LRT) PROJECT- JICA

Reference is made to your letter LRT-J/16/UTI/11/DLG dated 15th December 2017 on above captioned matter.

Whilst thanking you for being concerned about the safety of our existing fiber optic cable paths, We have highlighted the existing road segments where our fiber cables are laid in the reference maps provided .

Further we would be much grateful if a JICA representative could participate for a joint inspection along with our Optical Fiber maintenance team to exactly locate the overlapping sections. This will help us on providing you with precise details which will ease your work as well as ensure the safety of our cables.

Please kindly inform us a date and time convenient to you to arrange this join inspection

Should you need further clarifications, please do not hesitate to contact Dilan. D. Perera Manager - Transmission Operations on 773331169.

Thank you very much for your kind cooperation in this regard.

Yours faithfully,

DIALOG BROADBAND NETWORKS (PVT) LIMITED

Wijin
1/9/2018

Pradeep De Almeida
Group Chief Technology Officer

Dialog Broadband Networks (Pvt) Ltd (PV 261)
475, Union Place, Colombo 02, Sri Lanka. Tel: +94 (0) 11 7 100 700 Fax: +94 (0) 11 7 100 701 www.dialog.lk
an axiata company

INSEE
ECOCYCLE

3rd April 2018

Eng. Chaminda Ariyadasa
Project Director,
Light Rail Transit Project - JICA,
Ministry of Megapolis and Western Development

Dear Sir,

Re: Request to Obtain Consent/Concurrence for the Acceptance of Wastes – Light Rail Transit Project from Fort to Malabe

With reference to your letter dated 22nd March 2018 on the above request, it is highly appreciated that you have select us as the preferred waste management partner for LRT project.

INSEE Ecocycle, the waste management unit of Siam City Cement (Lanka) Limited (SCCL) which was previously named as Geocycle under the former Holcim (Lanka) Limited, has been in the waste management industry since 2003 and had served to the nation in eliminating more than 600,000 MT of waste through its cement kiln, which would have otherwise ended up at the open dumping. We are pleased to covey our initial interest on secure disposal of material as per the waste profile provided with regards to the above project. We will have to separately analysis the waste generation and the disposal solution when the actual requirement arises after completion of the LRT project on 2025.

Looking forward to continuing strong relationship with LRT project.

Yours faithfully,

Siam City Cement (Lanka) Limited

Sanjeewa Chulakumara
General Manager - Ecocycle

Sanjeewa Chulakumara
General Manager
INSEE Ecocycle
Siam City Cement (Lanka) Limited
No. #13 R. A. De Mel Mawatha,
Colombo 03

Siam City Cement (Lanka) Limited
Reg No. PB 588
#11 R A De Mel Mawatha, Colombo 3, Sri Lanka
Tel: +94 11 7800 800
Website: www.siamcitycement.com/lk

Annex C

Traffic Impact Study

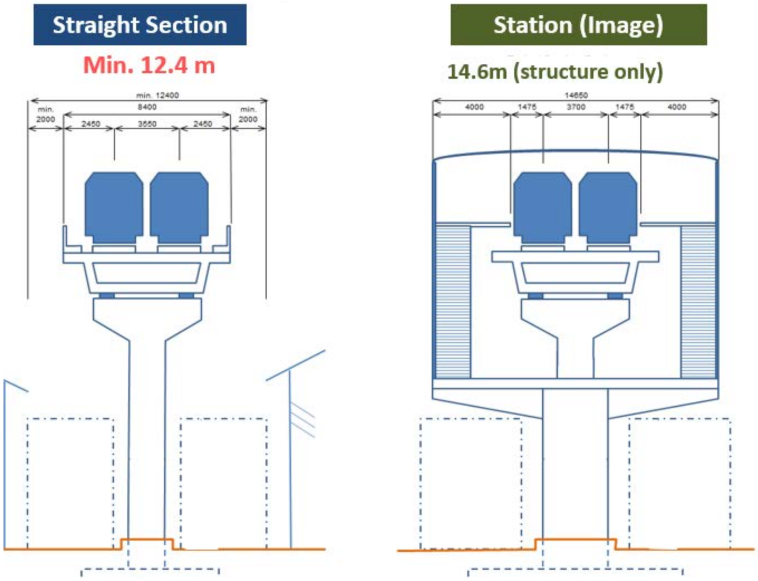
1 TRAFFIC IMPACT ANALYSIS FOR THE PROPOSED LRT LINE – RTS 1 (NORTHERN PART) AND RTS 4

1.1 Introduction

The Ministry of Megapolis and Western Region Development has proposed an Light Rapid Transit (LRT) network for the Western Region as one of their key developments in the transport master plan. The proposed LRT lines are the first phase of the LRT network. The total length of the LRT line is 16 km. The route of the proposed LRT lines and stations considered in the study are given in Figure 02 below.

1.2 Characteristics of the LRT Infrastructure

The infrastructure characteristics of the LRT line is an important consideration in assessment of its impact during the construction stage. The typical cross section of an elevated LRT line is given in Figure . The Right of Way (ROW) is 12.4m (8.4m for track and 2m gap on each side) on straight sections and 14.6 near stations. It is assumed that during construction minimum of 10m wide area will be allocated for construction works on straight sections and 15m at stations. 10m wide is equivalent to 2 lanes including the width of the centre median on roads with a centre medians.



Source: JICA

Figure 1. Typical cross sections of LRT line

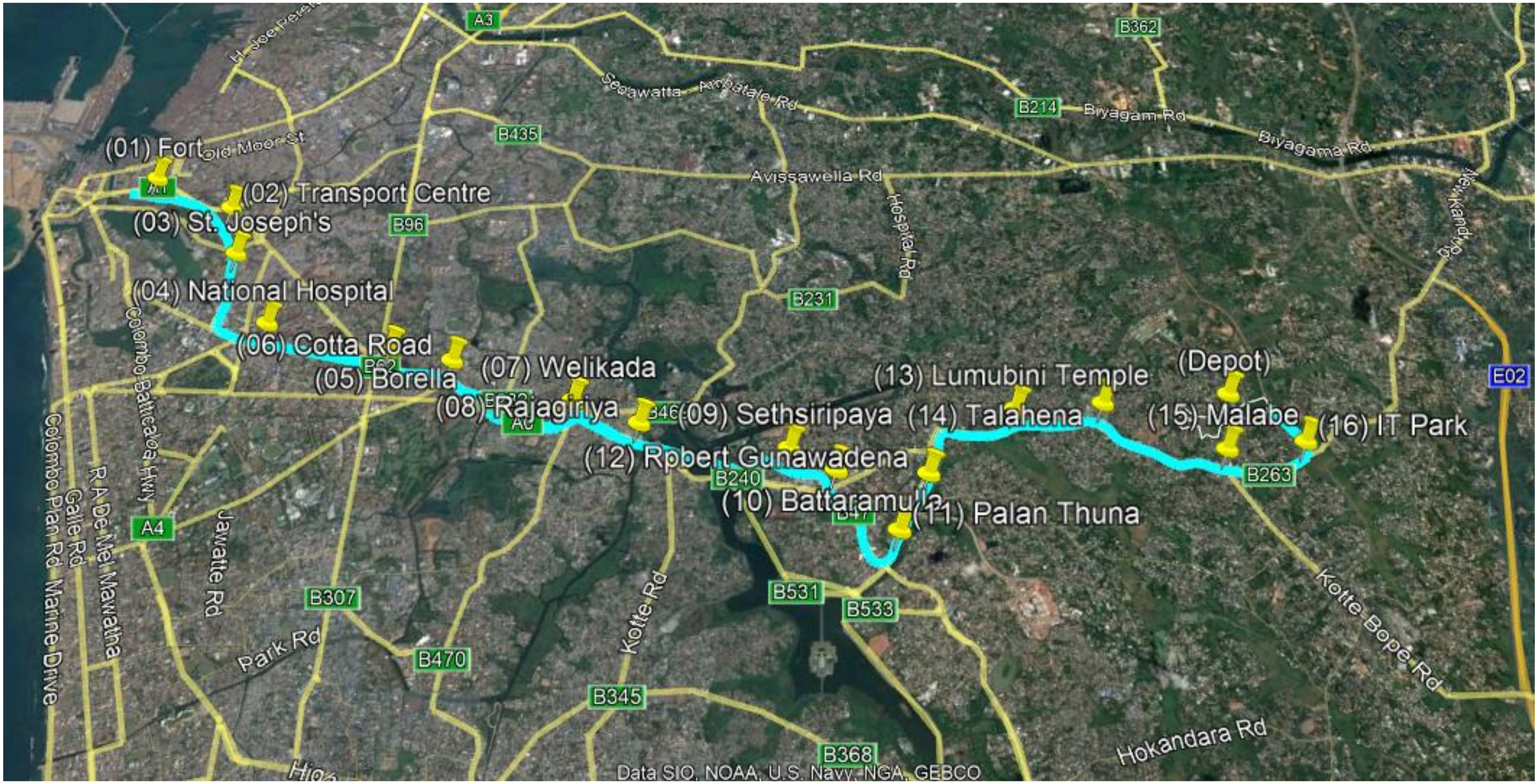


Figure 2: Proposed LRT route and stations

1.3 Road Network and Traffic Characteristics in the Project Impact Area

The LRT line is to constructed parallel to the existing roads for majority of its route except for section near Sethsiripaya Station and near Kotte-Bope Road. Therefore, it is expected that there will be significant impact on the road network during the construction phase.

The characteristics of the roads along which the LRT lines is proposed to be constructed and other roads affected at key intersections are listed in Table 1 below.

Table 1. Characteristics of Roads affected by the LRT Construction

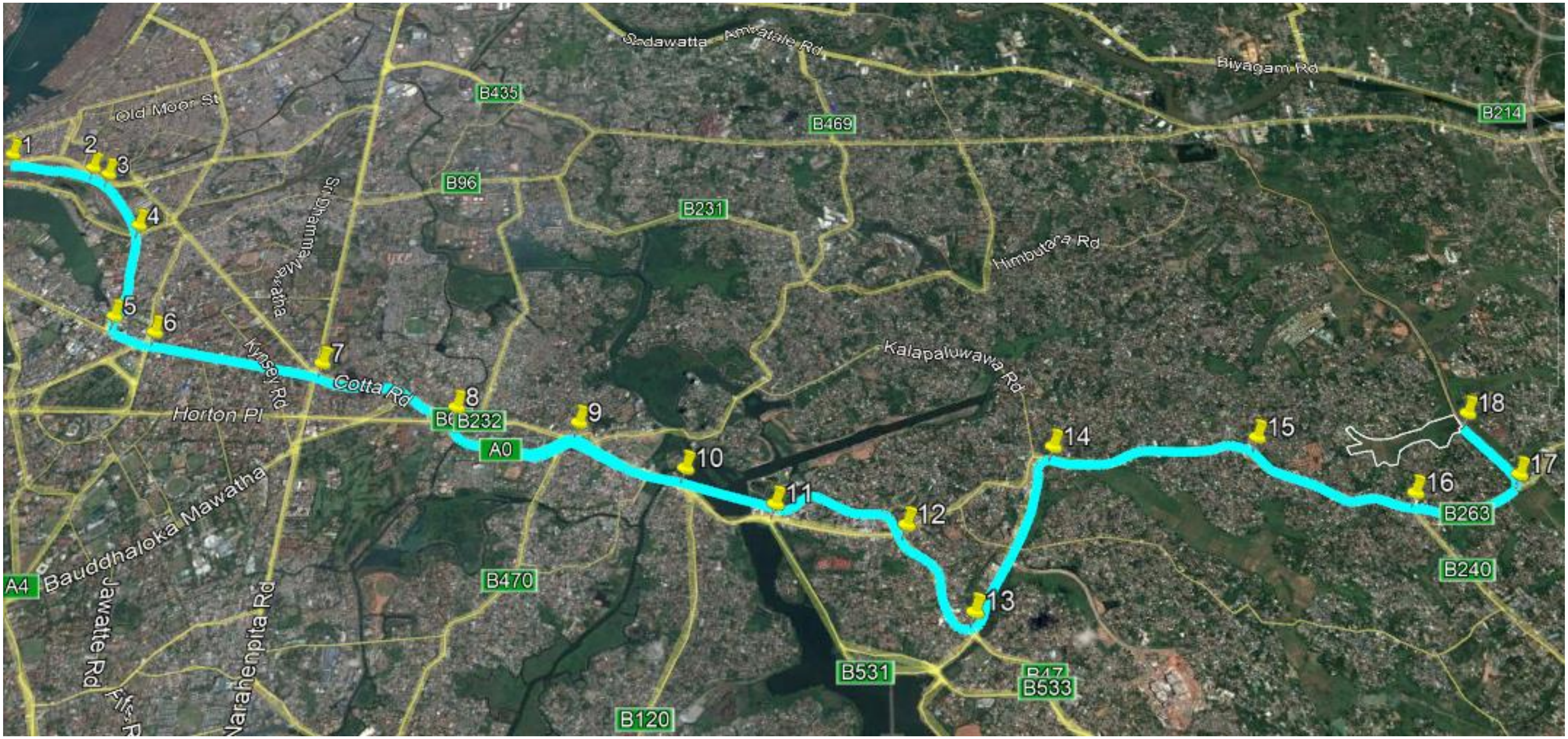
No.	Road Name	Class	Start node (a)	End node (b)	Node Type (a)	(b)	Road type	No. of lanes	Carriageway width (m)	Sidewalk width (m)
1	W E Bastian Mawatha		1	2	3	4S	One way	2	10	2.0-4.0m
2	Olcott Mawatha	A01	2	3	4S	3	Divided	5	21	> 4.0m
3	Trace Ln		3	4	3	3	Undivided			
4	T B Jayah Mawatha		4	5	3	3S	Divided	4	18	> 4.0m
5	Dr Colvin R de Silva Mawatha		5	6	3S	RS	Median Seperated	4	13	2.0-4.0m
6	Ward Place		6	7	RS	5S	Divided	4	13	2.0-4.0m
7	Cotta Rd	B62	7	8	5S	4S	Median Seperated	4	15	2.0-4.0m
8	Sri Jayawardenepura Mawatha	B240	8	9	4S	5	Median Seperated	6	24	2.0-4.0m
9	Sri Jayawardenepura Mawatha	B240	9	10	5	-	Median Seperated	6	21	> 4.0m
10	Sri Jayawardenepura Mawatha		10	11	-	3	-		-	-
11			11	12	3	3S	-	-	-	-
12	Battaramulla Rd	B47	12	13	3S	4S	Median Seperated	4	14	2.0-4.0m
13	Denzil Kobbekaduwa mawatha		13	14	4S	-	Undivided	4	12	> 4.0m
15	Kaduwela Rd	B240	14	15	-	3	Undivided	2	10	2.0-4.0m
16	Kaduwela Rd	B240	15	16	3	3	Undivided	2	10	<2m
17	Kaduwela Rd	B240	16	17	3	3	Undivided	2	10	<2m
18	Chandrika Kumaratunga Mwa		17	18	3	-	-	2	-	2.0-4.0m

Note: The junction type (at the node) and the traffic control mechanism is indicated as follows,

3	3 way (Y/T junction)
4	4 way
R	Roundabout
*S	Signalized

Midblock nodes are indicated as empty

Sections that are not constructed over existing major road links are highlighted in grey.



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17
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Old Moor St
Sadawatta
Ambatale Rd
Biyagam Rd
B435
B469
B214
B96
B231
Himbutana Rd
Sri Dhammа Mawatha
Kynsey Rd
Cotta Rd
Kalapaluwawa Rd
Horton Pl
B232
A0
B263
B240
Bauddhaloka Mawatha
A4
Jawatte Rd
Narahenpita Rd
B470
B120
B531
B47
B533

1.3.1 Bastian Mawatha (Node 1-2)

Bastian Mawatha operates as a one-way two-lane road with a 12 hr traffic volume of 18,230 vehicles and a peak flow of 1710 veh/hr. Traffic flow is fairly uniform during the day and reduces significantly after 6.00PM. The vehicle composition is predominantly buses and three-wheelers with 31% and 43% respectively, motorcycles are 13% and 6% cars/van/jeep category.

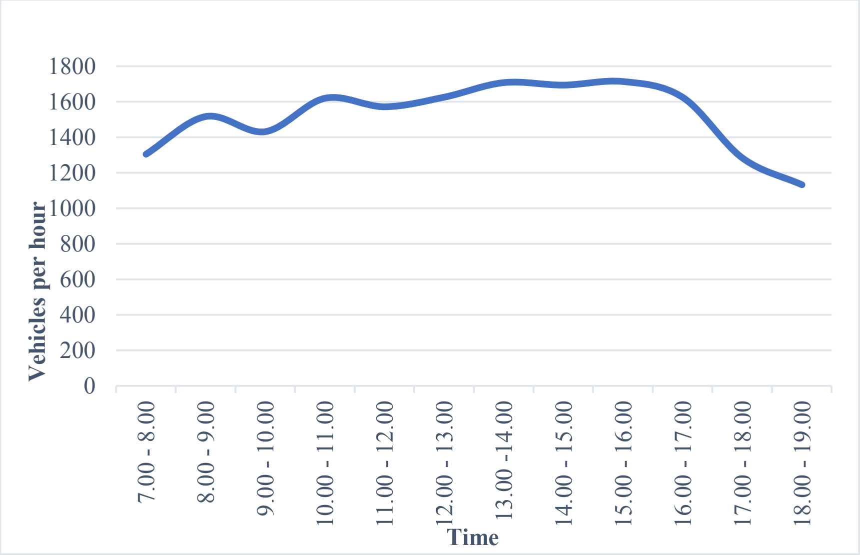

Figure 4. Hourly traffic flow on Bastian Mawatha

1.3.2 Olcott Mawatha (Node 2-3)

Olcott Mawatha section where the LRT is proposed to be constructed include several key intersections in the Fort area and is used to access the Pettah market, main bus and railway terminals in the city. The Lotus Road and York Street intersections are one of the busiest intersections in the city. As shown in Figure , there is significant congestion and queue build up from the York Street and Lotus Road intersections and towards Pettah on Olcott Mawatha during the peak hours.

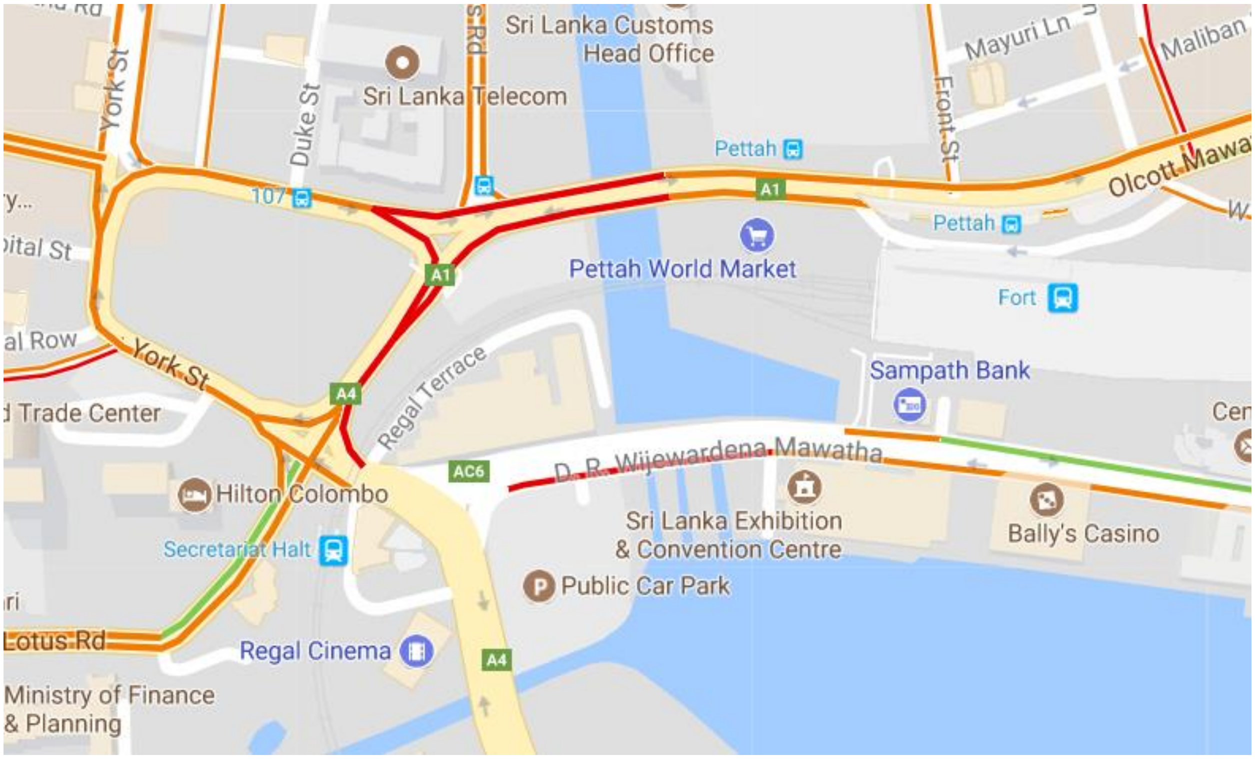

Figure 5. Traffic condition near Olcott Mawatha/Lotus Road/York Street intersections

A4/Olcott Mawatha/Lotus Road junction has a 12 hr traffic flow of over 72000 vehicles with peak hour flow in the range of 7300 veh/hr. Olcott Mawatha/York Street junction has nearly 63,500 vehicles during a 12 hour period, with peak flows in range of 6000 veh/hr. Traffic flow at the intersection (Node 8) on Olcott Mawatha is around 41,000. The average traffic flow during a 12 hr period along Olcott Mawatha is in the range of 35,000, with peak flow of 3199 veh/hr occurring during the mid-day period, hourly flows fairly even during the day (see Figure).

Olcott Mawatha has a very high pedestrian flow as well mainly due to, a) the public transport users from the Fort Railway Station and interprovincial and intra provincial bus terminals and b) the pettah market area.

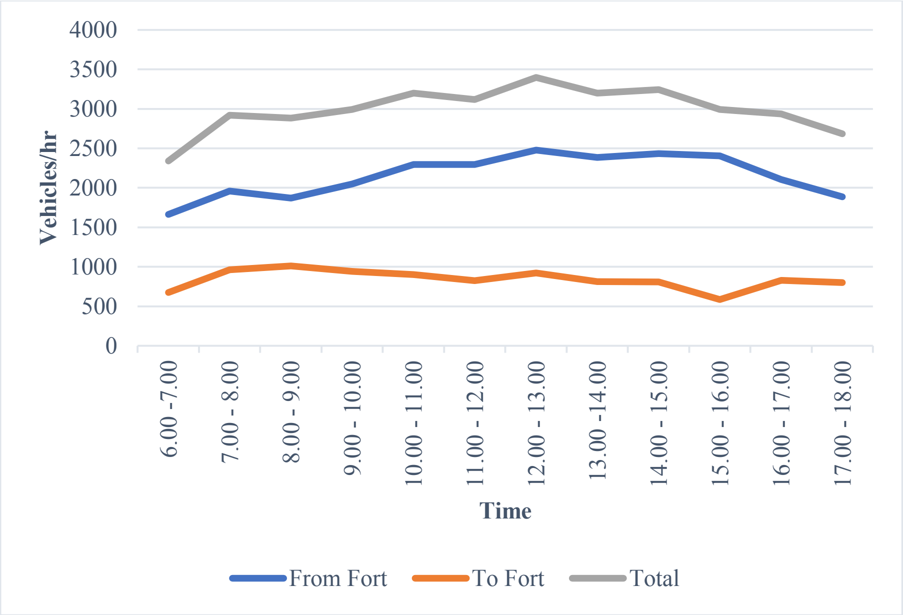

Figure 6. Hourly traffic flow on Olcott Mawatha (near Bastian Mawatha terminal)

1.3.3 T.B. Jayah Mawatha (Node 4-5)

T.B.Jayah Mawatha is a 4-lane road connecting D.R. Wijewardene Mawatha and Union Place. The 12 hr traffic volume is 30,180 vehicle and peak flow of 3175 veh/hr. There is a significant peak in traffic movement during the mid day period, due to the presence of a school and the afternoon period is especially congested due to traffic flow towards Union Place.

D.R. Wijewardene Mw./T.B.Jaya Mawatha intersection has a total traffic movement of 41,043 during the day time 12 hr period with a peak 15 min flow rate of 1250 vehicles occurring during the mid-day.

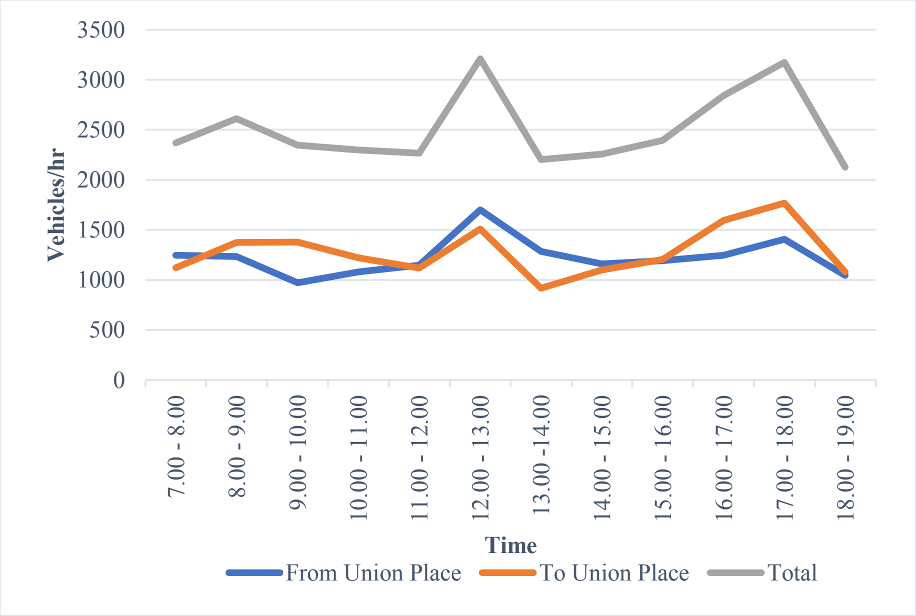

Figure 7. Hourly traffic flow on T.B. Jayah Mawatha

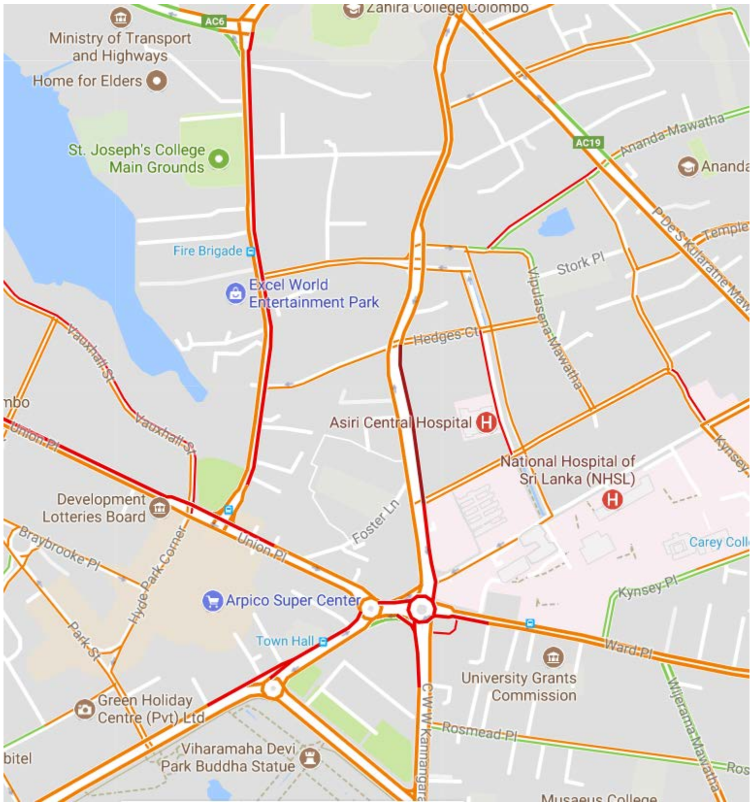

Figure 8. Traffic flow condition in the network near nodes 13-15 (PM peak period)

1.3.4 Union Place – Town Hall- Ward Place (Node 5-7)

The road section from Ibbanwala junction to Borella via Town Hall is a high traffic volume corridors with significant congestion oberserved at Ibbanwala junction, De Soysa Circus as well the Borella Junction (see Figure . Ibbanwala junction has 12 hr day time traffic demand of 63,604 vehicles with peak hour demand of 6139 veh/hr. Union Place road segment from Ibbanwala junction to Town Hall has a 12hr traffic volume of 44,202 vehicles, with peak flow of 4101 veh/hr and heavy traffic flows and congestion is observed towards Town Hall in the evening peak period.

Ward Place operates as a 4-lane road with a 12 hr traffic flow of 31,391 vehicles. Peak flow rate is 2981 veh/hr (see. Traffic flow speeds are relatively satisfactory compared to similar roads in the network and delays are near the two ends of the road. The vehicle composition is as follows, cars/van/jeep -26%, motorcycles -19%, three-wheelers-33%, goods vehicle -3%, buses- 4%. The road segment beyond Borella Cross Roads has less traffic since traffic toward Borella turn left from Ward Place on to Borella Cross Road.

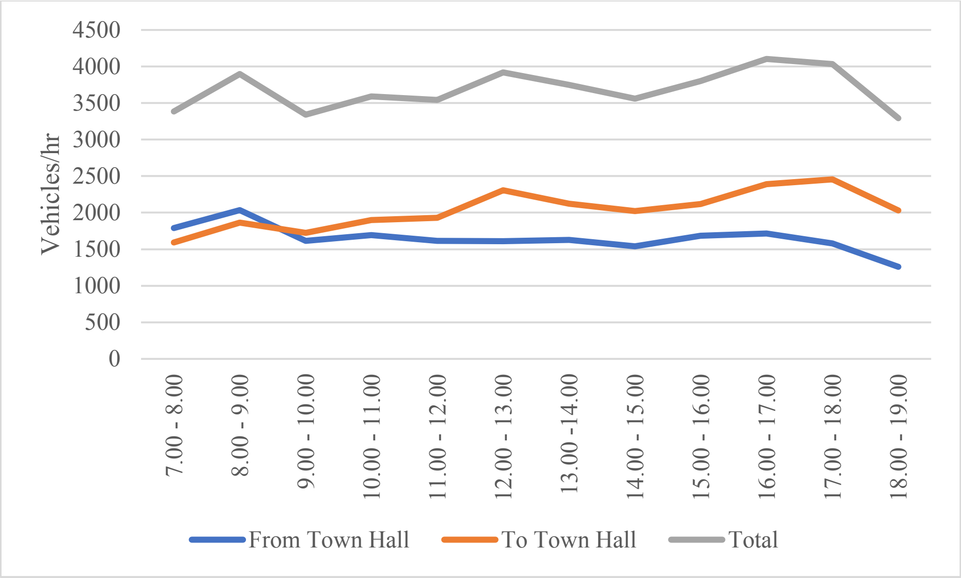

Figure 9. Hourly traffic flow on Union Place near Ibbanwala junction

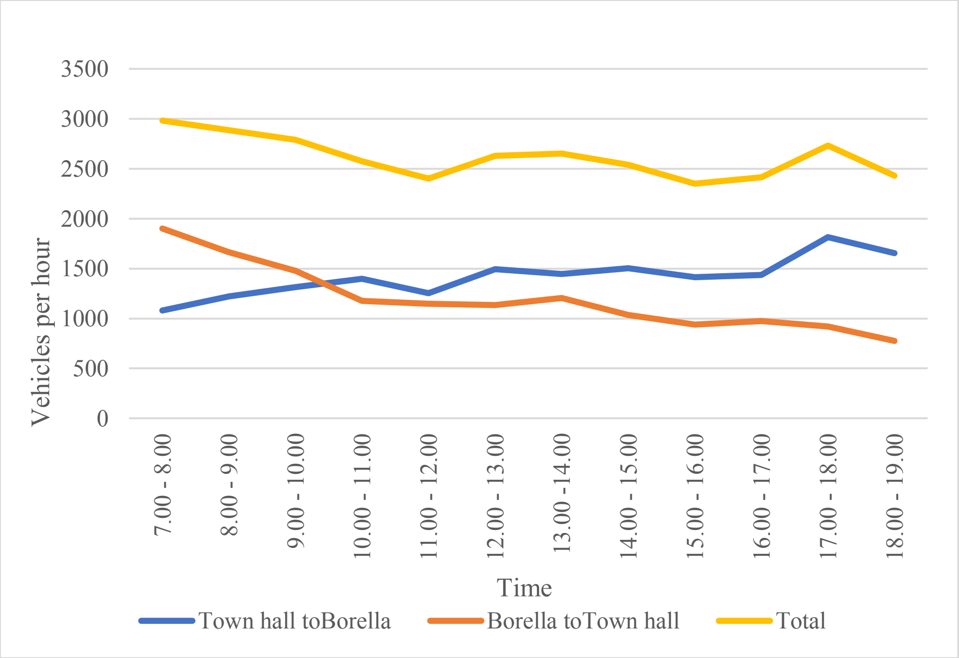

Figure 10. Hourly traffic flow on Ward Place

1.3.5 Cotta Road (Node 7-8)

Cotta Road operates as a 4-lane median divided road with a 12hr traffic flow of 44181 vehicles and a peak flow of 4012 veh/hr. The vehicle composition is as follows, cars/van/jeep -38%, motorcycles - 25%, three-wheelers-29%, goods vehicle -4%, buses- 4%. The Kelani Valley railway line crossing is located along this segment, and delays are typically observed near the crossing during closure period. In addition, as shown in Figure , there is heavy congestion towards Rajagiriya during the evening peak, especially near the Ayurveda and Rajagiriya junctions.

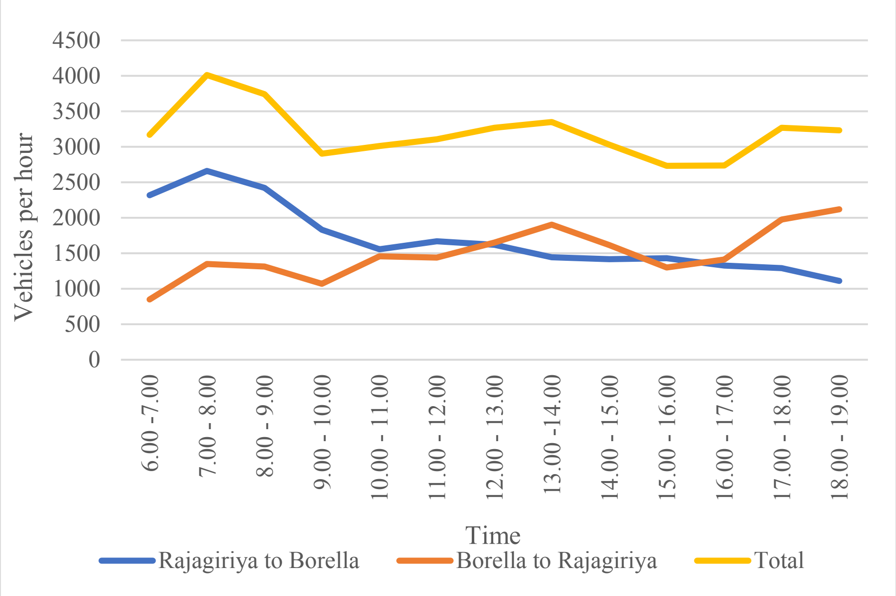

Figure 11. Hourly traffic flow on Cotta Road

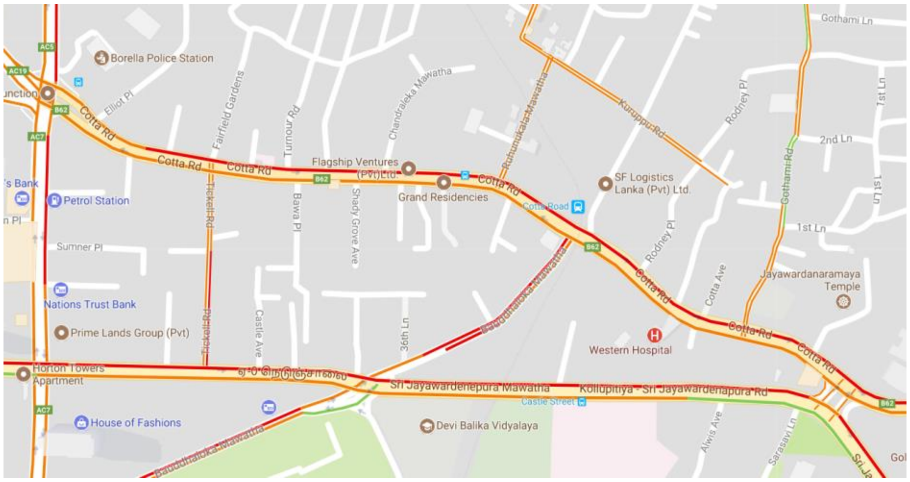

Figure 12. Traffic condition on Cotta Road (PM Peak)

1.3.6 Sri Jayawardenepura Mawatha (Node 8-9)

Sri Jayawardenepura Mawatha, at presently one of the most congested roads in Colombo. It serves a large population in Rajagiriya and Malabe corridors who make car oriented trips and several key intersections are located which that connects this to Cotta Road, Angoda, Nawala etc. which adds to the delays observed on the road segment. It operates as six lane median separated highway. Sri Jayawardenepura Mawatha has a 12 hr traffic volume of approximately 51,000 vehicles with two distinguishable peaks during the morning and the evening periods. The peak hour traffic flows are in the range of 4000-5000 vehicles/hr, with morning peak flow of nearly 4000 vehicles/hr towards Borella and evening peak flow of nearly 3000-4000 vehicles/hr towards Battaramulla. The vehicle composition is as follows, cars/van/jeep -41%, motorcycles - 23%, three-wheelers-26%, goods vehicle -4%, buses- 5%.

At present, a bus priority lane is in operation on section of this road in the morning and a flyover is under construction at Rajagiriya intersection.

1.3.7 Battaramulla Road – Denzil Kobbekaduwa Mw (Node -12-13-14)

Battaramulla road section between Palan thuna junction and Sri Jayawardenepura Road is 4 lane road which has a 12 hr traffic volume of 18410 vehicles and a peak flow rate of 1890 veh/hr. The traffic congestion is low on this link compared to other roads in the network. The vehicle composition is as follows, cars/van/jeep -42%, motorcycles - 22%, three-wheelers-30%, goods vehicle -3%, buses- 3%.

Denzil Kobbekaduwa Mawatha is a 4-lane road which has a 12 hr traffic volume of 36,858 vehicles and a peak flow rate of 3610 veh/hr. This section attracts high traffic volumes due to the numerous government institutions being established along the road.

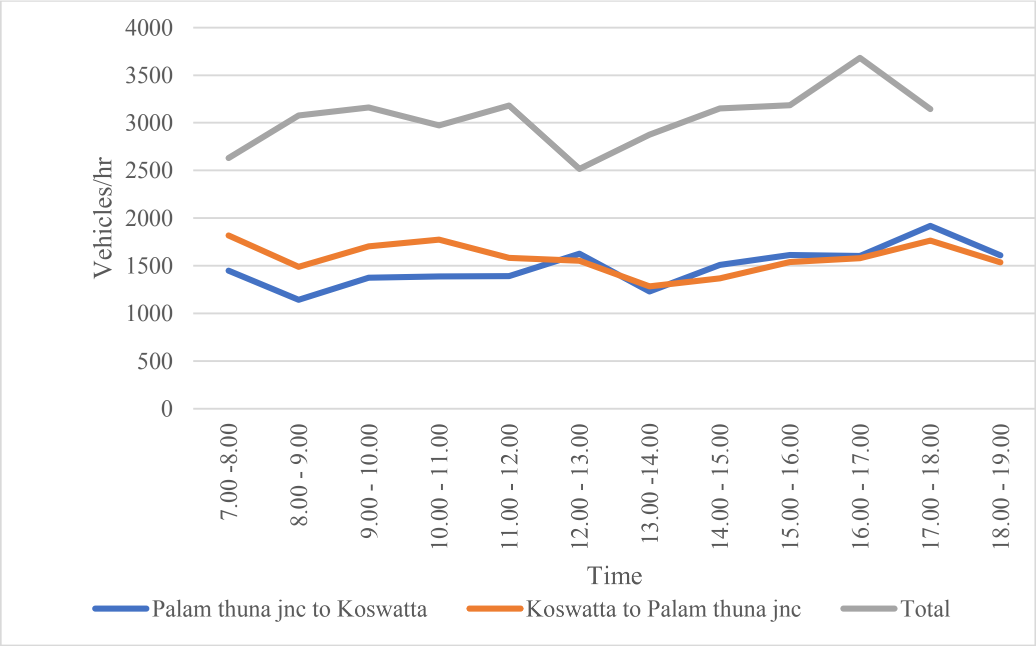

Figure 13. Hourly traffic flow on Denzil Kobbekaduwa Mawatha

1.3.8 Kotte-Bope Road (Node 14-15-16-17)

Kotte-Bope road (Between Malabe junction and IT park) serves as the main arterial road that connects the Malabe corridor to Rajagiriya, Battaramulla and Colombo. It is a 2-lane road with 31885 vehicles per day observed during a 12hr period. Peak flow rate is 3708 veh/hr and distinct peak periods are observed flow the hourly flow variation.

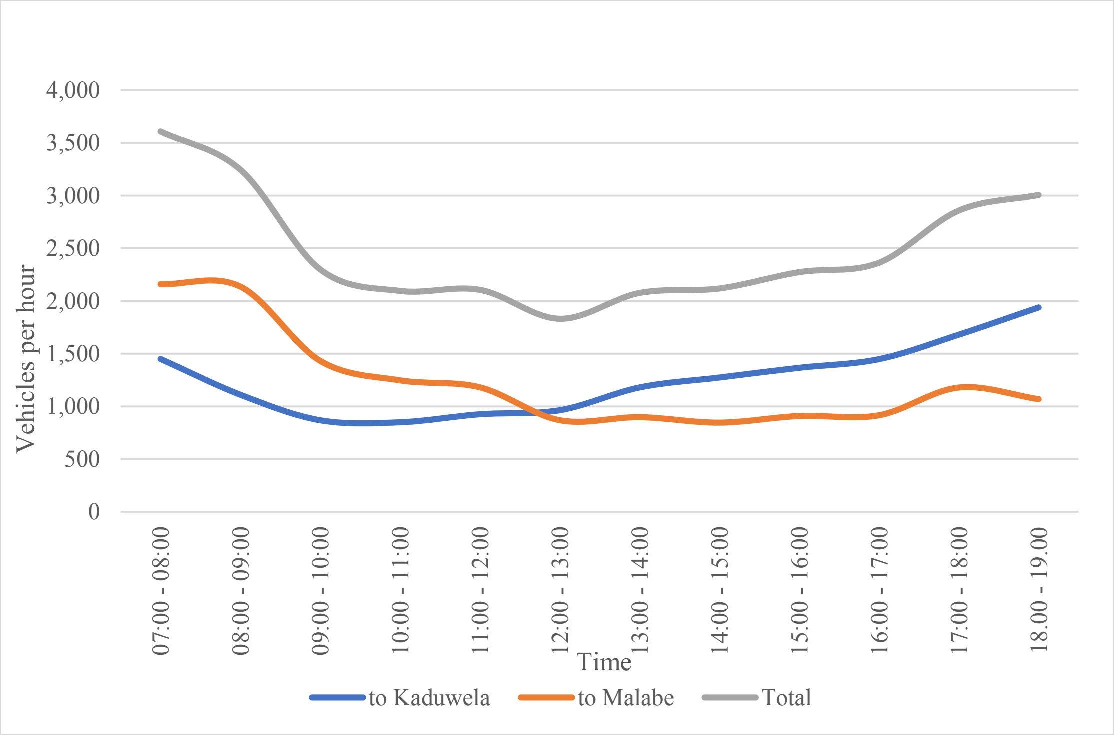

Figure 14. Hourly traffic flow on Kotte-Bope Road

1.3.9 Summary of the Link Traffic Flows

The volume to capacity analysis was carried to gauge the existing condition of road capacity for the road links where the LRT line will be constructed. The following assumptions were made,

Lane capacity – 1400 veh/hr/lane

Peak hour factor = 10% of daily traffic

Road capacity = Hourly capacity/Peak hour factor

Estimated ADT = 1.25 x 12 hr traffic volume

As evident from results in Table 2, most road links operate at or near capacity levels when you consider the total capacity of the road.

Table 2. Capacity Analysis for the Road Links

Link ID	Road Name	Class	Road type	No. of lanes	Link hourly Capacity (veh/h)	Estimated ADT	Total 12hr	V/C
1	Olcott Mawatha	A01	Divided	5	7000	45000	36000	0.64
2	W E Bastian Mawatha		One way	2	2800	22788	18230	0.81
3	T B Jayah Mawatha		Divided	4	5600	37635	30108	0.67
4	Dr Colvin R de Silva Mawatha		Median Seperated	4	5600	55253	44202	0.99
5	Ward Place		Divided	4	5600	39239	31391	0.70
6	Cotta Rd	B62	Median Seperated	4	5600	55226	44181	0.99
7	Sri Jayawardenepura Mawatha	B240	Median Seperated	6	8400	72554	58043	0.86
8	Battaramulla Rd	B47	Median Seperated	4	5600	12139	9711	0.22
9	Denzil Kobbekaduwa mawatha		Divided	4	5600	23319	18655	0.42
10	Kaduwela Rd	B240	Divided	2	2800	37356	29885	1.33

This suggests that flow rate increases that occur during peak periods where flow rate increases there is likely to be extended periods of congestion. This was also evident from the traffic condition observations.

1.4 Traffic Impact Analysis and Mitigatory Measures

The proposed LRT line is to be constructed on the major arterial roads in Colombo. More than 50% of these roads have a daily vehicle traffic demand in excess of 50,000 vehicles. There are several critical intersections that will be affected during the construction activities that may have network wide impacts in addition to the roads directly affected by the construction work.

1. T.B.Jaya Mw – D.R.Wijewardene Mw intersection
2. Ibbanwala junction
3. De Soysa Circus / Lipton Cicus
4. Borella junction
5. Ayurveda junction
6. Rajagiriya junction
7. Koswatta junction

In addition, there are roads with high pedestrian movement and links to key public transport services.

1.4.1 Road Link Capacity Reduction

A minimum of 10m wide work-zone is required for the LRT construction. Therefore, most road links will lose 2-3 lanes as per standard lane width allocation. Assuming, temporary lane widths of 2.7m given and 1-2m of sidewalks allocated for temporary roadways during the construction stages, the number of temporary lanes that can be provided on the affected roads during construction phase is estimated and given in Table 3. This would require removal of the existing center medians, if any and relocation of road side utility facilities. The temporary lane allocation would result in a capacity reduction of 30%-50% on most roads. However, it is recommended to provided minimum of 3m especially for the lanes utilized by buses.

Table 3. Temporary lane number estimation

Link	Road Name	Road type	No. lanes	Carriageway (m)	Sidewalk (m)	Width avail. During construc	Temp. lanes
1	Olcott Mawatha	Divided	5	21	> 4.0m	13	4
2	W E Bastian Mawatha	One way	2	12	2.0-4.0m	3	1
3	T B Jayah Mawatha	Divided	4	18	> 4.0m	10	3
4	Dr Colvin R de Silva Mawatha	Median Seperated	4	13	2.0-4.0m	5	1
5	Ward Place	Divided	4	13	2.0-4.0m	5	1
6	Cotta Rd	Median Seperated	4	15	2.0-4.0m	6	2
7	Sri Jayawardenepura Mawatha	Median Seperated	6	24	2.0-4.0m	16	5
8	Battaramulla Rd	Median Seperated	4	14	2.0-4.0m	6	2
9	Denzil Kobbekaduwa mawatha[1]	Undivided	4	12	> 4.0m	9	3
10	Kaduwela Rd[1]	Divided	2	10	2.0-4.0m	7	2

Note: 1. Assume LRT line will be constructed on the edge of the carriageway and 5m on the existing roadway will be utilized for construction work zone.

1.4.2 Traffic Diversion

As a result of the reduced capacity of the links due to construction activity, it would be required to divert traffic especially during the peak periods during the construction phase. It is evident that similar to these roads affected, most of the links in the alternative routes have also reached their capacity. Diversion requirement may be in the order of 5000-10,000 veh/day for the affected roads. Therefore, it is required to clearly identify the stages of construction and the timeline to identify the alternative routes available and the phases when the diversion will take pace. Traffic diversion will be even more challenging if turning movements at intersections are obstructed during the construction activity.

1.5 Pedestrians

Pedestrian movement will be severely hindered during construction work, therefore it is recommended to ensure walkable paths maintained for pedestrian movement especially where high density of pedestrian flow is expected such as at Olcott Mawatha, Liberty Roundabout,Borella junction area.

1.6 Bus operations

Bus operations are likely to be severely affected during the project work. This includes the recently established bus lane operation in some corridors. It would be required to change the operational path of some bus routes and to relocate bus stops etc. The most critical segment would be that of Olcott Mawatha and Bastian Mawatha where the bus and rail terminals are located.

1.7 Safety

Ensuring safety during the construction period is of high importance. The consultants are required to adhere to the work zone management guidelines given by RDA for the required standards.

1.8 Recommendations

A comprehensive traffic study should be carried out to assess the different scenarios of stage-wise construction, traffic diversion options for each construction phase and its impact on the network traffic flow for the study period. This study should be accompanied by a micro-simulation traffic model for the study area to assess possible changes that will be made in the future. A separate intersection wise analysis is also recommended for the key intersections affected by the study. It is also recommended to update the model with any changes made to the traffic management schemes in the area, such as bus lane implementation, traffic signal installation etc.

Appoint a stake holder committee with the participation of project consultants, Colombo Municipal Council and the other relevant local government bodies, Road Development Authority and Traffic Police to give guidance on the developed traffic management plan as well as to continuously monitor its implementation during construction stage. The traffic management plan should be made available to the public and adequate time to be allowed for familiarization of the new routes.

Based on the above, the consultant is required to propose a traffic management scheme for each stage of construction for the work zone area and mechanism to be set up to monitor the traffic flow characteristics during the construction stage.

Annex D

Noise measurement survey

Monitoring of Background Noise Levels
And Existing Noise Levels
Report No. SS – 1708661

Report to :
Consulting Engineers & Architects Associated (Pvt) Ltd.
No. 500/5, ThalapathpitiyaRoad,
Madiwela,
Kotte.

Issued By:
Noise & Vibration Group
Electro Technology Laboratory

2017, September 08

Monitoring of Background Noise Levels
And Existing Noise Levels
Report No. SS – 1708661

1. Customer :

Consulting Engineers & Architects Associated (Pvt) Ltd.
No. 500/5, 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 the proposed project for Establishment of New Light Rail Transit System under the Western Region Megapolis Development.

3. Location of Project :

The proposed New Light Rail Transit System in Colombo, Light train travel through Kollupitiya, Gangaramaya temple, Fort, General hospital, Borella, Diyatha uyana, Thalangama and Malabe.

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 $\underline{L_{A90,\ 15min}}$ descriptor.

4.2 Assessment Background Level (ABL)

The single figure background level representing each assessment period, day, evening and night (three assessment background levels are determined for each 24-hour monitoring period.) The **tenth percentile method** is used to determine the assessment background level.

4.3 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 time period.

4.4 Existing Noise Level (ENL)

The existing noise levels is determined as the logarithmic average of individual $\underline{L_{Aeq,\ 15min}}$ levels of each day time period.

4.5 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 Twenty four hour background and existing noise level measurements

The background noise level measurements were carried out 24 hours continuously at the eight locations (weekday & weekend) including, day, evening and night. The period for a day where the assessments are made is given below.

Day - 0600h to 1800h
Evening - 1800h to 2200h
Night - 2200h to 0600h

6. Instrumentation Details

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

6.1 Noise data logger : Modular precision Level Analyzer, Bruel and Keajer Type 2270, 2260, 2250& 2250L Enhanced sound analysis software BZ 7202 versions 2, Bruel and Keajer

Field calibrator : Bruel and Keajer type 4231 acoustic calibrator traceable to primary standard maintained at Brüel & Kjær, The Calibration Laboratory, Denmark. Certificate No. CDK 1601194.

6.2 Anemometer : Novalynx Model:200-WS-25

6.3 Digital Thermo Hygrometer : Commet Logger S3121

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 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 Noiseand Vibration Monitoring Programme

Names of the ITI staff who carried out the measurement:

Mr. C.M. Kalansuriya	Research Scientist
Mr. D.C. Jayaratne	Research Technologist
Mr. K.K.N. Darshana	Assistant Research Technologist
Mr. P.N. Alagiyawanna	Assistant Research Technologist

Representatives from the following organization/person was present on the day of measurement.

Mr. H.K.S.P. Perera	Instrument Operator- Industrial Technology Institute

8. Result

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

Summary of noise level measurement data for eight measurement locations (weekday & weekend) are presented in table 1 to table 4. (day, evening and night. - 24 hour locations)

8.1 Summary of Noise level data

Summary of measurement data for eight measurement locations (weekday & weekend) are presented on table-1 totable-4 (day, evening and night - 24 hour locations)

Table 1: Noise Level Results – 24 hour Measurement Locations - N1 to N4

Weekday measurement

Date	***Measurement Location***		***Assessment time period-Day***			***Assessment time period-Evening***			***Assessment time period-Night***		
			ABL **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**	***ABL*** **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**	***ABL*** **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**
2017 July 06 & 2017 July 07	N1	6°54'31.98"N 79°57'26.93"E	61	67	72	64	67	72	51	53	67
2017 July 12 & 2017 July 13	N2	6°54'13.22"N 79°57'25.36"E	61	62	73	56	60	69	49	50	65
2017 July 06 & 2017 July 07	N3	6°54'2.12"N 79°55'37.11"E	41	45	57	43	47	57	41	43	54
2017 July 06 & 2017 July 07	N4	6°54'14.17"N 79°54'41.83"E	56	57	63	54	56	65	46	49	56

ABL -Assessment background level ($L_{A90,15min}$) RBL - Rating background level ($L_{A90,15min}$) ENL -Existing noise level ($L_{Aeq,h}$) h-hour

Table 2: Noise Level Results – 24 hour Measurement Locations – N5 to N8

Weekday measurement

Date	***Measurement Location***		***Assessment time period-Day***			***Assessment time period-Evening***			***Assessment time period-Night***		
			ABL **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**	***ABL*** **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**	***ABL*** **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**
2017 July 06 & 2017 July 07	N5	6°54'41.80"N 79°53'15.69"E	55	61	67	53	56	62	44	49	56
2017 July 12 & 2017 July 13	N6	6°54'56.22"N 79°52'23.66"E	58	66	75	61	64	75	45	46	68
2017 July 12 & 2017 July 13	N7	6°55'1.83"N 79°51'57.45"E	64	66	72	59	62	69	43	45	63
2017 July 12 & 2017 July 13	N8	6°54'55.41"N 79°51'21.83"E	66	68	72	61	64	70	47	51	63

ABL -Assessment background level ($L_{A90,15min}$) RBL - Rating background level ($L_{A90,15min}$) ENL -Existing noise level ($L_{Aeq,h}$) h-hour

Table 3: Noise Level Results – 24 hour Measurement Locations - N1 to N4
Weekend measurement

Date	***Measurement Location***		***Assessment time period-Day***			***Assessment time period-Evening***			***Assessment time period-Night***		
			ABL **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**	***ABL*** **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**	***ABL*** **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**
2017 July 01 & 2017 July 02	N1	6°54'31.98"N 79°57'26.93"E	44	47	61	45	45	57	48	54	59
2017 July 15 & 2017 July 16	N2	6°54'13.22"N 79°57'25.36"E	57	60	66	56	59	65	48	49	61
2017 July 01 & 2017 July 02	N3	6°54'2.12"N 79°55'37.11"E	55	60	66	55	58	64	41	45	59
2017 July 01 & 2017 July 02	N4	6°54'14.17"N 79°54'41.83"E	54	57	63	54	57	64	48	52	61

ABL -Assessment background level ($L_{A90,15min}$)   RBL - Rating background level ($L_{A90,15min}$)   ENL -Existing noise level ($L_{Aeq,h}$) h-hour

Table 4: Noise Level Results – 24 hour Measurement Locations – N5 to N8
Weekend measurement

Date	***Measurement Location***		***Assessment time period- Day***			***Assessment time period- Evening***			***Assessment time period- Night***		
			ABL **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**	***ABL*** **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**	***ABL*** **dB(A)**	***RBL*** **dB(A)**	***ENL*** **dB(A)**
2017 July 01 & 2017 July 02	N5	6°54'41.80"N 79°53'15.69"E	62	64	70	60	62	68	50	53	67
2017 July 15 & 2017 July 16	N6	6°54'56.22"N 79°52'23.66"E	53	66	77	61	62	73	48	49	69
2017 July 15 & 2017 July 16	N7	6°55'1.83"N 79°51'57.45"E	63	65	73	58	61	68	44	47	63
2017 July 15 & 2017 July 16	N8	6°54'55.41"N 79°51'21.83"E	59	66	70	61	64	69	50	53	65

ABL -Assessment background level ($L_{A90,15min}$) RBL - Rating background level ($L_{A90,15min}$) ENL -Existing noise level ($L_{Aeq,h}$) h-hour

8.2 Measurement data

Annexure 1	: Noise level measurements locations (GPS co-ordinates)
Annexure 2	: Map of the Noise level measurements locations
Annexure 3	: Method for determining the tenth percentile value
Annexure 4	: Definitions of terms
Annexure 05 to 20	: Noise Measurement data of 24 hour
Annexure 21 & 24	: Environment conditions (Ambient temperature, Ambient Humidity and Wind speed)
Annexure 25	: Noise Measurement location

9. 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 – D*escription, 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

………………………

Performed by

……………………
D. C. Jayaratne
Research Technologist

2017, September 08

SS – 1708661

Industrial Technology Institute
Noise level measurements locations

Measurement Location	G.P.S. Point	Location
N1	6°54'31.98"N 79°57'26.93"E	No. 852/71, Asokarama Road, Malabe
N2	6°54'13.22"N 79°57'25.36"E	Malabe Boys' School, Malabe
N3	6°54'2.12"N 79°55'37.11"E	Central Environmental Authority 104, Denzil Kobbekaduwa Mawatha, Battaramulla
N4	6°54'14.17"N79° 54'41.83"E	DiyathaUyana (Park in Sri Jayawardenepura Kotte) Kaduwela Road, Sri Jayawardenepura Kotte.
N5	6°54'41.80"N 79°53'15.69"E	Jayawardanaramaya Temple, Dr. N.M. PereraMawatha, Colombo 08
N6	6°54'56.22"N79° 52'23.66"E	Windsor Tower Ward place, Colombo 08
N7	6°55'1.83"N 79°51'57.45"E	National Hospital Colombo 10
N8	6°54'55.41"N 79°51'21.83"E	Sri Jinarathana Vocational Technical Training Center Sir James Peiris Mawatha, Colombo 02

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Proposed light rail transit system project

Noise level measurement locations

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.

Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project **_Annexure – 05_**

Measurement Point :N1 – Weekday measurement
Date of measurement :06th July 2017 & 07th July 2017
Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	68	49
0615h	2	66	49
0630h	3	68	54
0645h	4	70	59
0700h	5	70	61
0715h	6	71	64
0730h	7	72	65
0745h	8	72	66
0800h	9	72	67
0815h	10	72	67
0830h	11	72	67
0845h	12	73	67
0900h	13	73	68
0915h	14	74	69
0930h	15	72	67
0945h	16	74	68
1000h	17	73	68
1015h	18	71	67
1030h	19	72	66
1045h	20	74	67
1100h	21	74	67
1115h	22	72	67
1130h	23	72	67
1145h	24	71	66
1200h	25	72	66
1215h	26	72	67
1230h	27	71	66
1245h	28	72	67
1300h	29	72	67
1315h	30	73	68
1330h	31	73	67
1345h	32	73	67
1400h	33	72	67
1415h	34	73	67
1430h	35	73	67
1445h	36	73	68
1500h	37	75	67
1515h	38	74	68
1530h	39	73	67
1545h	40	71	66
1600h	41	72	67
1615h	42	72	67
1630h	43	72	66
1645h	44	72	66
1700h	45	72	67
1715h	46	72	67
1730h	47	72	67
1745h	48	73	68

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	73	68
1815h	50	72	67
1830h	51	72	67
1845h	52	73	68
1900h	53	72	67
1915h	54	72	67
1930h	55	73	67
1945h	56	72	67
2000h	57	72	67
2015h	58	71	66
2030h	59	73	66
2045h	60	73	65
2100h	61	71	65
2115h	62	70	64
2130h	63	70	64
2145h	64	70	64
2200h	65	69	64
2215h	66	69	62
2230h	67	69	63
2245h	68	69	61
2300h	69	69	60
2315h	70	68	60
2330h	71	68	59
2345h	72	68	58
0000h	73	68	57
0015h	74	68	56
0030h	75	68	54
0045h	76	67	54
0100h	77	66	53
0115h	78	66	52
0130h	79	65	53
0145h	80	65	50
0200h	81	64	52
0215h	82	64	52
0230h	83	66	52
0245h	84	65	52
0300h	85	63	51
0315h	86	64	51
0330h	87	61	51
0345h	88	64	52
0400h	89	64	52
0415h	90	67	51
0430h	91	64	46
0445h	92	67	46
0500h	93	64	52
0515h	94	66	53
0530h	95	65	53
0545h	96	67	53

Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project **_Annexure – 06_**

Measurement Point :N1 – Weekend measurement
Date of measurement :01st July 2017 & 02nd July 2017
Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	52	44
0615h	2	51	44
0630h	3	55	45
0645h	4	58	47
0700h	5	64	49
0715h	6	63	50
0730h	7	61	50
0745h	8	61	49
0800h	9	62	46
0815h	10	61	44
0830h	11	57	43
0845h	12	58	44
0900h	13	59	44
0915h	14	60	45
0930h	15	62	47
0945h	16	64	49
1000h	17	61	53
1015h	18	62	53
1030h	19	58	46
1045h	20	60	50
1100h	21	62	50
1115h	22	60	48
1130h	23	57	46
1145h	24	59	48
1200h	25	62	54
1215h	26	66	56
1230h	27	66	50
1245h	28	60	47
1300h	29	61	54
1315h	30	67	54
1330h	31	67	50
1345h	32	58	48
1400h	33	55	47
1415h	34	57	45
1430h	35	59	45
1445h	36	56	45
1500h	37	58	44
1515h	38	59	47
1530h	39	59	46
1545h	40	63	46
1600h	41	61	47
1615h	42	58	45
1630h	43	63	46
1645h	44	57	45
1700h	45	56	44
1715h	46	62	47
1730h	47	60	47
1745h	48	57	45

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	57	45
1815h	50	60	46
1830h	51	56	45
1845h	52	58	45
1900h	53	57	43
1915h	54	58	45
1930h	55	58	45
1945h	56	60	45
2000h	57	56	45
2015h	58	56	45
2030h	59	52	47
2045h	60	55	47
2100h	61	56	48
2115h	62	53	48
2130h	63	52	47
2145h	64	58	47
2200h	65	56	54
2215h	66	58	55
2230h	67	56	52
2245h	68	54	48
2300h	69	51	48
2315h	70	52	47
2330h	71	52	48
2345h	72	53	48
0000h	73	52	49
0015h	74	54	51
0030h	75	57	52
0045h	76	55	53
0100h	77	57	55
0115h	78	66	56
0130h	79	62	59
0145h	80	61	61
0200h	81	62	61
0215h	82	62	62
0230h	83	62	62
0245h	84	62	62
0300h	85	61	61
0315h	86	61	60
0330h	87	61	60
0345h	88	59	58
0400h	89	57	56
0415h	90	57	56
0430h	91	55	54
0445h	92	54	52
0500h	93	53	51
0515h	94	60	48
0530h	95	55	44
0545h	96	58	44

Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 07

Measurement Point :N2 – Weekday measurement

Date of measurement :12th July 2017 & 13th July 2017

Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	70	60
0615h	2	71	61
0630h	3	70	61
0645h	4	74	63
0700h	5	73	65
0715h	6	74	64
0730h	7	79	65
0745h	8	73	64
0800h	9	71	62
0815h	10	73	63
0830h	11	74	63
0845h	12	72	64
0900h	13	74	63
0915h	14	73	63
0930h	15	72	62
0945h	16	70	61
1000h	17	72	61
1015h	18	72	63
1030h	19	72	63
1045h	20	71	62
1100h	21	73	62
1115h	22	74	61
1130h	23	72	62
1145h	24	74	61
1200h	25	74	62
1215h	26	75	62
1230h	27	72	62
1245h	28	73	62
1300h	29	70	62
1315h	30	74	63
1330h	31	73	65
1345h	32	75	64
1400h	33	70	61
1415h	34	74	63
1430h	35	71	63
1445h	36	71	62
1500h	37	74	62
1515h	38	74	63
1530h	39	74	63
1545h	40	71	62
1600h	41	71	62
1615h	42	71	63
1630h	43	74	63
1645h	44	74	63
1700h	45	73	63
1715h	46	77	63
1730h	47	70	62
1745h	48	69	61
1800h	49	69	61
1815h	50	70	60
1830h	51	70	60
1845h	52	70	61
1900h	53	67	61
1915h	54	68	61
1930h	55	68	60
1945h	56	73	60
2000h	57	66	60
2015h	58	67	60
2030h	59	66	58
2045h	60	66	58
2100h	61	67	58
2115h	62	68	56
2130h	63	67	57
2145h	64	65	56
2200h	65	66	55
2215h	66	64	54
2230h	67	65	56
2245h	68	65	53
2300h	69	64	53
2315h	70	64	52
2330h	71	64	52
2345h	72	64	51
0000h	73	65	51
0015h	74	64	50
0030h	75	63	50
0045h	76	65	50
0100h	77	63	49
0115h	78	63	50
0130h	79	63	50
0145h	80	64	49
0200h	81	62	49
0215h	82	61	49
0230h	83	66	48
0245h	84	62	49
0300h	85	63	49
0315h	86	62	49
0330h	87	62	49
0345h	88	61	48
0400h	89	63	49
0415h	90	63	50
0430h	91	63	50
0445h	92	65	50
0500h	93	66	51
0515h	94	66	52
0530h	95	69	55
0545h	96	69	58

Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 08

Measurement Point :N2 – Weekend measurement
Date of measurement :15th July 2017 & 16th July 2017
Day : (0600h to 1800h) Evening : (1800h to 2200h) Night : (2200h to 0600h)

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	64	54
0615h	2	64	53
0630h	3	64	55
0645h	4	65	57
0700h	5	65	57
0715h	6	64	56
0730h	7	65	58
0745h	8	66	59
0800h	9	67	60
0815h	10	66	60
0830h	11	67	59
0845h	12	68	61
0900h	13	66	61
0915h	14	66	61
0930h	15	66	61
0945h	16	67	61
1000h	17	65	60
1015h	18	67	61
1030h	19	67	61
1045h	20	67	60
1100h	21	67	61
1115h	22	66	61
1130h	23	67	61
1145h	24	66	60
1200h	25	66	60
1215h	26	66	60
1230h	27	66	60
1245h	28	65	60
1300h	29	66	60
1315h	30	66	60
1330h	31	66	60
1345h	32	65	59
1400h	33	66	60
1415h	34	65	59
1430h	35	66	60
1445h	36	66	59
1500h	37	66	60
1515h	38	66	60
1530h	39	66	61
1545h	40	65	60
1600h	41	65	59
1615h	42	66	60
1630h	43	66	60
1645h	44	66	60
1700h	45	66	60
1715h	46	66	60
1730h	47	66	61
1745h	48	66	60

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	65	60
1815h	50	66	61
1830h	51	66	60
1845h	52	65	59
1900h	53	66	59
1915h	54	67	60
1930h	55	64	59
1945h	56	67	59
2000h	57	67	59
2015h	58	64	59
2030h	59	64	57
2045h	60	65	57
2100h	61	64	58
2115h	62	64	55
2130h	63	63	56
2145h	64	63	56
2200h	65	63	55
2215h	66	63	56
2230h	67	63	56
2245h	68	62	53
2300h	69	63	52
2315h	70	61	51
2330h	71	62	51
2345h	72	61	50
0000h	73	62	51
0015h	74	60	50
0030h	75	61	49
0045h	76	59	49
0100h	77	60	50
0115h	78	60	49
0130h	79	60	49
0145h	80	57	48
0200h	81	59	48
0215h	82	58	48
0230h	83	58	48
0245h	84	60	49
0300h	85	58	49
0315h	86	58	48
0330h	87	58	48
0345h	88	59	48
0400h	89	59	49
0415h	90	61	49
0430h	91	63	49
0445h	92	61	50
0500h	93	60	49
0515h	94	62	50
0530h	95	64	51
0545h	96	63	52

Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 09

Measurement Point :N3 – Weekday measurement
Date of measurement :06th July 2017 & 07th July 2017
Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	52	41
0615h	2	54	41
0630h	3	57	43
0645h	4	59	47
0700h	5	60	47
0715h	6	62	49
0730h	7	63	46
0745h	8	60	45
0800h	9	59	46
0815h	10	57	46
0830h	11	57	46
0845h	12	59	47
0900h	13	57	46
0915h	14	58	50
0930h	15	56	46
0945h	16	58	46
1000h	17	59	47
1015h	18	57	48
1030h	19	53	40
1045h	20	53	40
1100h	21	53	42
1115h	22	53	51
1130h	23	54	43
1145h	24	54	41
1200h	25	54	41
1215h	26	55	45
1230h	27	58	46
1245h	28	57	47
1300h	29	58	45
1315h	30	55	45
1330h	31	56	46
1345h	32	57	46
1400h	33	56	45
1415h	34	55	44
1430h	35	55	42
1445h	36	57	50
1500h	37	59	50
1515h	38	57	45
1530h	39	54	44
1545h	40	55	50
1600h	41	56	50
1615h	42	52	43
1630h	43	53	42
1645h	44	55	44
1700h	45	55	43
1715h	46	58	41
1730h	47	54	40
1745h	48	54	41

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	55	43
1815h	50	60	45
1830h	51	56	45
1845h	52	57	47
1900h	53	57	47
1915h	54	58	46
1930h	55	62	48
1945h	56	58	48
2000h	57	57	48
2015h	58	54	48
2030h	59	57	51
2045h	60	55	52
2100h	61	55	52
2115h	62	58	47
2130h	63	58	46
2145h	64	52	43
2200h	65	51	41
2215h	66	49	41
2230h	67	53	41
2245h	68	50	41
2300h	69	50	41
2315h	70	46	41
2330h	71	46	41
2345h	72	45	41
0000h	73	45	41
0015h	74	61	41
0030h	75	56	41
0045h	76	56	42
0100h	77	55	42
0115h	78	45	43
0130h	79	56	44
0145h	80	47	44
0200h	81	47	45
0215h	82	55	47
0230h	83	54	52
0245h	84	52	48
0300h	85	51	48
0315h	86	51	47
0330h	87	48	47
0345h	88	48	47
0400h	89	47	46
0415h	90	57	46
0430h	91	48	44
0445h	92	54	43
0500h	93	45	43
0515h	94	60	44
0530h	95	63	42
0545h	96	52	40

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Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 10

Measurement Point :N3 – Weekend measurement
Date of measurement :01st July 2017 & 02nd July 2017
Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	63	49
0615h	2	62	50
0630h	3	63	52
0645h	4	64	54
0700h	5	65	55
0715h	6	64	57
0730h	7	64	58
0745h	8	65	58
0800h	9	65	59
0815h	10	65	58
0830h	11	66	58
0845h	12	65	59
0900h	13	66	60
0915h	14	67	61
0930h	15	65	61
0945h	16	65	61
1000h	17	66	61
1015h	18	65	60
1030h	19	65	60
1045h	20	66	60
1100h	21	65	60
1115h	22	65	60
1130h	23	65	60
1145h	24	65	60
1200h	25	66	60
1215h	26	65	60
1230h	27	65	60
1245h	28	65	60
1300h	29	64	59
1315h	30	65	60
1330h	31	66	60
1345h	32	65	60
1400h	33	65	59
1415h	34	65	60
1430h	35	64	59
1445h	36	65	59
1500h	37	66	59
1515h	38	65	59
1530h	39	65	60
1545h	40	71	63
1600h	41	66	61
1615h	42	65	61
1630h	43	68	62
1645h	44	66	61
1700h	45	66	61
1715h	46	66	60
1730h	47	65	60
1745h	48	65	60
1800h	49	65	60
1815h	50	65	61
1830h	51	64	60
1845h	52	65	60
1900h	53	64	59
1915h	54	64	59
1930h	55	64	59
1945h	56	65	58
2000h	57	63	58
2015h	58	64	57
2030h	59	64	58
2045h	60	64	56
2100h	61	62	55
2115h	62	63	55
2130h	63	62	55
2145h	64	63	55
2200h	65	61	54
2215h	66	62	52
2230h	67	61	50
2245h	68	61	51
2300h	69	62	53
2315h	70	61	51
2330h	71	60	48
2345h	72	59	47
0000h	73	60	46
0015h	74	60	45
0030h	75	60	47
0045h	76	57	46
0100h	77	58	43
0115h	78	63	50
0130h	79	59	47
0145h	80	58	46
0200h	81	57	45
0215h	82	58	45
0230h	83	56	41
0245h	84	55	42
0300h	85	56	42
0315h	86	57	43
0330h	87	58	43
0345h	88	57	41
0400h	89	55	41
0415h	90	56	41
0430h	91	56	41
0445h	92	58	44
0500h	93	57	43
0515h	94	60	44
0530h	95	61	45
0545h	96	61	48

Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 11

Measurement Point :N4 – Weekday measurement
Date of measurement :06th July 2017 & 07th July 2017
Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	60	55
0615h	2	62	56
0630h	3	61	56
0645h	4	61	56
0700h	5	62	56
0715h	6	60	56
0730h	7	62	57
0745h	8	61	57
0800h	9	60	56
0815h	10	62	56
0830h	11	62	57
0845h	12	63	57
0900h	13	61	58
0915h	14	63	57
0930h	15	63	56
0945h	16	62	56
1000h	17	63	58
1015h	18	63	58
1030h	19	62	57
1045h	20	63	58
1100h	21	63	58
1115h	22	62	58
1130h	23	62	58
1145h	24	63	58
1200h	25	62	57
1215h	26	62	57
1230h	27	62	57
1245h	28	63	57
1300h	29	62	57
1315h	30	63	57
1330h	31	62	57
1345h	32	62	57
1400h	33	63	58
1415h	34	62	57
1430h	35	63	58
1445h	36	65	59
1500h	37	63	59
1515h	38	64	57
1530h	39	63	57
1545h	40	62	57
1600h	41	63	58
1615h	42	67	60
1630h	43	63	57
1645h	44	64	57
1700h	45	62	57
1715h	46	62	57
1730h	47	61	56
1745h	48	62	57

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	62	57
1815h	50	63	56
1830h	51	62	56
1845h	52	61	56
1900h	53	61	55
1915h	54	70	56
1930h	55	61	56
1945h	56	62	57
2000h	57	62	57
2015h	58	61	56
2030h	59	72	57
2045h	60	61	55
2100h	61	60	55
2115h	62	64	55
2130h	63	59	54
2145h	64	59	54
2200h	65	59	54
2215h	66	60	54
2230h	67	60	54
2245h	68	59	53
2300h	69	58	53
2315h	70	58	53
2330h	71	56	51
2345h	72	56	51
0000h	73	56	50
0015h	74	55	50
0030h	75	57	50
0045h	76	53	49
0100h	77	54	49
0115h	78	53	48
0130h	79	53	48
0145h	80	54	47
0200h	81	51	47
0215h	82	54	46
0230h	83	51	45
0245h	84	55	46
0300h	85	51	44
0315h	86	52	46
0330h	87	53	46
0345h	88	53	45
0400h	89	56	47
0415h	90	57	48
0430h	91	55	48
0445h	92	55	47
0500h	93	55	49
0515h	94	55	50
0530h	95	58	52
0545h	96	59	53

Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 12

Measurement Point :N4 – Weekend measurement
Date of measurement :01st July 2017 & 02nd July 2017
Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	57	51
0615h	2	57	51
0630h	3	59	53
0645h	4	58	53
0700h	5	60	54
0715h	6	59	54
0730h	7	59	54
0745h	8	60	56
0800h	9	61	56
0815h	10	59	54
0830h	11	61	56
0845h	12	61	56
0900h	13	62	55
0915h	14	62	55
0930h	15	64	55
0945h	16	63	57
1000h	17	62	58
1015h	18	63	60
1030h	19	62	57
1045h	20	67	59
1100h	21	64	58
1115h	22	63	58
1130h	23	62	58
1145h	24	63	58
1200h	25	65	58
1215h	26	62	58
1230h	27	62	57
1245h	28	64	58
1300h	29	63	57
1315h	30	63	58
1330h	31	63	58
1345h	32	62	57
1400h	33	63	58
1415h	34	61	57
1430h	35	62	57
1445h	36	63	57
1500h	37	62	57
1515h	38	61	57
1530h	39	68	59
1545h	40	63	56
1600h	41	61	57
1615h	42	60	57
1630h	43	60	57
1645h	44	60	57
1700h	45	59	57
1715h	46	63	58
1730h	47	66	60
1745h	48	66	60

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	67	60
1815h	50	66	60
1830h	51	65	60
1845h	52	63	59
1900h	53	64	59
1915h	54	63	59
1930h	55	63	59
1945h	56	64	59
2000h	57	62	57
2015h	58	65	56
2030h	59	63	57
2045h	60	62	56
2100h	61	61	55
2115h	62	63	56
2130h	63	62	54
2145h	64	60	53
2200h	65	59	53
2215h	66	58	53
2230h	67	59	53
2245h	68	61	53
2300h	69	60	54
2315h	70	63	57
2330h	71	63	57
2345h	72	62	57
0000h	73	63	58
0015h	74	61	54
0030h	75	58	52
0045h	76	59	52
0100h	77	69	50
0115h	78	59	52
0130h	79	58	50
0145h	80	58	50
0200h	81	57	52
0215h	82	57	52
0230h	83	57	50
0245h	84	56	48
0300h	85	60	47
0315h	86	55	48
0330h	87	56	47
0345h	88	54	48
0400h	89	57	50
0415h	90	57	49
0430h	91	57	49
0445h	92	57	48
0500h	93	57	49
0515h	94	59	51
0530h	95	60	54
0545h	96	63	55

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Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 13

Measurement Point :N5 – Weekday measurement
Date of measurement :06th July 2017 & 07th July 2017
Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	58	53
0615h	2	58	54
0630h	3	59	55
0645h	4	58	54
0700h	5	59	54
0715h	6	68	58
0730h	7	69	63
0745h	8	70	64
0800h	9	69	64
0815h	10	70	64
0830h	11	70	64
0845h	12	68	63
0900h	13	68	62
0915h	14	69	62
0930h	15	67	64
0945h	16	67	64
1000h	17	66	61
1015h	18	66	62
1030h	19	69	64
1045h	20	68	64
1100h	21	68	63
1115h	22	68	62
1130h	23	67	61
1145h	24	67	62
1200h	25	66	62
1215h	26	68	62
1230h	27	69	62
1245h	28	66	62
1300h	29	67	61
1315h	30	66	61
1330h	31	66	61
1345h	32	65	61
1400h	33	66	61
1415h	34	66	61
1430h	35	66	61
1445h	36	66	61
1500h	37	66	61
1515h	38	67	62
1530h	39	66	61
1545h	40	66	61
1600h	41	69	62
1615h	42	66	61
1630h	43	66	61
1645h	44	67	61
1700h	45	68	62
1715h	46	65	60
1730h	47	66	61
1745h	48	67	61

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	66	61
1815h	50	65	60
1830h	51	66	61
1845h	52	65	60
1900h	53	64	59
1915h	54	62	56
1930h	55	59	56
1945h	56	60	56
2000h	57	61	56
2015h	58	63	58
2030h	59	60	55
2045h	60	59	55
2100h	61	59	55
2115h	62	58	54
2130h	63	58	53
2145h	64	59	53
2200h	65	57	54
2215h	66	58	54
2230h	67	56	52
2245h	68	57	53
2300h	69	56	52
2315h	70	56	51
2330h	71	55	49
2345h	72	54	50
0000h	73	54	47
0015h	74	54	49
0030h	75	54	49
0045h	76	54	49
0100h	77	54	48
0115h	78	53	44
0130h	79	50	43
0145h	80	53	45
0200h	81	51	45
0215h	82	52	46
0230h	83	52	44
0245h	84	53	44
0300h	85	52	44
0315h	86	53	45
0330h	87	55	47
0345h	88	55	47
0400h	89	55	47
0415h	90	56	48
0430h	91	57	50
0445h	92	57	50
0500h	93	57	50
0515h	94	58	51
0530h	95	59	53
0545h	96	62	54

Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 14

Measurement Point :N5 – Weekend measurement
Date of measurement :01st July 2017 & 02nd July 2017
Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	67	59
0615h	2	67	61
0630h	3	67	59
0645h	4	67	61
0700h	5	68	62
0715h	6	69	65
0730h	7	68	64
0745h	8	69	65
0800h	9	69	63
0815h	10	70	64
0830h	11	69	67
0845h	12	72	66
0900h	13	70	66
0915h	14	72	67
0930h	15	70	67
0945h	16	72	67
1000h	17	73	68
1015h	18	71	67
1030h	19	71	66
1045h	20	72	66
1100h	21	71	67
1115h	22	71	66
1130h	23	71	66
1145h	24	71	66
1200h	25	69	65
1215h	26	72	66
1230h	27	72	67
1245h	28	72	66
1300h	29	73	65
1315h	30	69	64
1330h	31	71	65
1345h	32	70	64
1400h	33	69	64
1415h	34	69	65
1430h	35	70	64
1445h	36	70	64
1500h	37	69	65
1515h	38	69	64
1530h	39	72	64
1545h	40	67	62
1600h	41	69	64
1615h	42	70	64
1630h	43	69	63
1645h	44	68	64
1700h	45	69	64
1715h	46	69	64
1730h	47	69	64
1745h	48	69	64
1800h	49	72	64
1815h	50	68	63
1830h	51	69	63
1845h	52	71	62
1900h	53	69	64
1915h	54	69	63
1930h	55	67	63
1945h	56	68	63
2000h	57	67	62
2015h	58	67	62
2030h	59	67	62
2045h	60	67	62
2100h	61	67	61
2115h	62	67	60
2130h	63	65	60
2145h	64	67	59
2200h	65	64	59
2215h	66	65	58
2230h	67	65	58
2245h	68	66	59
2300h	69	64	57
2315h	70	63	56
2330h	71	62	56
2345h	72	61	56
0000h	73	61	54
0015h	74	62	52
0030h	75	61	53
0045h	76	60	52
0100h	77	72	53
0115h	78	79	59
0130h	79	60	51
0145h	80	60	52
0200h	81	61	52
0215h	82	60	54
0230h	83	61	55
0245h	84	61	53
0300h	85	59	51
0315h	86	60	48
0330h	87	59	47
0345h	88	59	48
0400h	89	61	51
0415h	90	62	51
0430h	91	62	52
0445h	92	63	51
0500h	93	62	50
0515h	94	62	53
0530h	95	73	55
0545h	96	68	58

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Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 15

Measurement Point :N6 – Weekday measurement
Date of measurement :12th July 2017 & 13th July 2017
Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	67	48
0615h	2	71	51
0630h	3	69	53
0645h	4	74	56
0700h	5	71	58
0715h	6	74	61
0730h	7	75	63
0745h	8	75	66
0800h	9	76	66
0815h	10	75	68
0830h	11	73	68
0845h	12	74	68
0900h	13	77	68
0915h	14	77	69
0930h	15	77	65
0945h	16	77	66
1000h	17	75	66
1015h	18	74	66
1030h	19	76	64
1045h	20	74	64
1100h	21	76	65
1115h	22	76	65
1130h	23	75	65
1145h	24	75	65
1200h	25	77	66
1215h	26	74	65
1230h	27	76	66
1245h	28	75	66
1300h	29	77	68
1315h	30	75	65
1330h	31	75	66
1345h	32	77	68
1400h	33	78	68
1415h	34	75	68
1430h	35	76	67
1445h	36	74	67
1500h	37	75	66
1515h	38	77	63
1530h	39	74	64
1545h	40	74	65
1600h	41	74	64
1615h	42	75	64
1630h	43	75	66
1645h	44	74	66
1700h	45	75	66
1715h	46	75	65
1730h	47	74	65
1745h	48	75	68

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	80	67
1815h	50	75	67
1830h	51	75	67
1845h	52	74	66
1900h	53	74	66
1915h	54	73	64
1930h	55	75	66
1945h	56	73	64
2000h	57	73	64
2015h	58	72	64
2030h	59	73	62
2045h	60	72	62
2100h	61	73	62
2115h	62	75	62
2130h	63	73	61
2145h	64	72	59
2200h	65	71	61
2215h	66	72	58
2230h	67	72	60
2245h	68	71	59
2300h	69	71	59
2315h	70	70	56
2330h	71	69	55
2345h	72	70	54
0000h	73	69	54
0015h	74	68	53
0030h	75	69	50
0045h	76	68	49
0100h	77	68	47
0115h	78	68	48
0130h	79	66	45
0145h	80	65	45
0200h	81	66	45
0215h	82	65	46
0230h	83	64	45
0245h	84	65	45
0300h	85	63	45
0315h	86	64	45
0330h	87	64	45
0345h	88	64	45
0400h	89	59	44
0415h	90	62	44
0430h	91	62	44
0445h	92	65	45
0500h	93	64	45
0515h	94	68	46
0530h	95	66	45
0545h	96	66	47

Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 16

Measurement Point :N6 – Weekend measurement
Date of measurement :15th July 2017 & 16th July 2017
Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	67	49
0615h	2	68	50
0630h	3	70	52
0645h	4	70	53
0700h	5	69	53
0715h	6	72	58
0730h	7	71	54
0745h	8	72	54
0800h	9	71	56
0815h	10	72	64
0830h	11	74	63
0845h	12	75	65
0900h	13	75	66
0915h	14	75	65
0930h	15	74	66
0945h	16	75	65
1000h	17	76	67
1015h	18	74	66
1030h	19	75	65
1045h	20	74	64
1100h	21	75	66
1115h	22	75	67
1130h	23	74	66
1145h	24	75	64
1200h	25	74	65
1215h	26	74	64
1230h	27	75	66
1245h	28	75	66
1300h	29	76	66
1315h	30	76	66
1330h	31	76	66
1345h	32	74	66
1400h	33	74	66
1415h	34	74	67
1430h	35	76	67
1445h	36	76	67
1500h	37	77	66
1515h	38	75	66
1530h	39	74	64
1545h	40	76	66
1600h	41	74	66
1615h	42	77	70
1630h	43	82	76
1645h	44	87	76
1700h	45	86	73
1715h	46	79	69
1730h	47	75	65
1745h	48	74	64

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	74	64
1815h	50	76	65
1830h	51	73	62
1845h	52	75	64
1900h	53	73	64
1915h	54	73	63
1930h	55	73	62
1945h	56	73	65
2000h	57	73	62
2015h	58	72	62
2030h	59	74	64
2045h	60	73	61
2100h	61	73	62
2115h	62	73	62
2130h	63	72	61
2145h	64	71	61
2200h	65	73	61
2215h	66	72	58
2230h	67	72	59
2245h	68	71	57
2300h	69	70	59
2315h	70	70	57
2330h	71	71	58
2345h	72	69	55
0000h	73	70	54
0015h	74	71	54
0030h	75	72	54
0045h	76	71	55
0100h	77	70	53
0115h	78	69	52
0130h	79	69	52
0145h	80	68	49
0200h	81	68	48
0215h	82	69	50
0230h	83	67	49
0245h	84	67	48
0300h	85	67	48
0315h	86	66	49
0330h	87	67	48
0345h	88	66	48
0400h	89	67	48
0415h	90	63	47
0430h	91	65	46
0445h	92	65	48
0500h	93	66	48
0515h	94	65	49
0530h	95	68	48
0545h	96	65	47

Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 17

Measurement Point :N7 – Weekday measurement

Date of measurement :12th July 2017 & 13th July 2017

Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	68	61
0615h	2	70	62
0630h	3	71	63
0645h	4	71	64
0700h	5	71	64
0715h	6	71	64
0730h	7	71	64
0745h	8	72	65
0800h	9	72	64
0815h	10	71	64
0830h	11	71	65
0845h	12	72	65
0900h	13	72	65
0915h	14	71	66
0930h	15	72	66
0945h	16	72	66
1000h	17	72	66
1015h	18	72	66
1030h	19	73	66
1045h	20	73	66
1100h	21	71	66
1115h	22	72	66
1130h	23	74	66
1145h	24	72	66
1200h	25	74	67
1215h	26	73	67
1230h	27	72	66
1245h	28	73	66
1300h	29	74	67
1315h	30	73	66
1330h	31	74	66
1345h	32	73	66
1400h	33	74	66
1415h	34	70	65
1430h	35	71	65
1445h	36	71	64
1500h	37	72	65
1515h	38	71	65
1530h	39	72	66
1545h	40	72	65
1600h	41	71	66
1615h	42	76	67
1630h	43	72	66
1645h	44	74	66
1700h	45	71	65
1715h	46	73	65
1730h	47	73	66
1745h	48	72	66

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	70	65
1815h	50	70	65
1830h	51	70	63
1845h	52	70	65
1900h	53	69	63
1915h	54	69	62
1930h	55	68	62
1945h	56	70	62
2000h	57	68	63
2015h	58	68	62
2030h	59	68	62
2045h	60	67	62
2100h	61	67	60
2115h	62	67	59
2130h	63	67	60
2145h	64	66	58
2200h	65	66	59
2215h	66	65	56
2230h	67	66	56
2245h	68	64	53
2300h	69	65	54
2315h	70	64	52
2330h	71	63	49
2345h	72	63	51
0000h	73	64	52
0015h	74	62	45
0030h	75	62	47
0045h	76	60	44
0100h	77	62	44
0115h	78	59	43
0130h	79	59	43
0145h	80	59	42
0200h	81	59	44
0215h	82	59	41
0230h	83	57	41
0245h	84	60	43
0300h	85	57	43
0315h	86	57	43
0330h	87	59	44
0345h	88	60	44
0400h	89	61	44
0415h	90	59	43
0430h	91	63	49
0445h	92	64	50
0500h	93	64	50
0515h	94	65	54
0530h	95	65	58
0545h	96	67	59

Proposed light rail transit system project

Annexure – 18

Measurement Point :N7 – Weekend measurement

Date of measurement :15th July 2017 & 16th July 2017

Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	66	58
0615h	2	67	60
0630h	3	72	62
0645h	4	70	63
0700h	5	71	63
0715h	6	71	65
0730h	7	70	64
0745h	8	72	64
0800h	9	70	64
0815h	10	71	64
0830h	11	71	65
0845h	12	70	64
0900h	13	70	64
0915h	14	72	64
0930h	15	71	64
0945h	16	72	65
1000h	17	72	64
1015h	18	70	64
1030h	19	74	65
1045h	20	70	65
1100h	21	72	66
1115h	22	70	65
1130h	23	71	65
1145h	24	73	66
1200h	25	71	65
1215h	26	72	66
1230h	27	72	65
1245h	28	71	66
1300h	29	72	66
1315h	30	74	66
1330h	31	73	67
1345h	32	71	65
1400h	33	72	65
1415h	34	71	65
1430h	35	71	64
1445h	36	70	64
1500h	37	71	64
1515h	38	71	64
1530h	39	75	66
1545h	40	82	75
1600h	41	83	70
1615h	42	78	71
1630h	43	72	65
1645h	44	71	64
1700h	45	71	65
1715h	46	70	64
1730h	47	70	65
1745h	48	70	64

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	71	65
1815h	50	70	64
1830h	51	69	64
1845h	52	69	62
1900h	53	69	62
1915h	54	69	62
1930h	55	69	61
1945h	56	68	63
2000h	57	68	62
2015h	58	68	61
2030h	59	68	61
2045h	60	66	58
2100h	61	67	60
2115h	62	66	58
2130h	63	66	59
2145h	64	66	59
2200h	65	65	57
2215h	66	66	59
2230h	67	64	57
2245h	68	65	55
2300h	69	65	55
2315h	70	65	53
2330h	71	64	55
2345h	72	65	53
0000h	73	63	52
0015h	74	63	49
0030h	75	61	48
0045h	76	62	46
0100h	77	62	47
0115h	78	62	46
0130h	79	60	46
0145h	80	62	45
0200h	81	60	46
0215h	82	59	45
0230h	83	61	46
0245h	84	60	44
0300h	85	57	44
0315h	86	59	43
0330h	87	57	43
0345h	88	60	44
0400h	89	60	46
0415h	90	59	46
0430h	91	59	47
0445h	92	63	49
0500h	93	63	52
0515h	94	65	54
0530h	95	65	58
0545h	96	66	58

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Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 19

Measurement Point :N8 – Weekday measurement
Date of measurement :12th July 2017 & 13th July 2017
Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	67	61
0615h	2	67	61
0630h	3	69	63
0645h	4	70	65
0700h	5	70	66
0715h	6	70	66
0730h	7	71	67
0745h	8	71	67
0800h	9	71	67
0815h	10	72	67
0830h	11	71	67
0845h	12	73	68
0900h	13	72	69
0915h	14	71	68
0930h	15	72	68
0945h	16	71	69
1000h	17	72	69
1015h	18	73	69
1030h	19	72	69
1045h	20	72	69
1100h	21	73	69
1115h	22	73	69
1130h	23	73	69
1145h	24	73	69
1200h	25	72	69
1215h	26	73	68
1230h	27	74	68
1245h	28	73	69
1300h	29	74	69
1315h	30	73	69
1330h	31	72	68
1345h	32	73	69
1400h	33	77	69
1415h	34	73	69
1430h	35	74	69
1445h	36	73	70
1500h	37	72	68
1515h	38	73	69
1530h	39	76	68
1545h	40	72	68
1600h	41	72	68
1615h	42	72	68
1630h	43	72	68
1645h	44	72	68
1700h	45	71	68
1715h	46	70	67
1730h	47	73	67
1745h	48	71	67

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	72	68
1815h	50	71	68
1830h	51	72	67
1845h	52	70	67
1900h	53	70	67
1915h	54	69	66
1930h	55	70	66
1945h	56	70	65
2000h	57	68	64
2015h	58	69	64
2030h	59	69	64
2045h	60	69	63
2100h	61	68	62
2115h	62	67	62
2130h	63	66	60
2145h	64	67	61
2200h	65	66	59
2215h	66	65	58
2230h	67	64	57
2245h	68	66	58
2300h	69	64	54
2315h	70	65	55
2330h	71	64	53
2345h	72	64	54
0000h	73	62	54
0015h	74	62	51
0030h	75	62	50
0045h	76	61	48
0100h	77	60	48
0115h	78	60	48
0130h	79	58	47
0145h	80	58	47
0200h	81	59	47
0215h	82	59	46
0230h	83	60	46
0245h	84	59	46
0300h	85	58	47
0315h	86	59	47
0330h	87	57	47
0345h	88	57	47
0400h	89	61	50
0415h	90	62	52
0430h	91	61	52
0445h	92	62	52
0500h	93	63	55
0515h	94	63	55
0530h	95	65	58
0545h	96	66	60

Measurement Data of 24 hours - Measurement Locations

Industrial Technology Institute

Proposed light rail transit system project

Annexure – 20

Measurement Point :N8 – Weekend measurement

Date of measurement :15th July 2017 & 16th July 2017

Day : (0600h to 1800h) *Evening : (1800h to 2200h)* *Night : (2200h to 0600h)*

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
0600h	1	67	58
0615h	2	66	58
0630h	3	66	58
0645h	4	67	59
0700h	5	67	59
0715h	6	66	59
0730h	7	68	61
0745h	8	70	66
0800h	9	71	66
0815h	10	70	65
0830h	11	71	65
0845h	12	70	66
0900h	13	72	67
0915h	14	71	66
0930h	15	71	67
0945h	16	72	66
1000h	17	70	67
1015h	18	70	67
1030h	19	71	66
1045h	20	71	66
1100h	21	71	67
1115h	22	71	66
1130h	23	71	66
1145h	24	71	67
1200h	25	70	67
1215h	26	71	67
1230h	27	71	66
1245h	28	71	67
1300h	29	71	67
1315h	30	71	66
1330h	31	70	66
1345h	32	71	66
1400h	33	70	66
1415h	34	71	66
1430h	35	71	66
1445h	36	70	66
1500h	37	71	67
1515h	38	70	66
1530h	39	70	66
1545h	40	70	65
1600h	41	72	66
1615h	42	70	66
1630h	43	70	65
1645h	44	69	65
1700h	45	70	66
1715h	46	70	65
1730h	47	69	65
1745h	48	70	65

Start time	Time Interval (15 min)	Measured Noise Level (dBA)	
		LAeq	LA90,15min
1800h	49	70	66
1815h	50	70	66
1830h	51	70	64
1845h	52	69	65
1900h	53	69	65
1915h	54	70	65
1930h	55	68	64
1945h	56	68	64
2000h	57	70	64
2015h	58	69	64
2030h	59	69	63
2045h	60	69	63
2100h	61	68	64
2115h	62	69	63
2130h	63	67	61
2145h	64	67	61
2200h	65	67	60
2215h	66	67	59
2230h	67	68	60
2245h	68	68	59
2300h	69	66	58
2315h	70	65	56
2330h	71	65	57
2345h	72	68	56
0000h	73	64	54
0015h	74	65	56
0030h	75	65	53
0045h	76	65	54
0100h	77	63	52
0115h	78	64	54
0130h	79	63	51
0145h	80	64	52
0200h	81	68	52
0215h	82	63	51
0230h	83	63	51
0245h	84	61	50
0300h	85	63	50
0315h	86	61	50
0330h	87	60	49
0345h	88	61	51
0400h	89	61	51
0415h	90	63	53
0430h	91	62	53
0445h	92	66	52
0500h	93	61	53
0515h	94	64	55
0530h	95	64	58
0545h	96	66	58

Environmental Condition – 24 hour

Industrial Technology Institute

Annexure – 21

Proposed light rail transit system project

Measurement Point :N7 – Weekday measurement

Date of measurement :12th July 2017 & 13th July 2017

Start time	Temp.	R.H.	Wind speed	
			Max	Avg.
06.00 - 06.15	23.5	80	0.0	0.0
06.15 - 06.30	23.5	80	0.0	0.0
06.30 - 06.45	23.5	80	0.0	0.0
06.45 - 07.00	24.0	80	0.0	0.0
07.00 - 07.15	24.0	80	0.0	0.0
07.15 - 07.30	24.0	80	0.0	0.0
07.30 - 07.45	24.0	80	0.0	0.0
07.45 - 08.00	24.0	79	0.0	0.0
08.00 - 08.15	24.5	78	0.0	0.0
08.15 - 08.30	24.5	76	0.0	0.0
08.30 - 08.45	25.5	75	0.0	0.0
08.45 - 09.00	25.5	73	0.0	0.0
09.00 - 09.15	26.5	70	0.4	0.0
09.15 - 09.30	26.5	69	0.0	0.0
09.30 - 09.45	26.5	68	0.6	0.0
09.45 - 10.00	27.0	67	0.7	0.0
10.00 - 10.15	27.0	67	0.0	0.0
10.15 - 10.30	27.5	67	0.5	0.0
10.30 - 10.45	28.5	65	0.9	0.0
10.45 - 11.00	28.5	62	0.7	0.0
11.00 - 11.15	28.5	59	1.2	0.4
11.15 - 11.30	28.5	57	0.6	0.0
11.30 - 11.45	28.0	55	0.7	0.0
11.45 - 12.00	28.0	54	0.9	0.4
12.00 - 12.15	28.0	53	1.2	0.3
12.15 - 12.30	28.5	53	1.9	0.8
12.30 - 12.45	28.5	53	1.3	0.4
12.45 - 13.00	28.5	53	0.8	0.3
13.00 - 13.15	29.0	54	1.2	0.4
13.15 - 13.30	29.0	55	0.7	0.3
13.30 - 13.45	28.5	57	1.2	0.6
13.45 - 14.00	28.5	58	0.9	0.3
14.00 - 14.15	28.0	59	0.6	0.0
14.15 - 14.30	28.0	61	0.0	0.0
14.30 - 14.45	28.0	62	0.7	0.0
14.45 - 15.00	28.0	64	1.2	0.4
15.00 - 15.15	28.0	66	0.8	0.0
15.15 - 15.30	27.5	67	0.5	0.0
15.30 - 15.45	27.5	70	0.8	0.3
15.45 - 16.00	27.5	72	1.1	0.4
16.00 - 16.15	27.0	74	0.9	0.0
16.15 - 16.30	26.5	76	1.6	0.7
16.30 - 16.45	26.5	78	0.8	0.0
16.45 - 17.00	26.5	80	0.5	0.0
17.00 - 17.15	26.5	81	0.0	0.0
17.15 - 17.30	26.5	82	0.0	0.0
17.30 - 17.45	26.5	82	0.6	0.0
17.45 - 18.00	26.0	81	0.6	0.0
18.00 - 18.15	26.0	81	0.4	0.0
18.15 - 18.30	26.0	81	0.0	0.0
18.30 - 18.45	26.0	81	0.0	0.0
18.45 - 19.00	26.0	81	0.4	0.0
19.00 - 19.15	26.0	81	0.0	0.0
19.15 - 19.30	26.0	81	0.0	0.0
19.30 - 19.45	26.0	81	0.0	0.0
19.45 - 20.00	26.0	81	0.0	0.0
20.00 - 20.15	26.0	81	0.0	0.0
20.15 - 20.30	26.0	81	0.0	0.0
20.30 - 20.45	26.0	81	0.0	0.0
20.45 - 21.00	26.0	80	0.0	0.0
21.00 - 21.15	26.0	80	0.0	0.0
21.15 - 21.30	26.0	80	0.0	0.0
21.30 - 21.45	25.5	80	0.0	0.0
21.45 - 22.00	25.5	80	0.0	0.0
22.00 - 22.15	25.5	80	0.0	0.0
22.15 - 22.30	25.5	80	0.0	0.0
22.30 - 22.45	25.5	80	0.0	0.0
22.45 - 23.00	25.5	80	0.0	0.0
23.00 - 23.15	25.5	80	0.0	0.0
23.15 - 23.30	25.5	80	0.0	0.0
23.30 - 23.45	25.5	80	0.0	0.0
23.45 - 24.00	25.5	80	0.0	0.0
00.00 - 00.15	25.0	80	0.0	0.0
00.15 - 00.30	25.0	80	0.0	0.0
00.30 - 00.45	25.0	80	0.0	0.0
00.45 - 01.00	25.0	80	0.0	0.0
01.00 - 01.15	25.0	80	0.0	0.0
01.15 - 01.30	25.0	80	0.0	0.0
01.30 - 01.45	25.0	80	0.0	0.0
01.45 - 02.00	25.0	80	0.0	0.0
02.00 - 02.15	25.0	80	0.0	0.0
02.15 - 02.30	25.0	80	0.0	0.0
02.30 - 02.45	25.0	80	0.0	0.0
02.45 - 03.00	25.0	80	0.0	0.0
03.00 - 03.15	25.0	80	0.0	0.0
03.15 - 03.30	25.0	80	0.0	0.0
03.30 - 03.45	25.0	80	0.0	0.0
03.45 - 04.00	25.0	80	0.0	0.0
04.00 - 04.15	25.0	80	0.0	0.0
04.15 - 04.30	25.0	80	0.0	0.0
04.30 - 04.45	24.5	80	0.0	0.0
04.45 - 05.00	24.5	80	0.0	0.0
05.00 - 05.15	24.5	80	0.0	0.0
05.15 - 05.30	24.5	80	0.0	0.0
05.30 - 05.45	24.0	80	0.0	0.0
05.45 - 06.00	24.0	80	0.0	0.0

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Environmental Condition – 24 hour

Industrial Technology Institute

Annexure – 22

Proposed light rail transit system project

Measurement Point :N4 – Weekday measurement
Date of measurement :06th July 2017 & 07th July 2017

Start time	Temp.	R.H.	Wind speed	
			Max	Avg.
06.00 - 06.15	22.3	80	0.0	0.0
06.15 - 06.30	22.3	80	0.0	0.0
06.30 - 06.45	22.3	79	0.0	0.0
06.45 - 07.00	22.4	79	0.0	0.0
07.00 - 07.15	22.5	79	0.0	0.0
07.15 - 07.30	22.5	79	0.0	0.0
07.30 - 07.45	22.8	78	0.5	0.0
07.45 - 08.00	23.5	76	0.3	0.0
08.00 - 08.15	25.0	70	0.0	0.0
08.15 - 08.30	25.5	67	0.5	0.0
08.30 - 08.45	26.0	66	0.0	0.0
08.45 - 09.00	26.2	68	0.7	0.0
09.00 - 09.15	26.5	67	0.6	0.0
09.15 - 09.30	26.5	66	0.0	0.0
09.30 - 09.45	27.0	65	1.0	0.3
09.45 - 10.00	27.3	63	0.6	0.0
10.00 - 10.15	27.5	60	1.2	0.4
10.15 - 10.30	27.7	58	0.8	0.0
10.30 - 10.45	27.8	58	0.6	0.0
10.45 - 11.00	28.0	57	1.4	0.5
11.00 - 11.15	28.3	56	0.8	0.0
11.15 - 11.30	28.6	54	1.2	0.3
11.30 - 11.45	28.8	55	0.8	0.3
11.45 - 12.00	29.0	54	2.2	0.6
12.00 - 12.15	29.0	53	0.7	0.0
12.15 - 12.30	29.3	53	0.0	0.0
12.30 - 12.45	29.5	52	1.1	0.5
12.45 - 13.00	29.5	51	0.8	0.0
13.00 - 13.15	29.6	50	1.7	0.4
13.15 - 13.30	29.3	50	1.3	0.5
13.30 - 13.45	29.7	50	0.6	0.0
13.45 - 14.00	30.2	50	0.0	0.0
14.00 - 14.15	30.1	49	1.2	0.4
14.15 - 14.30	30.2	49	0.8	0.3
14.30 - 14.45	30.0	49	1.3	0.6
14.45 - 15.00	30.0	48	1.7	0.5
15.00 - 15.15	29.8	47	0.7	0.0
15.15 - 15.30	29.9	48	0.6	0.0
15.30 - 15.45	29.8	49	0.8	0.0
15.45 - 16.00	29.7	50	0.4	0.4
16.00 - 16.15	29.9	50	0.5	0.0
16.15 - 16.30	29.9	53	1.0	0.5
16.30 - 16.45	29.7	54	0.6	0.0
16.45 - 17.00	29.5	55	0.0	0.0
17.00 - 17.15	29.4	56	0.0	0.0
17.15 - 17.30	29.0	57	0.4	0.0
17.30 - 17.45	28.7	58	0.6	0.0
17.45 - 18.00	28.5	59	0.4	0.0

Start time	Temp.	R.H.	Wind speed	
			Max	Avg.
18.00 - 18.15	28.0	71	0.0	0.4
18.15 - 18.30	28.5	71	0.0	0.5
18.30 - 18.45	28.0	72	0.0	0.4
18.45 - 19.00	28.5	72	0.0	0.6
19.00 - 19.15	28.0	75	0.0	0.4
19.15 - 19.30	28.5	78	0.0	0.4
19.30 - 19.45	28.5	78	0.0	0.0
19.45 - 20.00	28.0	80	0.0	0.4
20.00 - 20.15	27.5	82	0.0	0.0
20.15 - 20.30	27.5	82	0.0	0.5
20.30 - 20.45	27.0	84	0.0	0.0
20.45 - 21.00	27.0	84	0.0	0.4
21.00 - 21.15	27.0	85	0.0	0.0
21.15 - 21.30	27.0	85	0.0	0.0
21.30 - 21.45	27.0	84	0.0	0.0
21.45 - 22.00	27.5	83	0.0	0.0
22.00 - 22.15	27.0	84	0.0	0.0
22.15 - 22.30	27.5	84	0.0	0.0
22.30 - 22.45	27.0	83	0.0	0.0
22.45 - 23.00	27.0	84	0.0	0.0
23.00 - 23.15	26.0	84	0.0	0.0
23.15 - 23.30	26.0	85	0.0	0.0
23.30 - 23.45	26.0	86	0.0	0.0
23.45 - 24.00	26.0	86	0.0	0.0
00.00 - 00.15	26.0	88	0.0	0.0
00.15 - 00.30	25.5	88	0.0	0.0
00.30 - 00.45	25.5	88	0.0	0.0
00.45 - 01.00	25.5	86	0.0	0.0
01.00 - 01.15	25.5	86	0.0	0.0
01.15 - 01.30	26.0	85	0.0	0.0
01.30 - 01.45	26.0	84	0.0	0.0
01.45 - 02.00	26.0	84	0.0	0.0
02.00 - 02.15	26.0	82	0.0	0.0
02.15 - 02.30	26.0	82	0.0	0.0
02.30 - 02.45	26.0	82	0.0	0.0
02.45 - 03.00	27.0	82	0.0	0.0
03.00 - 03.15	27.0	82	0.0	0.0
03.15 - 03.30	27.0	81	0.0	0.0
03.30 - 03.45	26.5	81	0.0	0.0
03.45 - 04.00	26.5	81	0.0	0.0
04.00 - 04.15	26.5	81	0.0	0.0
04.15 - 04.30	26.5	81	0.0	0.0
04.30 - 04.45	26.5	81	0.0	0.0
04.45 - 05.00	26.5	81	0.0	0.0
05.00 - 05.15	26.5	82	0.0	0.0
05.15 - 05.30	26.5	82	0.0	0.0
05.30 - 05.45	26.5	82	0.0	0.0
05.45 - 06.00	26.5	82	0.0	0.0

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Environmental Condition – 24 hour

Industrial Technology Institute

Annexure – 23

Proposed light rail transit system project

Measurement Point :N5 – Weekend measurement

Date of measurement :01st July 2017 & 02nd July 2017

Start time	Temp.	R.H.	Wind speed	
			Max	Avg.
06.00 - 06.15	25.0	88	0.0	0.0
06.15 - 06.30	25.0	88	0.0	0.5
06.30 - 06.45	25.0	87	0.5	1.0
06.45 - 07.00	25.0	86	0.7	1.9
07.00 - 07.15	25.0	86	0.9	2.7
07.15 - 07.30	25.0	85	0.9	1.5
07.30 - 07.45	25.5	85	1.1	3.0
07.45 - 08.00	26.0	85	0.6	1.3
08.00 - 08.15	26.5	83	0.8	1.7
08.15 - 08.30	26.5	83	0.9	1.6
08.30 - 08.45	27.0	83	1.2	2.7
08.45 - 09.00	27.0	80	1.8	3.1
09.00 - 09.15	27.5	80	1.5	2.8
09.15 - 09.30	28.0	79	0.9	2.1
09.30 - 09.45	28.5	78	0.7	1.7
09.45 - 10.00	28.5	75	0.5	1.6
10.00 - 10.15	29.0	75	0.6	1.8
10.15 - 10.30	29.0	73	1.2	2.8
10.30 - 10.45	29.5	70	0.7	2.4
10.45 - 11.00	30.0	70	0.7	1.6
11.00 - 11.15	30.0	69	0.6	2.1
11.15 - 11.30	30.0	67	0.5	2.5
11.30 - 11.45	30.5	67	0.7	2.7
11.45 - 12.00	30.5	67	0.3	1.0
12.00 - 12.15	31.0	66	0.5	1.9
12.15 - 12.30	31.0	66	0.9	2.3
12.30 - 12.45	31.5	66	0.3	1.7
12.45 - 13.00	31.5	66	1.1	2.2
13.00 - 13.15	31.5	65	0.6	2.7
13.15 - 13.30	32.0	65	1.0	4.1
13.30 - 13.45	32.0	66	0.9	2.7
13.45 - 14.00	32.0	66	1.2	2.7
14.00 - 14.15	32.0	66	1.1	4.0
14.15 - 14.30	32.0	67	1.2	4.3
14.30 - 14.45	32.0	67	1.9	3.6
14.45 - 15.00	31.5	68	1.5	3.9
15.00 - 15.15	31.5	68	1.3	4.1
15.15 - 15.30	31.5	69	1.2	3.9
15.30 - 15.45	31.5	69	1.0	3.0
15.45 - 16.00	31.0	69	1.1	4.0
16.00 - 16.15	31.0	69	0.7	2.7
16.15 - 16.30	31.0	71	0.9	3.4
16.30 - 16.45	30.0	73	0.8	2.3
16.45 - 17.00	30.0	74	1.2	3.7
17.00 - 17.15	30.0	74	0.7	2.2
17.15 - 17.30	29.5	75	0.5	2.1
17.30 - 17.45	29.5	75	0.7	0.5
17.45 - 18.00	29.5	75	0.0	0.5

Start time	Temp.	R.H.	Wind speed	
			Max	Avg.
18.00 - 18.15	29.0	77	0.0	0.8
18.15 - 18.30	29.0	77	0.3	1.1
18.30 - 18.45	29.0	78	0.5	0.8
18.45 - 19.00	29.0	80	0.0	0.7
19.00 - 19.15	28.5	80	0.0	0.5
19.15 - 19.30	28.5	82	0.0	0.7
19.30 - 19.45	28.0	82	0.0	0.0
19.45 - 20.00	27.0	83	0.0	0.0
20.00 - 20.15	27.0	83	0.0	0.6
20.15 - 20.30	26.5	83	0.0	0.5
20.30 - 20.45	26.5	84	0.0	0.0
20.45 - 21.00	26.0	84	0.0	0.0
21.00 - 21.15	25.5	86	0.0	0.0
21.15 - 21.30	25.5	86	0.0	0.0
21.30 - 21.45	25.5	87	0.0	0.0
21.45 - 22.00	25.0	88	0.0	0.0
22.00 - 22.15	25.0	88	0.0	0.0
22.15 - 22.30	25.0	90	0.0	0.0
22.30 - 22.45	25.0	91	0.0	0.0
22.45 - 23.00	25.0	91	0.0	0.0
23.00 - 23.15	25.0	92	0.0	0.0
23.15 - 23.30	25.0	92	0.0	0.0
23.30 - 23.45	25.0	94	0.0	0.0
23.45 - 24.00	25.0	94	0.0	0.0
00.00 - 00.15	25.0	94	0.0	0.0
00.15 - 00.30	25.0	94	0.0	0.0
00.30 - 00.45	25.0	94	0.0	0.0
00.45 - 01.00	24.5	94	0.0	0.0
01.00 - 01.15	24.5	94	0.0	0.0
01.15 - 01.30	24.5	94	0.0	0.0
01.30 - 01.45	24.5	94	0.0	0.0
01.45 - 02.00	24.5	94	0.0	0.0
02.00 - 02.15	24.5	93	0.0	0.0
02.15 - 02.30	24.5	93	0.0	0.0
02.30 - 02.45	24.5	92	0.0	0.0
02.45 - 03.00	24.5	91	0.0	0.0
03.00 - 03.15	24.5	91	0.0	0.0
03.15 - 03.30	24.5	91	0.0	0.0
03.30 - 03.45	24.5	91	0.0	0.0
03.45 - 04.00	24.0	91	0.0	0.0
04.00 - 04.15	24.0	90	0.0	0.0
04.15 - 04.30	24.0	90	0.0	0.0
04.30 - 04.45	24.0	90	0.0	0.0
04.45 - 05.00	24.5	89	0.0	0.0
05.00 - 05.15	24.5	89	0.0	0.0
05.15 - 05.30	24.5	89	0.0	0.0
05.30 - 05.45	24.5	89	0.0	0.0
05.45 - 06.00	24.5	89	0.0	0.0

Environmental Condition – 24 hour

Industrial Technology Institute

Annexure – 24

Proposed light rail transit system project

Measurement Point :N7 – Weekend measurement
Date of measurement :15th July 2017 & 16th July 2017

Start time	Temp.	R.H.	Wind speed	
			Max	Avg.
06.00 - 06.15	24.0	85	0.7	1.6
06.15 - 06.30	24.0	85	0.7	1.5
06.30 - 06.45	24.0	85	0.4	1.7
06.45 - 07.00	24.0	85	0.8	1.9
07.00 - 07.15	24.0	85	0.5	1.6
07.15 - 07.30	24.5	84	0.0	0.6
07.30 - 07.45	25.0	83	0.0	0.5
07.45 - 08.00	25.0	82	0.0	0.5
08.00 - 08.15	26.5	82	0.0	0.4
08.15 - 08.30	26.5	81	0.0	1.0
08.30 - 08.45	27.0	81	0.0	0.7
08.45 - 09.00	27.0	81	0.0	1.0
09.00 - 09.15	27.0	81	0.0	1.0
09.15 - 09.30	27.0	81	0.0	0.6
09.30 - 09.45	27.0	80	0.0	1.9
09.45 - 10.00	27.5	79	0.0	1.1
10.00 - 10.15	27.5	78	0.0	0.6
10.15 - 10.30	27.5	78	0.0	0.5
10.30 - 10.45	27.5	78	0.0	0.7
10.45 - 11.00	27.5	77	0.6	1.6
11.00 - 11.15	28.0	77	0.0	0.0
11.15 - 11.30	28.0	77	0.0	0.0
11.30 - 11.45	28.5	76	0.0	0.0
11.45 - 12.00	28.5	76	0.0	2.2
12.00 - 12.15	28.5	77	0.0	0.7
12.15 - 12.30	29.0	76	0.0	0.6
12.30 - 12.45	29.5	76	0.8	1.9
12.45 - 13.00	29.5	75	0.0	0.6
13.00 - 13.15	30.5	75	0.0	0.5
13.15 - 13.30	31.0	75	0.0	0.7
13.30 - 13.45	31.0	74	0.0	0.7
13.45 - 14.00	31.0	74	0.7	1.6
14.00 - 14.15	31.0	74	0.7	1.1
14.15 - 14.30	31.0	74	0.4	1.1
14.30 - 14.45	31.0	73	0.8	1.7
14.45 - 15.00	31.5	73	0.5	1.4
15.00 - 15.15	31.5	73	0.0	0.0
15.15 - 15.30	31.5	73	0.0	1.4
15.30 - 15.45	31.5	73	0.0	0.6
15.45 - 16.00	31.5	74	0.0	0.7
16.00 - 16.15	31.5	74	0.0	0.4
16.15 - 16.30	31.5	73	0.0	0.3
16.30 - 16.45	31.0	74	0.0	0.8
16.45 - 17.00	31.0	74	0.0	0.6
17.00 - 17.15	31.0	74	0.0	0.0
17.15 - 17.30	30.5	75	0.0	0.0
17.30 - 17.45	30.5	75	0.0	0.0
17.45 - 18.00	30.0	75	0.0	0.0
18.00 - 18.15	29.0	74	0.0	1.1
18.15 - 18.30	29.0	74	0.6	1.5
18.30 - 18.45	29.0	70	0.0	1.0
18.45 - 19.00	28.5	74	0.0	0.8
19.00 - 19.15	27.0	76	0.0	0.6
19.15 - 19.30	27.0	76	0.6	2.4
19.30 - 19.45	26.5	77	0.4	0.8
19.45 - 20.00	26.5	77	0.6	0.0
20.00 - 20.15	26.5	77	0.0	0.0
20.15 - 20.30	26.5	78	0.4	1.7
20.30 - 20.45	26.5	78	0.5	0.9
20.45 - 21.00	26.5	78	0.0	0.4
21.00 - 21.15	26.5	80	0.0	0.0
21.15 - 21.30	26.0	80	0.0	0.0
21.30 - 21.45	26.0	80	0.0	0.0
21.45 - 22.00	26.0	80	0.0	0.0
22.00 - 22.15	26.0	81	0.0	0.0
22.15 - 22.30	26.0	83	0.0	0.0
22.30 - 22.45	26.0	83	0.0	0.0
22.45 - 23.00	26.0	83	0.0	0.0
23.00 - 23.15	26.0	83	0.0	0.0
23.15 - 23.30	26.0	83	0.0	0.0
23.30 - 23.45	26.0	83	0.0	0.0
23.45 - 24.00	25.5	83	0.0	0.0
00.00 - 00.15	25.5	82	0.0	0.0
00.15 - 00.30	25.5	82	0.0	0.0
00.30 - 00.45	25.5	82	0.0	0.0
00.45 - 01.00	25.5	83	0.0	0.0
01.00 - 01.15	25.5	83	0.0	0.0
01.15 - 01.30	25.5	83	0.0	0.0
01.30 - 01.45	25.5	83	0.0	0.0
01.45 - 02.00	25.5	83	0.0	0.0
02.00 - 02.15	25.5	84	0.0	0.0
02.15 - 02.30	25.5	84	0.0	0.0
02.30 - 02.45	25.5	84	0.0	0.0
02.45 - 03.00	25.5	85	0.0	0.0
03.00 - 03.15	25.5	85	0.0	0.0
03.15 - 03.30	25.0	85	0.0	0.0
03.30 - 03.45	25.0	85	0.0	0.0
03.45 - 04.00	25.0	85	0.0	0.0
04.00 - 04.15	25.0	85	0.0	0.0
04.15 - 04.30	25.0	85	0.0	0.0
04.30 - 04.45	25.0	85	0.0	0.0
04.45 - 05.00	25.0	85	0.0	0.0
05.00 - 05.15	24.0	85	0.0	0.0
05.15 - 05.30	24.0	85	0.0	0.0
05.30 - 05.45	24.0	85	0.0	0.0
05.45 - 06.00	24.0	86	0.0	0.0

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24 hours - NoiseMeasurement Locations
Industrial Technology Institute

***Noise Monitoring Programme for Proposed* light rail transit system project**

Location - N1

Location - N2

Location - N3

Location - N4

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Location – N5

Location – N6

Location – N7

Location – N8

Annex E

Water Quality Survey

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.
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ISO/ IEC 17025
TL 004 - 01

TEST REPORT

Reference No: SS 1708662

Report to :

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

Issued by :

Chemical and Microbiological Laboratory
Industrial Technology Institute

2017/09/02

2017/09/08

17/09/08

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SS 1708662

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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.

2017/09/08

17/09/08

ISO/ IEC 17025
TL 004 - 01

TEST REPORT

Reference No. SS 1708662

CUSTOMER :

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

Test Items : Water

Service requested :

Sampling and Analysis for parameters requested by the customer's letter dated 2017/04/20

Collection Points :

Surface water
(1) Diyawannawa (2) Palamthuna Junction canal
(3) Bandaranayake canal (4) Beira lake

Ground water
(1) Well at Sri Parakumba Piriven Maha Viharaya.
(2) Well at P.W. Joachim, No. 487/11, Thalahena.
(3) Well at D.P.R. Dias, No. 146, Batalawatta, Thalahena.
(4) Well at Asokaramaya- Malabe.

Sampling Method : Grab sampling #

Description of test items at collection :

Surface Water
(1) Slightly turbid colourless water
(2) Turbid light brownish colour turbid water with particles
(3) Turbid brownish colour water with particles
(4) Turbid greenish colour water with particles

Ground Water
Clear colourless water (each item)

Quantity of test items collected :

Surface Water
Approximately 04 L of water collected into plastic container. (each test item)

Ground Water
Approximately 03 L of water collected into plastic container and
200 mL into a sterilized bottle (each test item)

2017/09/08

17/09/08

SS 1708662

Sampling carried out by : Mr. Deshan Perera of ITI.

Witness : Mr. W.K.A. Madawa, Design Engineer from Consulting Engineers & Architects Associated (Pvt) Ltd,

Date & Time of sampling :

Surface water
(1) 2017/08/21 at 11.03 a.m (2) 2017/08/21 at 11.50 a.m
(3) 2017/08/21 at 12.35 p.m (4) 2017/08/21 at 10.00 a.m

Ground water
(1) 2017/08/21 at 11.20 a.m (2) 2017/08/21 at 12.10 p.m
(3) 2017/08/21 at 1.35 p.m (4) 2017/08/21 at 1.52 p.m

Temperature of test items at collection :
Surface water – (1), (2) & (4) - 31 ^{0}C (3) – 30 ^{0}C
Ground water – (1) - 28 ^{0}C (2), (3) & (4) – 29 ^{0}C

Date & time of reception of test items at ITI : 2017/08/21 at 5.15 p.m

Temperature of test items at reception :
Surface water – 26 ^{0}C (each item)
Ground water – 24 ^{0}C (each item) } (stored in a cool box)

Condition of test items at reception : Satisfactory

\# **SLAB** Accredited

Test dates : 2017/08/21 – 2017/08/26

17/09/08

2017/09/08

ISO/ IEC 17025
TL 004 - 01

SS 1708662

TEST RESULTS : **Surface water**

Test	Unit	Method	Results				L.O.D	EU % (K=2)
			01	02	03	04		
# pH *	-	APHA 4500 – H^+ B	7.07 at 31 ^{0}C	6.63 at 31 ^{0}C	6.50 at 30 ^{0}C	8.6 at 31 ^{0}C	-	-
Temperature,* ^{0}C	-	APHA 2550 B	31	31	30	31	-	-
Dissolved Oxygen	mg/L	APHA 4500 O & G	4.0	2.4	3.4	6.5	-	-
# Turbidity	NTU	APHA 2130 B	2.9	12.0	619.5	154	-	20
BOD_3 at 30 ^{0}C	mg/L	APHA 5210 B	2	2.5	ND	6	2	-
Oil & Grease	mg/L	APHA 5520 B	ND	ND	ND	ND	2	-
# Total Suspended Solids at 103 – 105 ^{0}C mg/L	mg/L	APHA 2540 D	7	31	247	81	-	3

Ground water

Test	Unit	Method	Results				L.O.D	EU % (K=2)
			01	02	03	04		
# pH *	-	APHA 4500 – H^+ B	6.48 at 28 ^{0}C	5.31 at 29 ^{0}C	4.40 at 29 ^{0}C	3.95 at 29 ^{0}C	-	-
Temperature,* ^{0}C	-	APHA 2550 B	28	29	29	29	-	-
Water Level * (From Ground Level)	m	-	3.3	5.3	11.0	9.2	-	-
BOD_3 at 30 ^{0}C	mg/L	APHA 5210 B	ND	3	2	ND	2	-
# Electrical Conductivity	µS/cm	APHA 2510 B	417	160	186	137		4
Total Coliforms/100 mL (Confirmed MPN)	-	APHA 9221 C	2200	2800	$2.4x10^3$	230	-	-

APHA – Standard Methods for the examination of water and waste water APHA, AWWA , WEF, 2012 22nd edition

 # SLAB Accredited **L.O.D – Limit of Detection** **EU – Expanded Uncertainty**
*** Measured on site** **ND – Not detected**

Analyses were carried out by Mr. Deshan Perera – Research Scientist, Ms. K. de Alwis & Ms. Y. Pitawela – Senior Research Technologists Ms. R. Weerasooriya, Mr. A. Peiris & Mr. H.L.E. Hasalaka – Assistant Research Technologists & Ms. S. Amarasena – Assistant Research Technologist under supervision of Ms. S. Liyanage – Research Scientist.

....
Authorized Signatory

2017/09/02
/dpc

Himashi Karunaratne
B.Sc. (Hons.) M.Sc.
Research Scientist
Chemical & Microbiological Laboratory
Industrial Technology Institute

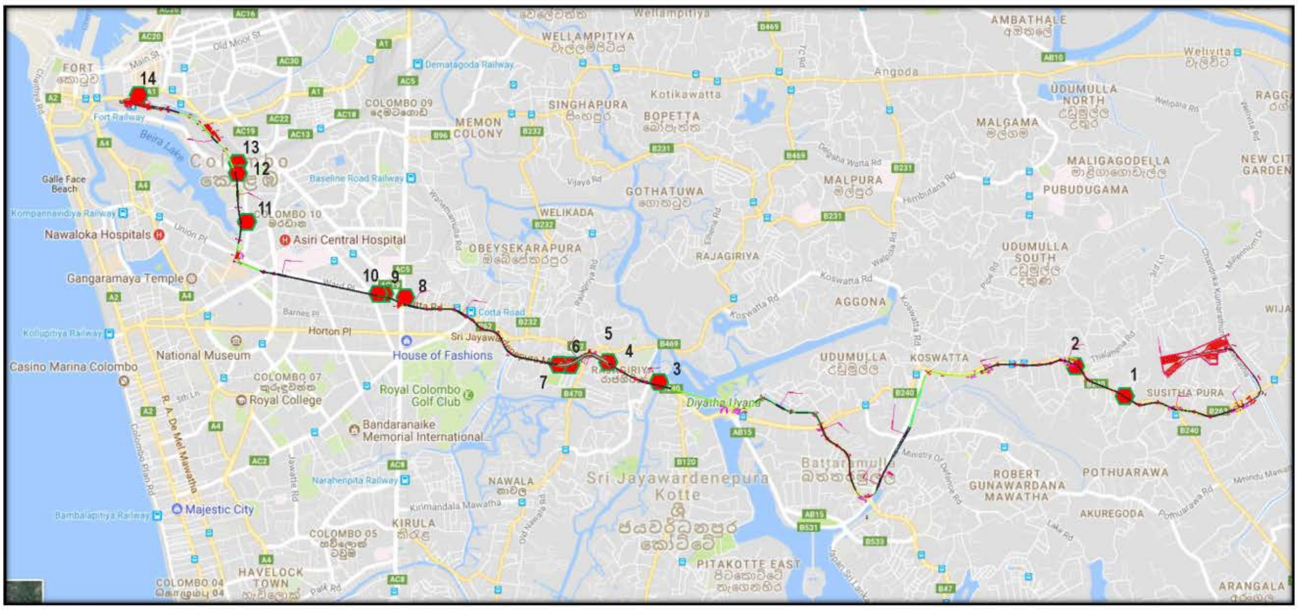
....
Authorized Signatory

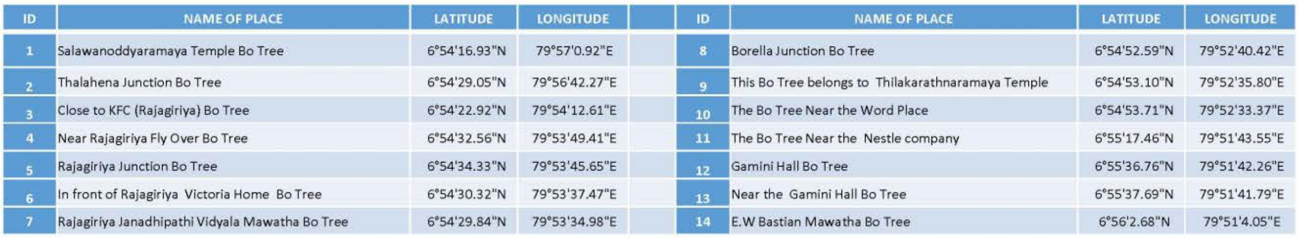
Dr. Kushani Mahatantila
B.Sc,.M.Phil. D.Sc. (Japan)
Research Scientist
Chemical and Microbiological Laboratory

Annex F

Bo tree survey

1. List of Bo Trees along proposed LRT route





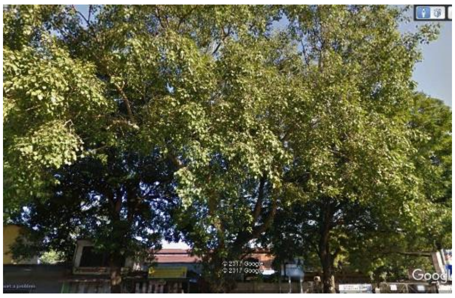
ID	NAME OF PLACE	LATITUDE	LONGITUDE	ID	NAME OF PLACE	LATITUDE	LONGITUDE
1	Salawanoddyaramaya Temple Bo Tree	6°54'16.93"N	79°57'0.92"E	8	Borella Junction Bo Tree	6°54'52.59"N	79°52'40.42"E
2	Thalahena Junction Bo Tree	6°54'29.05"N	79°56'42.27"E	9	This Bo Tree belongs to Thilakarathnaramaya Temple	6°54'53.10"N	79°52'35.80"E
3	Close to KFC (Rajagiriya) Bo Tree	6°54'22.92"N	79°54'12.61"E	10	The Bo Tree Near the Word Place	6°54'53.71"N	79°52'33.37"E
4	Near Rajagiriya Fly Over Bo Tree	6°54'32.56"N	79°53'49.41"E	11	The Bo Tree Near the Nestle company	6°55'17.46"N	79°51'43.55"E
5	Rajagiriya Junction Bo Tree	6°54'34.33"N	79°53'45.65"E	12	Gamini Hall Bo Tree	6°55'36.76"N	79°51'42.26"E
6	In front of Rajagiriya Victoria Home Bo Tree	6°54'30.32"N	79°53'37.47"E	13	Near the Gamini Hall Bo Tree	6°55'37.69"N	79°51'41.79"E
7	Rajagiriya Janadhipathi Vidyala Mawatha Bo Tree	6°54'29.84"N	79°53'34.98"E	14	E.W Bastian Mawatha Bo Tree	6°56'2.68"N	79°51'4.05"E

Figure 1 Location of Bo tree along LRT route

Table1: detail of each Bo tree

ID	Location	PHOTO	NOTE
1	Bo tree belongs to Shalawanoddyaramaya Temple		One major branch have to be cut down. According to the priest this great Bo tree has a miracle power.
2	Bo Tree at Thalahena Junction		Branches to be trimmed. This Bo tree belongs to the temple. (Kotte)

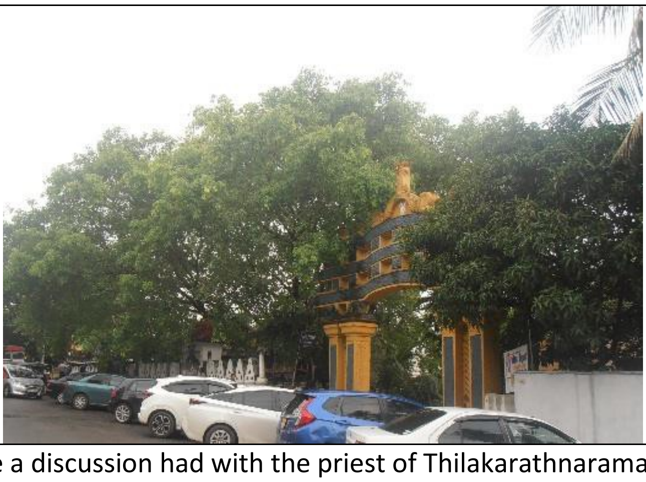
ID	Location	PHOTO	NOTE
3	Bo Tree near KFC - Rajagiriya		Some branches have to be cut down. There is shrine. This Bo tree maintains by the temple. (Kotte).The religious ceremony calls "Breaking water" occurs this place.
4	Bo Tree near Rajagiriya Fly Over		Some branches have to be cut down. There is a shrine.
5	Bo Tree at Rajagiriya Junction		Branches to be trimmed. There is a shrine.
6	Bo Tree In front of Rajagiriya Victoria Home		Some branches have to be cut down. Victoria Home people attends all religious activities.
7	Bo Tree near Rajagiriya Janadhipathi Vidyalaya		Some branches have to be cut down. Premises owned by Rajagiriya Janadhipathi Vidyalaya. There is a shrine. Religious activities undertaken by school or Montessori community.
8	Tree at Borella Junction		Branches to be trimmed. There is a shrine. Premises owned by CMC. People in surrounding area continuous religious activities.

ID	Location	PHOTO	NOTE
9	Bo Tree belongs to Thilakarathnaramaya Temple		Branches to be trimmed. According to priest Rathgama Upananda Thero this old Bo Tree is owned by the temple. (Thilakarathnaramaya). No objections for trimming. But should be organized religious activities when trimming or cutting branches . After that it should be balanced the tree.
10	ree near the Ward Place		Some branches have to be cut down. According to priest Rathgama Upananda Thero the area is owned by Thilakarathnaramaya temple. No shrine.
11	Tree near the Nestle Company		Branches to be trimmed. Part of the tree is on ROW. Other part is in side of the Nestle Co. premises. Very Old Bo tree. Religious activities carry out by workers of Nestle.
12	Bo Tree near Gamini Hall		Branches to be trimmed. There is a shrine. No special society or person to carry out religious activities. People in surrounding area continuous religious activities.
13	ee near the Gamini Hall		Some branches have to be cut down. Bo Tree is growing with Tamarind tree. It is on pavement area. No Shrine.
14	ee at E.W Bastian Mawatha		Branches to be trimmed. There is a shrine. People in the area takes on day to day religious activities. Land is owned by CGR or UDA.

2. Discussions with stakeholder regarding Bo Trees along the proposed Light Rail Route.

<table>
<tr><td colspan="2">**1:** *Shalawanodyaramaya Bo Tree*</td><td rowspan="3"></td></tr>
<tr><td>*ID*</td><td>*01*</td></tr>
<tr><td>*Potential Impact*</td><td>*A branch of the Bo tree May be impacted*</td></tr>
<tr><td colspan="3">*This Bo Tree own and maintains by a committee headed by chief priest of* Sri Shalawanadyramaya , Thalangama North, Malabe.The survey team had a discussion with the chief priest of the Temple.
The chief Priest of Sri Shalawanadyramaya , Thalangama North, Malabe is a very broad minded person. According to him he had been in Europe Countries for his researches. He expressed his views and ideas towards the very positive manner.
The Thero stated that the branch of the Bo tree must be cut down, because it is very dangerous. A high tension electricity line runs below this particular branch. According to the Thero, they tried to cut down 02 times after all religious activities. The Electricity Board also tried to cut down the branch. But it was notpossible. Finally Electricity Board has decided to put the cable as an under ground cable. Thero said that the Buddhist community believe this particular Bo Tree is having a miracle power. Also he thinks this particular branch is not growing. He can remember that during the last 20 years this branch is of same size.
The discussion completed with following suggestions.
• The Thero can inform to the Buddhist Society of the temple (Dhayaka Sabhawa) when the project design completed.
• At the beginning no need to discuss with (Dhayaka Sabhawa)
• Cutting down the branch should be done after performing all religious activities.
With the development, all people to be adapted to the realistic situations.</td></tr>
</table>

<table>
<tr><td colspan="2">2: <i>Thalahena Bo Tree</i></td><td rowspan="3"></td></tr>
<tr><td><i>ID</i></td><td><i>02</i></td></tr>
<tr><td><i>Potential Impact</i></td><td><i>No Direct Impact</i></td></tr>
<tr><td colspan="3">Discussion had with the Chief Priest of Sri Bodhi Rukkaramaya-Thalahena, Malabe <i>regarding Thalahena Bo Tree.</i> The Thalahena Bo Tree is owned by the “Bodhi Bharakara Mandalaya”.The chief Patron of the society is the Chief Priest of the Bodi Rukkaramaya Temple.The three wheel drivers of the surrounding area and the Buddhist people in the area take care the day to day religious activities for the Bo Tree.
The chief Priest expressed his ideas in a very positive manner.
The Thero stated that the if there is a need to cut down the branches ,considering the impacts for the community due to the project it should be done. But it must be done after performing all religious activities. The Thero said that there are 06 persons representing the “ Bodhi Bharakara Mandalaya” and at the correct time Thero discuss with them.
But according to the cad drawing the requirement is to trim some leaves.</td></tr>
</table>

<table>
<tr><td colspan="2">3: <i>Thilakarathnaramaya Bo Tree</i></td><td rowspan="3"></td></tr>
<tr><td><i>ID</i></td><td><i>09</i></td></tr>
<tr><td><i>Potential Impact</i></td><td><i>A branch of the Bo tree May be impacted</i></td></tr>
<tr><td colspan="3">For the information of this BO Tree a discussion had with the priest of Thilakarathnaramaya

This Bo Tree belonging to the temple Thilakarathnaramaya is very old one. The flower offering table in this temple close to the Bo Tree, was constructed in1885. The year in which the Wesak Full moon day was declared by the government as a public holiday. The Thero is very positive.. He said that all of us should be positive and flexible for the changes toward the development. His suggestions are ,

• Cutting down the branch should be done after performing all religious activities.
• Pruning the branches should be done balance the tree.</td></tr>
</table>

<table>
<tr><td colspan="2">4: <i>Bo Tree at the Nestle Company</i></td><td rowspan="3"></td></tr>
<tr><td><i>ID</i></td><td><i>10</i></td></tr>
<tr><td><i>Potential Impact</i></td><td><i>A branch of the Bo tree may be impacted</i></td></tr>
<tr><td colspan="3">This particular Bo Tree is at Nestle Company premises .Manager Administration expressed his views regarding the Bo Tree and the development of the projects. According to him This Bo tree also an old one. The staff of the company is performing the religious activities since 1947/1948.
They also believe that this Bo Tree has a miracle power. According to him even the foreign directors also respect to the Bo Tree. He said that if it is required to trim some small branches it should be done after performing all religious activities properly.</td></tr>
</table>

<table>
<tr><td colspan="2">5: <i>Boralla Bo Tree</i></td><td rowspan="3"></td></tr>
<tr><td><i>ID</i></td><td><i>08</i></td></tr>
<tr><td><i>Potential Impact</i></td><td><i>A branch of the Bo tree may be impacted</i></td></tr>
<tr><td colspan="3">Discussed with the devotees of the respected Boralla Bo Tree. The premises belongs to Colombo Municipal Council. People in surrounding area perform religious activities. The people is believing that the Bo Tree is very important for the Buddhist Community and the Bo Tree is having a miracle power. If it is removed it may come harm to the people involved. Their thought is to avoid the Bo tree.
After the explanation of the project and the type of the impact to this Bo Tree they accepted the smooth trimming . But before the trimming It should be performed all religious activities should be properly performed.</td></tr>
</table>

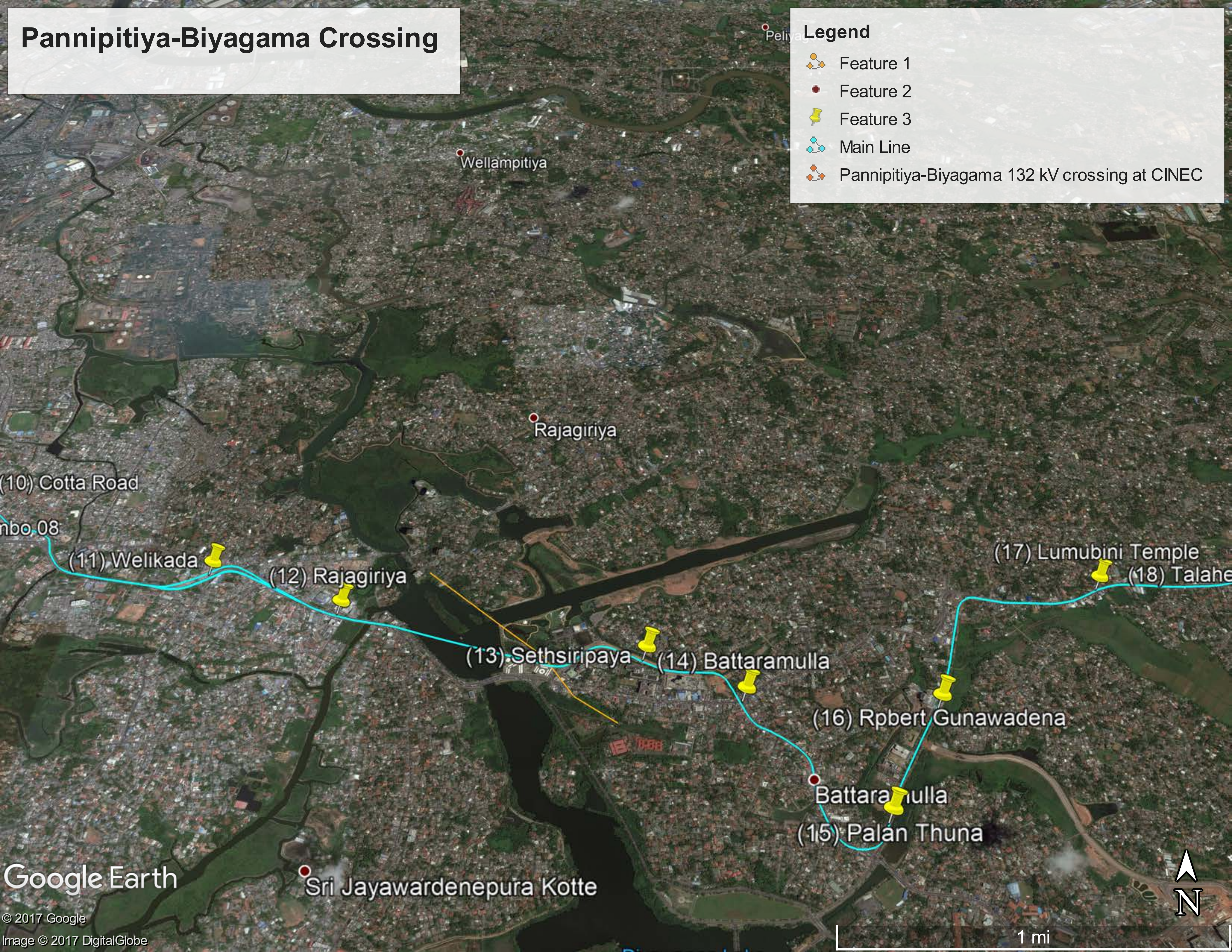
Annex G

Utility map

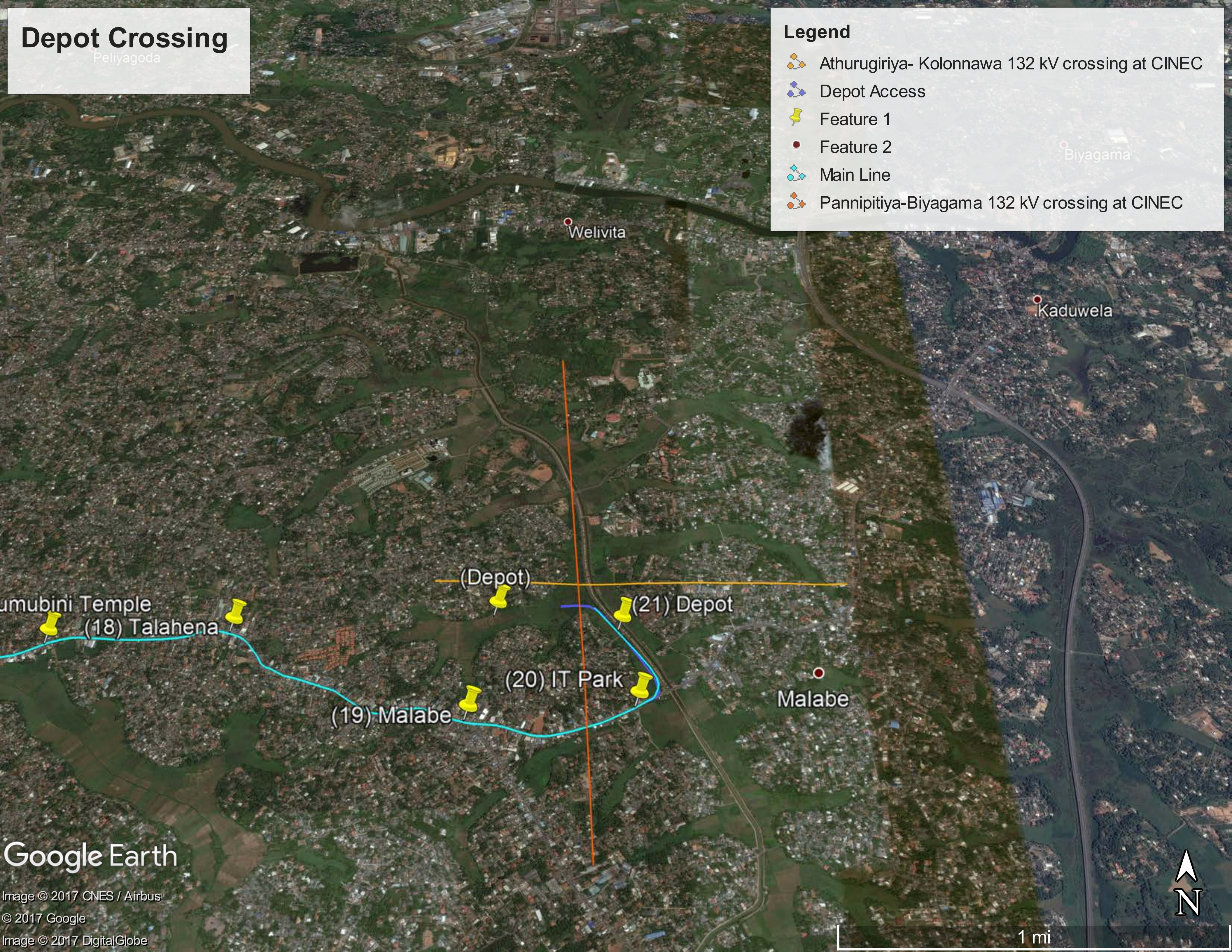
Transmission Line around the proposed LRT Route


Crossing
Legend
Athurugiriya- Kolonnawa 132 kV crossing at CINEC
Depot Access
Feature 1
Feature 2
Main Line
Pannipitiya-Biyagama 132 kV crossing at CINEC
Kandana
Welisara
Ragama
Eldeniya
Wattala
Gonawala
Peliyagoda
(04) WTC
(05) Fort
(03) Slave Island
(06) Transport Centre
(07) St. Joseph's
Colombo
(02) Seema Malakaya
(08) National Hospital
(09) Borella
(10) Cotta Road
(01) Kolupitiya
(11) Welikada
(12) Rajagiriya
(13) Sethsiripaya
(14) Battaramulla
(17) Lumubini Temple
(19) Malabe
(16) Rpbert Gunawadena
(15) Palan Thuna
Sri Jayawardenepura Kotte
Ruhunupura
Nugegoda
Maharagama
Google Earth
Image © 2017 CNES / Airbus
© 2017 Google
Image © 2017 DigitalGlobe
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
N
3 mi

Pannipitiya-Biyagama Crossing



Depot Crossing



Sewage system around the proposed LRT Route


N
KOVIL STREET
D.R.WIJEWARDANA MAWATHA
MORGAN ROAD
KEW POINTS ROAD
MALAY STREET
GLENNIE PASSAGE
GLENNIE STREET
POLICE LANE
VAUXHALL LANE
VELLONS PASSAGE
CHURCH STREET
KEW ROAD
DR.COLVIN R DE SILVA MAWATHA
STEWART STREET
DISPENSARY LANE
LILLIE STREET
STAPLES STREET
WEKANDE ROAD
NAWAM MAWATHA
SIR JAMES PEIRIS MAWATHA
SRI UTTARANANDA MAWATHA
T.B.J
1 2,000
Legend
Man les_pt
Stor Water_Ln
CM _pump_house
C _Manhole
C C_force_main
C C_Gravity_Sewer_final
MC_Main_Sewer
olombo_Road_edge
Colombo_Railway
Water_Bodies


N
YORK STREET
MALIBAN STREET
FRONT STREET
CHATHAM STREET
LOTUS ROAD
F.W.BASTIAN MAWATHA
OLCOTT MAWATHA
MIHINDU MAWATHA
M.D.GUNASENA MAWATHA
SANCHIARACHI'S GARDEN
KOVIL STREET
D.R.WIJEWARDANA MAWATHA
SIR CHITTAMPALAM A GARDINER MAWATHA
MALAY STREET
KEW POINTS ROAD
MORGAN ROAD
KUMARAN RATHNAM ROAD
POLICE LANE
GLENNIE PASSAGE
BALADAKSHA MAWATHA
1:2,000
Legend
ManHoles_pt
StormWater_Ln
CMC_pump_house
CMC_Manhole
CMC_force_main
CMC_Gravity_Sewer_final
CMC_Main_Sewer
Colombo_Road_edge
Colombo_Railway
Water_Bodies


N
D.R.WIJEWARDANA MAWATHA
KOVIL STREET
T.B.JAYAH MAWATHA
ORABIPASHA STREET
SYMONDS ROAD
CLIFTON LANE
1ST MALIGAKANDE LANE
VAUXHALL STREET
FORBES LANE
J.E GUNASEKARA AVENUE
STORK PLACE
DR.COLVIN R.DE SILVA MAWATHA
STAPLES STREET
FOUNTAIN-HOUSE LANE
NORRIS CANAL ROAD
1:2,000
Legend
ManHoles_pt
StormWater_Ln
CMC_pump_house
CMC_Manhole
CMC_force_main
CMC_Gravity_Sewer_final
CMC_Main_Sewer
Colombo_Road_edge
Colombo_Railway
Water_Bodies


FOUNTAIN-HOUSE LANE
NORRIS CANAL ROAD
NORRIS CANAL ROAD
VAUXHALL STREET
T.B.JAYAH MAWATHA
FRANCIS ROAD
GUNASEKARA LANE
PARK AVENUE
KYNSEY ROAD
ARCADIA GARDENS
F.R.SENANAYAKE MAWATHA
DR.C.W.W.KANNANGARA MAWATHA
ROSMEAD PLACE
KYNSEY TERRACE
ANANDA COOMARASAMY MAWATHA
1:2,000
Legend
● ManHoles_pt
StormWater_Ln
● CMC_pump_house
● CMC_Manhole
CMC_force_main
CMC_Gravity_Sewer_final
CMC_Main_Sewer
Colombo_Road_edge
Colombo_Railway
Water_Bodies


N
PARK AVENUE
MAGAZINE ROAD
LESLEY RANAGALA MAWATHA
SARANAPALA HIMI MAWATHA
DILENNIA ROAD
ECRIN PLACE
KURUPPU LANE
RODNEY STREET
GOTHAMI ROAD
ELLIOT PLACE
TURNOUR ROAD
GRENIER ROAD
RUHUNUKALA MAWATHA
RODNEY PLACE
KURUPPU ROAD
1ST LANE
KYNSEY TERRACE
MARINA AVENUE
BAWA PLACE
BALCOMBE PLACE
RT.HON.D.S.SENANAYAKE MAWATHA
CASTLE TERRACE
CASTLE AVENUE
36TH LANE
COTTA LANE
SRI JAYAWARDANAPURA ROAD
SARASAVI LANE
KYNSEY ROAD
1:2,000
Legend
ManHoles_pt
StormWater_Ln
CMC_pump_house
CMC_Manhole
CMC_force_main
CMC_Gravity_Sewer_final
CMC_Main_Sewer
Colombo_Road_edge
Colombo_Railway
Water_Bodies

Annex H

Biological survey

List of flora observed in the LRT trace from Malabe to Fort

Abbreviations Used:

E- Endemic, **N** - Native, **I** - Introduced, alien or Exotic, **IAS** - Alien invasive species, N**CS** - National Conservation Status, **EN**- Endangered, **VU**- Vulnerable, **NE** - Not Evaluated, **NT** - Near Threatened, **DD** - Data Deficient, **LC** - Least Concern

Family	Scientific Name	Common name	NCS	Origin
Acanthaceae	*Asystasia gangetica*	Puruk	LC	N
Acanthaceae	*Dipteracanthus prostratus*	Nil Puruk	LC	N
Acanthaceae	*Hygrophila auriculata*	Katu Ikiriya	LC	N
Amaranthaceae	*Achyranthes aspera*	Gas Karaal Heba	LC	N
Amaranthaceae	*Aerva lanata*	Pol pala	LC	N
Amaranthaceae	*Alternanthera sessilis*	Mukunuwenna	LC	N
Amaranthaceae	*Amaranthus viridis*	Kura Thampala	LC	N
Amaranthaceae	*Celosia argentea*	Kiri Henda	LC	N
Amaranthaceae	*Gomphrena celosioides*		NE	I
Anacardiaceae	*Lannea coromandelica*	Hik	LC	N
Anacardiaceae	*Mangifera indica*	Amba	NE	I
Anacardiaceae	*Spondias dulcis*	Amberella	NE	I
Annonaceae	*Annona glabra*	Wel Atha	NE	IAS
Annonaceae	*Annona muricata*	Katu Atha	NE	I
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N
Apocynaceae	*Alstonia macrophylla*	Havari Nuga	NE	IAS
Apocynaceae	*Alstonia scholaris*	Ruk-Attana	LC	N
Apocynaceae	*Cerbera odollam*	Gon Kaduru	LC	N
Apocynaceae	*Plumeria obusta*	Araliya	NE	I
Apocynaceae	*Tabernaemontana dichotoma*	Divi Kaduru	LC	N
Araceae	*Colocasia esculenta*	Gahala	LC	N
Araceae	***Lagenandra praetermissa***	Ketala	LC	E
Araceae	*Lasia spinosa*	Kohila	LC	N
Araceae	*Pistia stratiotes*	Diya Paradel	LC	N
Araceae	*Pothos scandens*	Pota Wel	LC	N
Arecaceae	*Areca catechu*	Puwak	NE	I
Arecaceae	*Areca triandra*		NE	I
Arecaceae	*Caryota urens*	Kithul	LC	N
Arecaceae	*Cocos nucifera*	Pol	NE	I
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I
Boraginaceae	*Heliotropium indicum*	Eth Honda	LC	N
Calophyllaceae	*Mesua ferrea*	Na	LC	N
Cannabaceae	*Trema orientalis*	Gedumba	LC	N
Casuarinaceae	*Casuarina equisetifolia*	Kasa	NE	I

Family	Scientific Name	Common name	NCS	Origin
Cleomaceae	*Cleome rutidosperma*		NE	I
Cleomaceae	*Cleome viscosa*	Wal Aba	LC	N
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N
Combretaceae	*Terminalia bellirica*	Bulu	LC	N
Combretaceae	*Terminalia catappa*	Kottamba	NE	I
Commelinaceae	*Commelina benghalensis*	Diya meneriya	LC	N
Commelinaceae	*Commelina diffusa*	Gira Pala	LC	N
Compositae	*Ageratum conyzoides*	Hulanthala	NE	I
Compositae	*Chromolaena odorata*	Podi Sinnamaran	NE	I
Compositae	*Cyanthillium cinereum*	Kumburuwenna	LC	N
Compositae	*Eclipta prostrata*	Kikirindi	LC	N
Compositae	*Emilia sonchifolia*	Kadu Pahara	LC	N
Compositae	*Mikania cordata*	Gam Palu	NE	I
Compositae	*Sphagneticola trilobata*	Udaya Kumari	NE	IAS
Compositae	*Struchium sparganophorum*		NE	I
Compositae	*Synedrella nodiflora*		NE	I
Compositae	*Tridax procumbens*	Wasu Sudu	NE	I
Compositae	*Xanthium strumarium*	Wal Rambutan	LC	N
Convolvulaceae	*Cuscuta campestris*		DD	N
Convolvulaceae	*Evolvulus nummularius*	Sudu Vishnukranthi	NE	I
Convolvulaceae	*Ipomoea aquatica*	Kankun	LC	N
Convolvulaceae	*Ipomoea cairica*		NE	I
Convolvulaceae	*Merremia tridentata*	Hawari Madu	LC	N
Cucurbitaceae	*Coccinia grandis*	Kowakka	LC	N
Cyperaceae	*Actinoscirpus grossus*		LC	N
Cyperaceae	*Cyperus iria*	Wel Hiri	LC	N
Dilleniaceae	*Dillenia suffruticosa*	Para	NE	IAS
Dipterocarpaceae	***Dipterocarpus zeylanicus***	Hora	NT	E
Ebenaceae	*Diospyros ebenum*	Kaluwara	EN	N
Elaeocarpaceae	*Elaeocarpus serratus*	Weralu	LC	N
Euphorbiaceae	*Acalypha indica*	Kuppameniya	LC	N
Euphorbiaceae	*Croton aromaticus*	Wel Keppetiya	LC	N
Euphorbiaceae	*Croton hirtus*	Wal Thippili	NE	I
Euphorbiaceae	*Euphorbia heterophylla*	Kepumkiriya	NE	I
Euphorbiaceae	*Euphorbia hirta*	Kiri Thala	LC	N
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N
Euphorbiaceae	*Microstachys chamaelea*	Rath Pitawakka	LC	N
Euphorbiaceae	*Ricinus communis*	Endaru	NE	I
Lamiaceae	*Clerodendrum indicum*	Wal Kirithekku	NE	I
Lamiaceae	*Hyptis capitata*		NE	I

Family	Scientific Name	Common name	NCS	Origin
Lamiaceae	*Hyptis suaveolens*	Ali Thala	NE	I
Lamiaceae	*Leucas zeylanica*	Geta Thumba	LC	N
Lamiaceae	*Tectona grandis*	Thekka	NE	I
Lamiaceae	*Vitex negundo*	Nika	LC	N
Lauraceae	*Litsea glutinosa*	Bomi	LC	N
Lauraceae	*Persea americana*	Ali-pera	NE	I
Lecythidaceae	*Barringtonia acutangula*	Ela midella	LC	N
Lecythidaceae	*Barringtonia asiatica*	Diya midella	LC	N
Lecythidaceae	*Couroupita surinamensis*	Sal	NE	I
Leguminosae	*Acacia auriculiformis*		NE	I
Leguminosae	*Adenanthera pavonina*	Madatiya	LC	N
Leguminosae	*Aeschynomene americana*		NE	I
Leguminosae	*Albizia saman*	Pini Mara	NE	I
Leguminosae	*Alysicarpus vaginalis*	Aswenna	LC	N
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I
Leguminosae	*Cassia fistula*	Ehela	NE	I
Leguminosae	*Centrosema pubescens*		NE	I
Leguminosae	*Delonix regia*	Mei- Mara	NE	I
Leguminosae	*Desmodium triflorum*	Heen Undupiyaliya	LC	N
Leguminosae	*Erythrina sp*			N
Leguminosae	*Gliricidia sepium*	Wetamara	NE	I
Leguminosae	*Leucaena leucocephala*	Ipil Ipil	NE	IAS
Leguminosae	*Mimosa diplotricha*	Wel Nidikumba	NE	I
Leguminosae	*Mimosa pigra*	Yoda Nidikumba	NE	IAS
Leguminosae	*Mimosa pudica*	Nidikumba	NE	I
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I
Leguminosae	*Pericopsis mooniana*	Nadun	VU	N
Leguminosae	*Pithecellobium dulce*	Pinikaral	NE	I
Leguminosae	*Pongamia pinnata*	Magul-Karanda	LC	N
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I
Leguminosae	*Pueraria phaseoloides*		NE	I
Leguminosae	*Senna alata*	Bu Thora	NE	I
Leguminosae	*Senna occidentalis*	Peni Thora	LC	N
Leguminosae	*Senna tora*	Pethi Thora	LC	N
Leguminosae	*Sesbania grandiflora*	Kathuru Murunga	NE	I
Leguminosae	*Tamarindus indica*	Siyambala	NE	I
Linderniaceae	*Lindernia anagallis*	Hadapath Wila	LC	N
Linderniaceae	*Lindernia ciliata*		NT	N
Linderniaceae	*Lindernia crustacea*		LC	N
Linderniaceae	*Lindernia rotundifolia*		LC	N

Family	Scientific Name	Common name	NCS	Origin
Loranthaceae	*Dendrophthoe falcata*	Pilila	LC	N
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N
Meliaceae	*Azadirachta indica*	Kohomba	NE	I
Meliaceae	*Swietenia macrophylla*	Mahogani	NE	I
Malvaceae	*Abutilon indicum*	Anodha	LC	N
Malvaceae	*Berrya coridifolia*	Halmilla	LC	N
Malvaceae	*Ceiba pentandra*	Kotta Pulun	LC	N
Malvaceae	*Grewia nervosa*	Kohu Kirilla	LC	N
Malvaceae	*Hibiscus tilliaceus*	Beli Patta	LC	N
Malvaceae	*Melochia corchorifolia*	Gas Kura	LC	N
Malvaceae	*Microcos paniculata*	Kohu Kirilla	LC	N
Malvaceae	*Sida rhombifolia*	Heen Bebila	LC	N
Malvaceae	*Sterculia foetida*	Telabu	LC	N
Malvaceae	*Triumfetta pentandra*	Epala	LC	N
Malvaceae	*Urena lobata*	Patta Epala	LC	N
Malvaceae	*Urena sinuata*	Heen Epala	LC	N
Moraceae	*Artocarpus incisus*	Rata-Del	NE	I
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N
Moraceae	*Ficus benjamina*	Walu Nuga	NE	I
Moraceae	*Ficus callosa*	Gonna	LC	N
Moraceae	*Ficus elastica*		NE	I
Moraceae	*Ficus exasperata*	Bu Deliya	LC	N
Moraceae	*Ficus hispida*	Kota Dimbula	LC	N
Moraceae	*Ficus racemosa*	Attikka	LC	N
Moraceae	*Ficus religiosa*	Bo	NE	I
Moringaceae	*Moringa oleifera*	Murunga	NE	I
Muntingiaceae	*Muntingia calabura*	Jam	NE	I
Musaceae	*Musa x paradisiaca*	Kesel	NE	I
Myrtaceae	*Eucalyptus* sp.	Eucalyptus	NE	I
Myrtaceae	*Psidium guajava*	Pera	NE	I
Myrtaceae	*Syzygium aromaticum*	Karambu	NE	I
Myrtaceae	*Syzygium caryophyllatum*	Dan	LC	N
Myrtaceae	*Syzygium cumini*	Ma-Dan	LC	N
Nymphaeaceae	*Nymphaea rubra*		NE	N
Onagraceae	*Ludwigia decurrens*		NE	I
Onagraceae	*Ludwigia hyssopifolia*		LC	N
Onagraceae	*Ludwigia peruviana*	Wel karabu	NE	I
Oxalidaceae	*Oxalis barrelieri*		NE	I
Pandanaceae	*Pandanus kaida*	Wetakeyya	LC	N

Family	Scientific Name	Common name	NCS	Origin
Passifloraceae	*Passiflora foetida*	Pada Gedi	NE	I
Phyllanthaceae	*Antidesma ghaesembilla*	Bu Embilla	LC	N
Phyllanthaceae	*Aporosa cardiosperma*	Mapath Kebella	LC	N
Phyllanthaceae	*Breynia retusa*	Wal Murunga	LC	N
Phyllanthaceae	*Bridelia retusa*	Keta kela	LC	N
Phyllanthaceae	*Flueggea leucopyrus*	Katu Pila	LC	N
Phyllanthaceae	*Glochidion zeylanicum*	Hunukirilla	LC	N
Phyllanthaceae	*Phyllanthus acidus*	Rata nelli	NE	I
Phyllanthaceae	*Phyllanthus amarus*	Pitawakka	LC	N
Phyllanthaceae	*Phyllanthus reticulatus*	Wel kaila	LC	N
Pinaceae	*Pinus sp.*		NE	I
Plantaginaceae	*Bacopa monnieri*	Lunuwila	LC	N
Plantaginaceae	*Scoparia dulcis*	Wal Koththamalli	NE	I
Plantaginaceae	*Stemodia verticillata*		NE	I
Poaceae	*Axonopus compressus*	Pothu Thana	NE	I
Poaceae	*Bambusa vulgaris*	Kaha Una	NE	I
Poaceae	*Chrysopogon aciculatus*	Thuththiri	LC	N
Poaceae	*Eleusine indica*	Bela Thana	LC	N
Poaceae	*Panicum maximum*	Gini Thana	NE	IAS
Poaceae	*Setaria barbata*		NE	I
Polygonaceae	*Persicaria barbata*	Rathu Kimbulwenna	LC	N
Pontederiaceae	*Eichhornia crassipes*	Japan Jabara	NE	IAS
Pontederiaceae	*Monochoria vaginalis*	Diya Habarala	LC	N
Rhizophoraceae	*Carallia brachiata*	Dawata	NT	N
Rubiaceae	*Mitracarpus hirtus*		NE	I
Rubiaceae	*Morinda citrifolia*	Ahu	LC	N
Rubiaceae	*Nauclea orientalis*	Bak Me	LC	N
Rubiaceae	***Oldenlandia auricularia***	Geta Kola	VU	E
Rubiaceae	*Oldenlandia corymbosa*	Wal Pathpadagam	LC	N
Rubiaceae	*Richardia brasiliensis*		NE	I
Rubiaceae	*Spermacoce alata*		NE	I
Rubiaceae	*Spermacoce exilis*		NE	I
Rubiaceae	*Spermacoce ocymifolia*		NE	I
Rubiaceae	*Spermacoce remota*		NE	I
Rubiaceae	*Spermacoce verticillata*		NE	I
Rutaceae	*Aegle marmelos*	Beli	NE	I
Rutaceae	*Glycosmis pentaphylla*	Dodam Pana	LC	N
Rutaceae	*Limonia acidissima*	Divul	LC	N
Sapindaceae	*Cardiospermum halicacabum*	Penela	LC	N
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N

Family	Scientific Name	Common name	NCS	Origin
Sapindaceae	*Nephelium lappaceum*	Rambutan	NE	I
Sapindaceae	*Pometia pinnata*	Bulumora	LC	N
Sapindaceae	*Schleichera oleosa*	Kon	LC	N
Sapotaceae	*Chrysophyllum cainito*	Kos-eta-lawalu	NE	I
Sapotaceae	*Madhuca longifolia*	Me	NT	N
Solanaceae	*Physalis angulata*		NE	I
Solanaceae	*Solanum americanum*	Kalu Kanheeriya	NE	I
Solanaceae	*Solanum torvum*	Thibbatu	LC	N
Typhaceae	*Typha angustifolia*	Hambu Pan	LC	N
Verbenaceae	*Lantana camara*	Gandapana	NE	IAS
Verbenaceae	*Stachytarpheta cayennensis*		NE	I
Verbenaceae	*Stachytarpheta urticifolia*		NE	I

Appendix . List of fauna observed in the LRT trace from Malabe to Slave Island

Abbreviations Used:

E- Endemic, **N** - Native, **I** - Introduced, alien or Exotic, **NCS** - National Conservation Status, **EN**-Endangered, **VU**- Vulnerable, **NE** - Not Evaluated, **NT** - Near Threatened, **DD** - Data Deficient, **LC** - Least Concern

Family	Scientific Name	Common English Name	NCS	Origin
BUTTERFLIES				
Pieridae	*Catopsilia scylla*	Orange Migrant	NE	I
Hesperiidae	*Cephrenes trichopepla*	Yellow Palm Dart	NE	I
Papilionidae	*Graphium agamemnon*	Tailed Jay	LC	N
Papilionidae	*Pachliopta aristolochiae*	Common Rose	LC	N
Papilionidae	*Pachliopta hector*	Crimson Rose	LC	N
Papilionidae	*Papilio clytia*	Mime	LC	N
Papilionidae	*Papilio demoleus*	Lime Butterfly	LC	N
Papilionidae	*Papilio polytes*	Common Mormon	LC	N
Pieridae	*Catopsilia pomona*	Lemon Emigrant	LC	N
Pieridae	*Catopsilia pyranthe*	Mottled Emigrant	LC	N
Pieridae	*Delias eucharis*	Jezebel	LC	N
Pieridae	*Eurema hecabe*	Common Grass Yellow	LC	N
Pieridae	*Leptosia nina*	Psyche	LC	N
Nymphalidae	*Acraea violae*	Tawny Coster	LC	N
Nymphalidae	*Danaus chrysippus*	Plain Tiger	LC	N
Nymphalidae	*Danaus genutia*	Common Tiger	LC	N
Nymphalidae	*Elymnias hypermnestra*	Common Palmfly	LC	N
Nymphalidae	*Euploea core*	Common Indian Crow	LC	N
Nymphalidae	*Euthalia aconthea*	Baron	LC	N
Nymphalidae	*Junonia almana*	Peacock Pansy	LC	N
Nymphalidae	*Junonia atlites*	Grey Pansy	LC	N
Nymphalidae	*Junonia iphita*	Chocolate Soldier	LC	N
Nymphalidae	*Melanitis leda*	Common Evening Brown	LC	N
Nymphalidae	*Mycalesis perseus*	Common Bushbrown	LC	N
Nymphalidae	*Neptis hylas*	Common Sailor	LC	N
Nymphalidae	*Orsotriaena medus*	Medus Brown	LC	N
Nymphalidae	*Parantica aglea*	Glassy Tiger	LC	N
Nymphalidae	*Phalanta phalantha*	Leopard	LC	N
Nymphalidae	*Tirumala limniace*	Blue Tiger	LC	N
Nymphalidae	*Ypthima ceylonica*	White Four-ring	LC	N
Lycaenidae	*Arhopala amantes*	Large Oakblue	LC	N
Lycaenidae	*Castalius rosimon*	Common Pierrot	LC	N
Lycaenidae	*Chilades lajus*	Lime Blue	LC	N
Lycaenidae	*Chilades pandava*	Plains Cupid	LC	N

Family	Scientific Name	Common English Name	NCS	Origin
Lycaenidae	*Everes lacturnus*	Indian Cupid	LC	N
Lycaenidae	*Jamides bochus*	Dark Cerulean	LC	N
Lycaenidae	*Jamides celeno*	Common Cerulean	LC	N
Lycaenidae	*Prosotas nora*	Common Lineblue	LC	N
Lycaenidae	*Rathinda amor*	Monkey-puzzle	LC	N
Lycaenidae	*Spalgis epeus*	Apefly	LC	N
Lycaenidae	*Tajuria cippus*	Peacock Royal	LC	N
Lycaenidae	*Zizina otis*	Lesser Grass Blue	LC	N
Lycaenidae	*Zizula hylax*	Tiny Grass Blue	LC	N
Hesperiidae	*Ampittia dioscorides*	Bush Hopper	LC	N
Hesperiidae	*Borbo cinnara*	Wallace's Swift	LC	N
Hesperiidae	*Iambrix salsala*	Chestnut Bob	LC	N
Hesperiidae	*Potanthus confuscius*	Tropic Dart	LC	N
Hesperiidae	*Suastus gremius*	Indian Palm Bob	LC	N
Hesperiidae	*Taractrocera maevius*	Common Grass Dart	LC	N
Hesperiidae	*Parnara bada*	Smallest Swift	NT	N
Nymphalidae	*Ideopsis similis*	Blue Glassy Tiger	VU	N
Hesperiidae	*Telicota bambusae*	Dark Palmdart	VU	N
DRAGONFLIES				
Coenagrionidae	*Ischnura senegalensis*	Common Bluetail, Marsh Bluetail	LC	N
Coenagrionidae	*Ceriagrion coromandelianum*	Yellow Waxtail	LC	N
Coenagrionidae	*Pseudagrion microcephalum*	Blue Sprite	LC	N
Platycnemididae	*Copera marginipes*	Yellow Featherleg	LC	N
Gomphidae	*Ictinogomphus rapax*	Rapacious Flangetail	LC	N
Libellulidae	*Orthetrum sabina*	Green Skimmer	LC	N
Libellulidae	*Acisoma panorpoides*	Asian Pintail	LC	N
Libellulidae	*Brachythemis contaminata*	Asian Groundling	LC	N
Libellulidae	*Crocothemis servilia*	Oriental Scarlet	LC	N
Libellulidae	*Diplacodes trivialis*	Blue Percher	LC	N
Libellulidae	*Neurothemis tullia*	Pied Parasol	LC	N
Libellulidae	*Rhyothemis variegata*	Variegate Flutterer	LC	N
Libellulidae	*Pantala flavescens*	Wandering Glider	LC	N
Libellulidae	*Urothemis signata*	Scarlet Basker	LC	N
Libellulidae	*Orthetrum luzonicum*	Marsh Skimmer	NT	N
Libellulidae	*Orthetrum pruinosum*	Pink Skimmer	NT	N
Libellulidae	*Neurothemis intermedia*	Paddyfield Parasol	NT	N
Libellulidae	*Rhodothemis rufa*	Spine-legged Redbolt	NT	N
Coenagrionidae	*Onychargia atrocyana*	Marsh Dancer	VU	N
FRESH WATER FISH				
Aplocheilidae	*Aplocheilus dayi*	Day’s killifish	E	EN

Family	Scientific Name	Common English Name	NCS	Origin
Belontiidae	*Trichogaster pectoralis*	Snake skin gourami	I	NE
Cichlidae	*Oreochromis niloticus*	Tilapia	I	NE
Cichlidae	*Oreochromis mossambicus*	Tilapia	I	NE
Cyprinidae	*Dawkinsia singhala*	Filamented barb	E	LC
Cyprinidae	*Puntius bimaculatus*	Redside barb	N	LC
Cyprinidae	*Rasbora dandia*	Striped rasbora / Common rasbora	N	LC
Cyprinidae	*Rasbora microcephalus*	Thin line Rasbora	N	LC
AMPHIBIANS				
Bufonidae	*Duttaphrynus melanostictus*	Common house toad	N	LC
Dicroglossidae	*Euphlyctis hexadactylus*	Sixtoe green frog	N	LC
Dicroglossidae	*Fejervarya syhadrensis*	Common paddy field frog	N	LC
REPTILES				
Bataguridae	*Melanochelys trijuga*	Black turtle	LC	N
Agamidae	*Calotes calotes*	Green garden lizard	LC	N
Agamidae	*Calotes versicolor*	Common garden lizard	LC	N
Gekkonidae	*Gehyra mutilata*	Four-claw gecko	LC	N
Gekkonidae	*Hemidactylus frenatus*	Common house-gecko	LC	N
Gekkonidae	*Hemidactylus parvimaculatus*	Spotted housegecko	LC	N
Scincidae	*Eutropis macularia*	Bronzegreen little skink	LC	N
Varanidae	*Varanus bengalensis*	Land monitor	LC	N
Varanidae	*Varanus salvator*	Water monitor	LC	N
Natricidae	*Amphiesma stolatum*	Buff striped keelback	LC	N
Natricidae	*Xenochrophis piscator*	Checkered Keelback	LC	N
Colubridae	*Dendrelaphis schokari*	Schokari's bronze back	LC	E
Colubridae	*Ptyas mucosa*	Rat snake	LC	N
BIRDS				
Accipitridae	*Haliastur indus*	Brahminy Kite	LC	N
Alcedinidae	*Halcyon smyrnensis*	White-throated Kingfisher	LC	N
Alcedinidae	*Alcedo atthis*	Common Kingfisher	LC	N
Anatidae	*Dendrocygna javanica*	Lesser Whistling-duck	LC	N
Apodidae	*Cypsiurus balasiensis*	Asian Palm-swift	LC	N
Ardeidae	*Ardea cinerea*	Grey Heron	LC	N
Ardeidae	*Ardea purpurea*	Purple Heron	LC	N
Ardeidae	*Ardeola grayii*	Indian Pond-heron	LC	N
Ardeidae	*Bubulcus ibis*	Cattle Egret	LC	N
Ardeidae	*Casmerodius albus*	Great Egret	LC	N
Charadriidae	*Vanellus indicus*	Red-wattled Lapwing	LC	N
Cisticolidae	*Cisticola juncidis*	Zitting Cisticola	LC	N
Cisticolidae	*Prinia inornata*	Plain Prinia	LC	N
Columbidae	*Ducula aenea*	Green Imperial-Pigeon	LC	N

Family	Scientific Name	Common English Name	NCS	Origin
Columbidae	*Stigmatopelia chinensis*	Spotted Dove	LC	N
Corvidae	*Corvus splendens*	House Crow	LC	N
Cuculidae	*Centropus sinensis*	Greater Coucal	LC	N
Cuculidae	*Eudynamys scolopaceus*	Asian Koel	LC	N
Dicruidae	*Dicrurus caerulescens*	White-bellied Drongo	LC	N
Nectariniidae	*Nectarinia lotenia*	Long-billed Sunbird	LC	N
Nectariniidae	*Nectarinia zeylonica*	Purple-rumped Sunbird	LC	N
Oriolidae	*Oriolus xanthornus*	Black-hooded Oriole	LC	N
Phalacrocoracidae	*Phalacrocorax niger*	Little Cormorant	LC	N
Phalacrocoracidae	*Phalacrocorax fuscicollis*	Indian Cormorant	LC	N
Psittacidae	*Psittacula krameri*	Rose-ringed Parakeet	LC	N
Pycnonotidae	*Pycnonotus cafer*	Red-vented Bulbul	LC	N
Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen	LC	N
Rallidae	*Porphyrio porphyrio*	Purple Swamphen	LC	N
Ramphastidae	*Megalaima zeylanica*	Brown-headed Barbet	LC	N
Sturnidae	*Acridotheres tristis*	Common Myna	LC	N
Sylviidae	*Orthotomus sutorius*	Common Tailorbird	LC	N
Threskiornithidae	*Threskiornis melanocephalus*	Black-headed Ibis	LC	N
Timalidae	*Turdoides affinis*	Yellow-billed Babbler	LC	N
MAMMALS				
Cercopithecidae	*Semnopithecus vetulus*	Sri Lanka Purple-faced langur	EN	E
Felidae	*Prionailurus viverrinus*	Fishing cat	EN	N
Hystricidae	*Hystrix indica*	Porcupine	LC	N
Scuiridae	*Funambulus palmarum*	Palm squirrel	LC	N

Appendix xx. Potential list of trees that will be affected by the LRT trace

Abbreviations Used:

E- Endemic, **N** - Native, **I** - Introduced, alien or Exotic, **IAS** - Invasive Alien Species,**NCS** - National Conservation Status, **EN**- Endangered, **VU**- Vulnerable, **NE** - Not Evaluated, **NT** - Near Threatened, **DD** - Data Deficient, **LC** - Least Concern

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Section 1: From LRT Depot to Malabe						
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	135	12
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	153	18
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	115	15
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	117	15
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	148	18
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	165	18
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	95	11
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	240	18
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	142	12
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	184	18
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	203	16
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	90	10
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	99	9
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	172	10
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	132	8
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	84	9
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	185	10
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	95	10
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	130	12
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	61	10
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	130	12
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	72	8
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	58	7
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	122	12
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	46	12
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	60	12
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	98	10
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	141	10
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	142	12
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	180	11
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	48	9
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	220	11
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	80	14

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	70	9
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	66	10
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	152	11
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	147	12
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	135	14
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	87	12
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	86	10
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	130	11
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	72	15
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	79	14
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	80	10
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	103	10
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	86	9
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	125	10
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	81	9
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	95	60
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	65	9
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	108	8
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	76	8
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	91	10
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	40	6
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	115	7
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	79	7
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	94	7
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	78	7
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	40	5
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	57	5
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	59	5
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	132	8
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	78	8
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	67	6
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	110	12
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	110	11
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	71	5
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	78	10
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	38	10
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	122	8
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	99	10
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	90	8
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	73	9

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	80	12
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	95	9
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	70	11
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	41	5
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	57	8
Apocynaceae	*Alstonia macrophylla*	Havari Nuga	NE	I	32	8
Apocynaceae	*Alstonia macrophylla*	Havari Nuga	NE	I	70	15
Apocynaceae	*Alstonia macrophylla*	Havari Nuga	NE	I	52	13
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	90	15
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	50	5
Malvaceae	*Microcos paniculata*	Kohu Kirilla	LC	N	32	15
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	72	10
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	55	14
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	40	9
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	51	11
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	40	9
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	60	8
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	119	20
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	65	8
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	67	8
Anacardiaceae	*Lannea coromandelica*	Hik	LC	N	41	4
Anacardiaceae	*Lannea coromandelica*	Hik	LC	N	86	11
Rubiaceae	*Nauclea orientalis*	Bak Me	LC	N	65	5
Annonaceae	*Annona glabra*	Wel Atha	NE	I	32	6
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	103	15
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	50	8
Lamiaceae	*Tectona grandis*	Thekka	NE	I	82	10
Annonaceae	*Annona muricata*	Katu Atha	NE	I	56	4
Myrtaceae	*Psidium guajava*	Pera	NE	I	25	10
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	70	12
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	83	7
Leguminosae	*Gliricidia sepium*	Wetamara	NE	I	47	3
Sapindaceae	*Nephelium lappaceum*	Rambutan	NE	I	28	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	54	8
Malvaceae	*Ceiba pentandra*	Kotta Pulun	LC	N	144	9
Cannabaceae	*Trema orientalis*	Gedumba	LC	N	155	4
Leguminosae	*Leucaena leucocephala*	Ipil Ipil	NE	I	70	10
Section 2: From Malabe to Koswatta						
Anacardiaceae	*Mangifera indica*	Amba	NE	I	30	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	130	9

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Anacardiaceae	*Mangifera indica*	Amba	NE	I	102	8
Anacardiaceae	*Mangifera indica*	Amba	NE	I	83	9
Anacardiaceae	*Mangifera indica*	Amba	NE	I	72	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	73	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	142	8
Anacardiaceae	*Mangifera indica*	Amba	NE	I	109	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	115	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	76	8
Anacardiaceae	*Mangifera indica*	Amba	NE	I	63	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	89	8
Anacardiaceae	*Mangifera indica*	Amba	NE	I	91	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	82	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	69	4
Anacardiaceae	*Mangifera indica*	Amba	NE	I	223	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	82	7
Anacardiaceae	*Mangifera indica*	Amba	NE	I	71	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	62	7
Anacardiaceae	*Mangifera indica*	Amba	NE	I	63	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	51	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	120	10
Anacardiaceae	*Mangifera indica*	Amba	NE	I	73	9
Anacardiaceae	*Mangifera indica*	Amba	NE	I	61	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	69	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	94	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	40	5
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	82	7
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	79	6
Moringaceae	*Moringa oleifera*	Murunga	NE	I	78	6
Leguminosae	*Sesbania grandiflora*	Kathuru Murunga	NE	I	30	6
Leguminosae	*Sesbania grandiflora*	Kathuru Murunga	NE	I	33	7
Arecaceae	*Cocos nucifera*	Pol	NE	I	91	11
Arecaceae	*Cocos nucifera*	Pol	NE	I	90	8
Arecaceae	*Cocos nucifera*	Pol	NE	I	85	8
Arecaceae	*Cocos nucifera*	Pol	NE	I	73	8
Arecaceae	*Cocos nucifera*	Pol	NE	I	92	12
Arecaceae	*Cocos nucifera*	Pol	NE	I	80	10
Arecaceae	*Cocos nucifera*	Pol	NE	I	74	8
Arecaceae	*Cocos nucifera*	Pol	NE	I	81	9
Arecaceae	*Cocos nucifera*	Pol	NE	I	52	7
Arecaceae	*Cocos nucifera*	Pol	NE	I	60	5

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Arecaceae	*Cocos nucifera*	Pol	NE	I	71	6
Arecaceae	*Cocos nucifera*	Pol	NE	I	69	6
Arecaceae	*Cocos nucifera*	Pol	NE	I	83	7
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	110	11
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	86	8
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	71	7
Sapindaceae	*Nephelium lappaceum*	Rambutan	NE	I	62	5
Sapindaceae	*Nephelium lappaceum*	Rambutan	NE	I	90	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	92	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	49	5
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	62	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	69	5
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	82	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	52	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	50	5
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	72	11
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	61	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	84	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	72	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	32	5
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	41	5
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	52	5
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	41	3
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	84	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	71	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	108	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	83	7
Moraceae	*Ficus callosa*	Gonna	LC	N	40	6
Moraceae	*Ficus callosa*	Gonna	LC	N	80	11
Cannabaceae	*Trema orientalis*	Gedumba	LC	N	42	8
Ebenaceae	*Diospyros ebenum*	Kaluwara	EN	N	102	12
Calophyllaceae	*Mesua ferrea*	Na	LC	N	41	6
Calophyllaceae	*Mesua ferrea*	Na	LC	N	43	6
Calophyllaceae	*Mesua ferrea*	Na	LC	N	32	5
Moraceae	*Ficus benjamina*	Walu Nuga	NE	I	32	6
Moraceae	*Ficus benjamina*	Walu Nuga	NE	I	31	6
Moraceae	*Ficus benjamina*	Walu Nuga	NE	I	64	7
Moraceae	*Ficus benjamina*	Walu Nuga	NE	I	49	5
Moraceae	*Ficus benjamina*	Walu Nuga	NE	I	63	6
Sapotaceae	*Madhuca longifolia*	Me	NT	N	81	9

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Sapotaceae	*Madhuca longifolia*	Me	NT	N	52	13
Sapotaceae	*Madhuca longifolia*	Me	NT	N	64	8
Sapotaceae	*Madhuca longifolia*	Me	NT	N	71	10
Sapotaceae	*Madhuca longifolia*	Me	NT	N	93	8
Sapotaceae	*Madhuca longifolia*	Me	NT	N	107	10
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	131	11
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	62	7
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	51	7
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	63	8
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	49	7
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	42	5
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	51	5
Fabaceae	*Cassia fistula*	Ehela	NE	I	31	4
Fabaceae	*Cassia fistula*	Ehela	NE	I	38	3
Fabaceae	*Cassia fistula*	Ehela	NE	I	31	6
Fabaceae	*Cassia fistula*	Ehela	NE	I	29	5
Apocynaceae	*Plumeria obusta*	Araliya	NE	I	55	4
Apocynaceae	*Plumeria obusta*	Araliya	NE	I	62	5
Apocynaceae	*Plumeria obusta*	Araliya	NE	I	45	4
Arecaceae	*Palm sp.*				62	5
Leguminosae	*Pericopsis mooniana*	Nadun	VU	N	63	7
Malvaceae	*Berrya coridifolia*	Halmilla	LC	N	102	11
Moraceae	*Ficus religiosa*	Bo	NE	I	507	10
Combretaceae	*Terminalia bellirica*	Bulu	LC	N	64	9
Lecythidaceae	*Couroupita surinamensis*	Sal	NE	I	62	7
Pinaceae	*Pinus sp.*		NE	I	83	15
Phyllanthaceae	*Bridelia retusa*	Keta kela	LC	N	112	10
Leguminosae	*Tamarindus indica*	Siyambala	NE	I	41	8
Leguminosae	*Tamarindus indica*	Siyambala	NE	I	50	7
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	114	10
Dipterocarpaceae	*Dipterocarpus zeylanicus*	Hora	NT	E	168	32
Myrtaceae	*Syzygium aromaticum*	Karambu	NE	I	41	8
Leguminosae	*Acacia auriculiformis*		NE	I	103	11
Lamiaceae	*Tectona grandis*	Thekka	NE	I	112	10
Lamiaceae	*Tectona grandis*	Thekka	NE	I	82	6
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	84	6
Arecaceae	*Areca catechu*	Puwak	NE	I	42	10
Rubiaceae	*Morinda citrifolia*	Ahu	LC	N	42	4
Anacardiaceae	*Lannea coromandelica*	Hik	LC	N	84	7
Anacardiaceae	*Spondias dulcis*	Amberella	NE	I	72	7

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Anacardiaceae	*Spondias dulcis*	Amberella	NE	I	63	5
Apocynaceae	*Cerbera odollam*	Gon Kaduru	LC	N	42	3
Apocynaceae	*Cerbera odollam*	Gon Kaduru	LC	N	33	4
Moraceae	*Ficus exasperata*	Bu Deliya	LC	N	42	4
Moraceae	*Artocarpus incisus*	Rata-Del	NE	I	63	5
Malvaceae	*Ceiba pentandra*	Kotta Pulun	LC	N	83	8
Section 3: From Koswatta to Battaramulla						
Apocynaceae	*Alstonia scholaris*	Ruk-Attana	LC	N	82	11
Leguminosae	*Tamarindus indica*	Siyambala	NE	I	41	8
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	62	9
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	91	9
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	62	5
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	70	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	122	11
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	114	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	51	9
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	132	12
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	81	8
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	80	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	122	14
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	133	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	62	9
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	148	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	124	8
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	40	6
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	124	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	122	9
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	133	15
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	98	13
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	110	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	112	9
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	124	8
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	67	4
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	59	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	73	9
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	154	9
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	120	11
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	144	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	72	8
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	72	7

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	133	9
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	125	7
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	94	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	110	8
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	121	8
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	112	9
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	79	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	125	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	99	9
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	81	8
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	114	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	123	8
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	139	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	101	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	121	11
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	123	11
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	83	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	114	11
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	91	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	121	11
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	114	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	103	5
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	81	4
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	89	8
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	106	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	91	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	114	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	110	11
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	103	11
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	100	10
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	72	8
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	41	7
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	52	4
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	41	3
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	94	7
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	82	6
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	53	6
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	71	6
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	84	6
Cannabaceae	*Trema orientalis*	Gedumba	LC	N	40	6

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Cannabaceae	*Trema orientalis*	Gedumba	LC		51	5
Cannabaceae	*Trema orientalis*	Gedumba	LC		32	7
Cannabaceae	*Trema orientalis*	Gedumba	LC		54	6
Cannabaceae	*Trema orientalis*	Gedumba	LC		53	7
Leguminosae	*Delonix regia*	Mei- Mara	NE	I	73	8
Annonaceae	*Annona glabra*	Wel Atha	NE	I	53	4
Annonaceae	*Annona glabra*	Wel Atha	NE	I	41	3
Rhizophoraceae	*Carallia brachiata*	Dawata	NT	N	84	15
Malvaceae	*Sterculia foetida*	Telabu	LC	N	132	14
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	82	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	81	10
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	42	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	72	11
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	70	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	44	3
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	65	5
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	81	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	74	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	91	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	84	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	81	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	64	4
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	41	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	57	6
Leguminosae	*Pithecellobium dulce*	Pinikaral	NE	I	76	5
Leguminosae	*Pithecellobium dulce*	Pinikaral	NE	I	72	5
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	92	10
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	84	11
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	91	9
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	84	11
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	90	8
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	81	6
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	94	9
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	90	11
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	82	11
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	84	8
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	71	7
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	49	10
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	93	9
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	69	5

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	81	10
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	54	6
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	96	8
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	91	13
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	72	10
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	84	9
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	85	5
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	107	12
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	83	10
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	101	10
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	82	6
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	113	11
Muntingiaceae	*Muntingia calabura*	Jam	NE	I	32	3
Muntingiaceae	*Muntingia calabura*	Jam	NE	I	41	4
Muntingiaceae	*Muntingia calabura*	Jam	NE	I	34	3
Muntingiaceae	*Muntingia calabura*	Jam	NE	I	41	3
Phyllanthaceae	*Glochidion zeylanicum*	Hunukirilla	LC	N	33	3
Phyllanthaceae	*Glochidion zeylanicum*	Hunukirilla	LC	N	71	10
Dilleniaceae	*Dillenia suffruticosa*	Para	NE	I	21	3
Dilleniaceae	*Dillenia suffruticosa*	Para	NE	I	22	3
Dilleniaceae	*Dillenia suffruticosa*	Para	NE	I	25	3
Dilleniaceae	*Dillenia suffruticosa*	Para	NE	I	25	4
Myrtaceae	*Syzygium caryophyllatum*	Dan	LC	N	43	3
Rubiaceae	*Nauclea orientalis*	Bak Me	LC	N	62	6
Lauraceae	*Litsea glutinosa*	Bomi	LC	N	62	4
Lauraceae	*Litsea glutinosa*	Bomi	LC	N	73	10
Anacardiaceae	*Mangifera indica*	Amba	NE	I	82	9
Anacardiaceae	*Mangifera indica*	Amba	NE	I	51	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	90	12
Anacardiaceae	*Mangifera indica*	Amba	NE	I	54	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	83	11
Anacardiaceae	*Mangifera indica*	Amba	NE	I	54	8
Rutaceae	*Aegle marmelos*	Beli	NE	I	62	6
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	82	6
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	81	8
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	62	4
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	64	7
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	55	6
Phyllanthaceae	*Bridelia retusa*	Keta kela	LC	N	72	5
Arecaceae	*Cocos nucifera*	Pol	NE	I	82	9

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Arecaceae	*Cocos nucifera*	Pol	NE	I	69	9
Phyllanthaceae	*Phyllanthus acidus*	Rata nelli	NE	I	42	4
Malvaceae	*Berrya coridifolia*	Halmilla	LC	N	45	6
Casuarinaceae	*Casuarina equisetifolia*	Kasa	NE	I	81	12
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	82	8
Elaeocarpaceae	*Elaeocarpus serratus*	Weralu	LC	N	41	8
Sapindaceae	*Nephelium lappaceum*	Rambutan	NE	I	73	7
Meliaceae	*Azadirachta indica*	Kohomba	NE	I	82	6
Section 4: From Battaramulla to Borella Junction						
Arecaceae	*Cocos nucifera*	Pol	NE	I	81	10
Arecaceae	*Cocos nucifera*	Pol	NE	I	86	10
Arecaceae	*Cocos nucifera*	Pol	NE	I	72	7
Arecaceae	*Cocos nucifera*	Pol	NE	I	81	7
Arecaceae	*Cocos nucifera*	Pol	NE	I	84	9
Anacardiaceae	*Mangifera indica*	Amba	NE	I	52	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	71	8
Anacardiaceae	*Mangifera indica*	Amba	NE	I	62	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	61	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	73	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	64	4
Anacardiaceae	*Mangifera indica*	Amba	NE	I	51	4
Anacardiaceae	*Mangifera indica*	Amba	NE	I	84	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	81	7
Moraceae	*Ficus benjamina*	Walu Nuga	NE	I	62	6
Moraceae	*Ficus benjamina*	Walu Nuga	NE	I	84	7
Moraceae	*Ficus benjamina*	Walu Nuga	NE	I	93	6
Moraceae	*Ficus benjamina*	Walu Nuga	NE	I	68	4
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	51	6
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	92	11
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	72	5
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	31	4
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	42	4
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	53	5
Myrtaceae	*Syzygium cumini*	Ma-Dan	LC	N	85	7
Myrtaceae	*Syzygium cumini*	Ma-Dan	LC	N	31	5
Sapotaceae	*Madhuca longifolia*	Me	NT	N	84	6
Fabaceae	*Cassia fistula*	Ehela	NE	I	44	4
Fabaceae	*Cassia fistula*	Ehela	NE	I	32	4
Lecythidaceae	*Barringtonia acutangula*	Ela midella	LC	N	32	3
Lecythidaceae	*Barringtonia acutangula*	Ela midella	LC	N	31	3

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Lecythidaceae	*Barringtonia acutangula*	Ela midella	LC	N	35	5
Lecythidaceae	*Barringtonia acutangula*	Ela midella	LC	N	44	6
Lecythidaceae	*Barringtonia acutangula*	Ela midella	LC	N	32	4
Lecythidaceae	*Barringtonia acutangula*	Ela midella	LC	N	31	4
Lecythidaceae	*Barringtonia acutangula*	Ela midella	LC	N	43	3
Lecythidaceae	*Barringtonia acutangula*	Ela midella	LC	N	52	7
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	73	6
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	102	10
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	94	6
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	108	11
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	93	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	81	11
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	92	10
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	79	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	72	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	51	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	88	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	72	9
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	88	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	74	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	81	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	61	5
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	75	5
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	91	10
Moraceae	*Ficus religiosa*	Bo	NE	I	208	12
Moraceae	*Ficus religiosa*	Bo	NE	I	84	5
Moraceae	*Ficus religiosa*	Bo	NE	I	95	10
Moraceae	*Ficus religiosa*	Bo	NE	I	81	8
Moraceae	*Ficus religiosa*	Bo	NE	I	72	8
Moraceae	*Ficus religiosa*	Bo	NE	I	51	6
Moraceae	*Ficus religiosa*	Bo	NE	I	84	7
Myrtaceae	*Eucalyptus* sp.	Eucalyptus	NE	I	41	6
Myrtaceae	*Eucalyptus* sp.	Eucalyptus	NE	I	44	5
Myrtaceae	*Eucalyptus* sp.	Eucalyptus	NE	I	75	5
Myrtaceae	*Eucalyptus* sp.	Eucalyptus	NE	I	81	9
Myrtaceae	*Eucalyptus* sp.	Eucalyptus	NE	I	62	4
Myrtaceae	*Eucalyptus* sp.	Eucalyptus	NE	I	86	10
Myrtaceae	*Eucalyptus* sp.	Eucalyptus	NE	I	73	6
Myrtaceae	*Eucalyptus* sp.	Eucalyptus	NE	I	77	6
Leguminosae	*Albizia saman*	Pini Mara	NE	I	144	9

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	52	8
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	104	9
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	110	11
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	177	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	60	6
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	66	6
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	65	7
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	52	4
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	54	4
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	51	3
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	44	3
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	80	9
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	107	11
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	81	9
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	72	7
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	76	7
Meliaceae	*Swietenia macrophylla*	Mahogani	NE	I	82	12
Meliaceae	*Swietenia macrophylla*	Mahogani	NE	I	71	7
Meliaceae	*Swietenia macrophylla*	Mahogani	NE	I	90	7
Meliaceae	*Swietenia macrophylla*	Mahogani	NE	I	104	10
Meliaceae	*Swietenia macrophylla*	Mahogani	NE	I	94	8
Meliaceae	*Swietenia macrophylla*	Mahogani	NE	I	92	8
Calophyllaceae	*Mesua ferrea*	Na	LC	N	72	6
Calophyllaceae	*Mesua ferrea*	Na	LC	N	39	3
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	72	5
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	107	8
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	103	9
Leguminosae	*Erythrina sp*				84	5
Arecaceae	*Caryota urens*	Kithul	LC	N	62	8
Lamiaceae	*Tectona grandis*	Thekka	NE	I	66	7
Leguminosae	*Pithecellobium dulce*	Pinikaral	NE	I	73	6
Leguminosae	*Pithecellobium dulce*	Pinikaral	NE	I	91	7
Leguminosae	*Pithecellobium dulce*	Pinikaral	NE	I	66	3
Combretaceae	*Terminalia bellirica*	Bulu	LC	N	97	10
Meliaceae	*Azadirachta indica*	Kohomba	NE	I	94	12
Rutaceae	*Limonia acidissima*	Divul	LC	N	54	5
Leguminosae	*Delonix regia*	Mei- Mara	NE	I	112	10
Leguminosae	*Delonix regia*	Mei- Mara	NE	I	91	6
Leguminosae	*Delonix regia*	Mei- Mara	NE	I	88	6
Anacardiaceae	*Spondias dulcis*	Amberella	NE	I	76	5

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	82	7
Lauraceae	*Persea americana*	Ali-pera	NE	I	66	4
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	85	6
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	80	5
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	92	4
Sapindaceae	*Schleichera oleosa*	Kon	LC	N	87	6
Section 5: From Borella Junction to Fort						
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	107	8
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	155	9
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	202	10
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	150	8
Moraceae	*Ficus religiosa*	Bo	NE	I	42	5
Moraceae	*Ficus religiosa*	Bo	NE	I	108	7
Moraceae	*Ficus religiosa*	Bo	NE	I	102	6
Moraceae	*Ficus religiosa*	Bo	NE	I	88	7
Moraceae	*Ficus religiosa*	Bo	NE	I	80	7
Moraceae	*Ficus religiosa*	Bo	NE	I	84	10
Moraceae	*Ficus religiosa*	Bo	NE	I	113	10
Anacardiaceae	*Mangifera indica*	Amba	NE	I	82	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	88	7
Anacardiaceae	*Mangifera indica*	Amba	NE	I	91	11
Anacardiaceae	*Mangifera indica*	Amba	NE	I	94	4
Anacardiaceae	*Mangifera indica*	Amba	NE	I	90	8
Anacardiaceae	*Mangifera indica*	Amba	NE	I	59	4
Anacardiaceae	*Mangifera indica*	Amba	NE	I	82	8
Arecaceae	*Cocos nucifera*	Pol	NE	I	80	9
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	71	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	55	4
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	62	5
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	41	3
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	72	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	71	5
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	72	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	68	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	72	9
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	74	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	81	7
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	88	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	85	7
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	84	8

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	86	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	91	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	84	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	84	7
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	79	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	77	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	84	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	81	7
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	80	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	80	7
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	83	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	88	9
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	74	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	91	8
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	72	7
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	91	10
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	88	10
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	70	6
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	82	8
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	103	9
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	82	7
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	85	9
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	104	9
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	102	10
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	86	7
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	83	6
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	94	8
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	91	8
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	80	7
Lamiaceae	*Tectona grandis*	Thekka	NE	I	92	10
Lamiaceae	*Tectona grandis*	Thekka	NE	I	94	10
Lamiaceae	*Tectona grandis*	Thekka	NE	I	82	9
Lamiaceae	*Tectona grandis*	Thekka	NE	I	107	11
Lamiaceae	*Tectona grandis*	Thekka	NE	I	86	8
Lamiaceae	*Tectona grandis*	Thekka	NE	I	84	8
Lamiaceae	*Tectona grandis*	Thekka	NE	I	82	8
Lamiaceae	*Tectona grandis*	Thekka	NE	I	79	8
Lamiaceae	*Tectona grandis*	Thekka	NE	I	87	7
Lamiaceae	*Tectona grandis*	Thekka	NE	I	82	8
Meliaceae	*Swietenia macrophylla*	Mahogani	NE	I	86	8

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Sapotaceae	*Madhuca longifolia*	Me	NT	N	72	8
Sapotaceae	*Madhuca longifolia*	Me	NT	N	76	7
Sapotaceae	*Madhuca longifolia*	Me	NT	N	82	6
Sapotaceae	*Madhuca longifolia*	Me	NT	N	80	9
Sapotaceae	*Madhuca longifolia*	Me	NT	N	83	8
Sapotaceae	*Madhuca longifolia*	Me	NT	N	95	9
Sapotaceae	*Madhuca longifolia*	Me	NT	N	84	11
Sapotaceae	*Madhuca longifolia*	Me	NT	N	98	10
Sapotaceae	*Madhuca longifolia*	Me	NT	N	91	9
Sapotaceae	*Madhuca longifolia*	Me	NT	N	84	7
Sapotaceae	*Madhuca longifolia*	Me	NT	N	115	11
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	92	10
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	87	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	92	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	95	11
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	93	8
Meliaceae	*Azadirachta indica*	Kohomba	NE	I	86	8
Fabaceae	*Cassia fistula*	Ehela	NE	I	76	5
Fabaceae	*Cassia fistula*	Ehela	NE	I	72	5
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	85	8
Myrtaceae	*Syzygium cumini*	Ma-Dan	LC	N	83	9
Apocynaceae	*Alstonia scholaris*	Ruk-Attana	LC	N	84	6
Apocynaceae	*Alstonia scholaris*	Ruk-Attana	LC	N	91	8
Leguminosae	*Pithecellobium dulce*	Pinikaral	NE	I	124	8
Leguminosae	*Pithecellobium dulce*	Pinikaral	NE	I	108	6
Malvaceae	*Berrya coridifolia*	Halmilla	LC	N	75	8
Malvaceae	*Berrya coridifolia*	Halmilla	LC	N	70	7
Combretaceae	*Terminalia bellirica*	Bulu	LC	N	86	9
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	74	6
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	70	6
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	41	5
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	86	8
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	92	9
Leguminosae	*Albizia saman*	Pini Mara	NE	I	106	10
Leguminosae	*Albizia saman*	Pini Mara	NE	I	93	8
Leguminosae	*Albizia saman*	Pini Mara	NE	I	80	7
Leguminosae	*Albizia saman*	Pini Mara	NE	I	108	9
Sapotaceae	*Chrysophyllum cainito*	Kos-eta-lawalu	NE	I	74	6
Sapindaceae	*Pometia pinnata*	Bulumora	LC	N	85	5
Ebenaceae	*Diospyros ebenum*	Kaluwara	EN	N	63	4

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Apocynaceae	*Plumeria obusta*	Araliya	NE	I	62	6
Apocynaceae	*Plumeria obusta*	Araliya	NE	I	57	3
Apocynaceae	*Plumeria obusta*	Araliya	NE	I	55	4
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I	54	4
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I	59	5
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I	51	4
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I	49	4
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I	57	5
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I	55	6
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I	51	4
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I	50	4
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I	55	5
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I	58	6
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I	54	4
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	91	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	94	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	75	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	72	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	67	4
Moraceae	*Ficus racemosa*	Attikka	LC	N	44	3
Moraceae	*Ficus racemosa*	Attikka	LC	N	83	9
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	112	11
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	119	11
Section 6: From Fort to Slave island						
Leguminosae	*Albizia saman*	Pini Mara	NE	I	122	11
Leguminosae	*Albizia saman*	Pini Mara	NE	I	130	13
Leguminosae	*Albizia saman*	Pini Mara	NE	I	127	11
Leguminosae	*Albizia saman*	Pini Mara	NE	I	98	10
Arecaceae	*Cocos nucifera*	Pol	NE	I	79	6
Arecaceae	*Cocos nucifera*	Pol	NE	I	81	6
Arecaceae	*Cocos nucifera*	Pol	NE	I	88	7
Arecaceae	*Cocos nucifera*	Pol	NE	I	83	6
Arecaceae	*Cocos nucifera*	Pol	NE	I	70	8
Arecaceae	*Cocos nucifera*	Pol	NE	I	84	9
Arecaceae	*Cocos nucifera*	Pol	NE	I	81	10
Arecaceae	*Cocos nucifera*	Pol	NE	I	85	10
Arecaceae	*Cocos nucifera*	Pol	NE	I	84	10
Arecaceae	*Cocos nucifera*	Pol	NE	I	83	11
Arecaceae	*Cocos nucifera*	Pol	NE	I	69	8
Arecaceae	*Cocos nucifera*	Pol	NE	I	74	8

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	607	11
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	402	8
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	359	9
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	351	9
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N	413	11
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	50	4
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	72	5
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	74	5
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	70	5
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	84	9
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I	92	10
Leguminosae	*Pithecellobium dulce*	Pinikaral	NE	I	82	6
Moraceae	*Ficus racemosa*	Attikka	LC	N	84	7
Moraceae	*Ficus racemosa*	Attikka	LC	N	80	8
Moraceae	*Ficus racemosa*	Attikka	LC	N	76	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	64	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	81	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	73	5
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	77	6
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	65	4
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	69	4
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	49	4
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	55	5
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	51	4
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	80	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	85	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	72	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	78	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	70	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	84	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	90	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	88	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	94	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	89	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	96	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	95	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	95	7
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	91	8
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	82	11
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	94	11

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	86	6
Myrtaceae	*Syzygium cumini*	Ma-Dan	LC	N	82	12
Myrtaceae	*Syzygium cumini*	Ma-Dan	LC	N	110	13
Lamiaceae	*Tectona grandis*	Thekka	NE	I	84	9
Anacardiaceae	*Mangifera indica*	Amba	NE	I	72	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	88	6
Anacardiaceae	*Mangifera indica*	Amba	NE	I	69	5
Anacardiaceae	*Mangifera indica*	Amba	NE	I	91	11
Anacardiaceae	*Mangifera indica*	Amba	NE	I	91	10
Anacardiaceae	*Mangifera indica*	Amba	NE	I	88	10
Anacardiaceae	*Mangifera indica*	Amba	NE	I	96	10
Anacardiaceae	*Mangifera indica*	Amba	NE	I	45	3
Anacardiaceae	*Mangifera indica*	Amba	NE	I	84	7
Anacardiaceae	*Mangifera indica*	Amba	NE	I	105	9
Anacardiaceae	*Mangifera indica*	Amba	NE	I	112	9
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	92	10
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	85	6
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	80	5
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	92	9
Arecaceae	*Palm sp.*				72	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	52	8
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N	74	8
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	80	4
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	76	6
Muntingiaceae	*Muntingia calabura*	Jam	NE	I	50	5
Muntingiaceae	*Muntingia calabura*	Jam	NE	I	77	5
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	92	6
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	94	6
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	81	9
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	112	10
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	108	10
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	102	10
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	90	8
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	94	8
Apocynaceae	*Plumeria obusta*	Araliya	NE	I	72	5
Apocynaceae	*Plumeria obusta*	Araliya	NE	I	69	5
Moraceae	*Ficus elastica*		NE	I	104	8
Rubiaceae	*Nauclea orientalis*	Bak Me	LC	N	62	8
Lecythidaceae	*Barringtonia asiatica*	Diya midella	LC	N	82	6
Lecythidaceae	*Barringtonia asiatica*	Diya midella	LC	N	92	6

Family	Scientific Name	Common name	NCS	Origin	GBH (cm)	Height (m)
Lecythidaceae	*Barringtonia asiatica*	Diya midella	LC	N	92	10
Meliaceae	*Swietenia macrophylla*	Mahogani	NE	I	94	11
Meliaceae	*Azadirachta indica*	Kohomba	NE	I	106	13
Sapotaceae	*Madhuca longifolia*	Me	NT	N	90	8
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	82	6
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I	84	6
Moraceae	*Ficus religiosa*	Bo	NE	I	84	8
Moraceae	*Ficus religiosa*	Bo	NE	I	108	9
Moraceae	*Ficus religiosa*	Bo	NE	I	107	9
Moraceae	*Ficus religiosa*	Bo	NE	I	96	7
Moraceae	*Ficus religiosa*	Bo	NE	I	112	7
Moraceae	*Ficus religiosa*	Bo	NE	I	107	6
Moraceae	*Ficus religiosa*	Bo	NE	I	110	8
Moraceae	*Ficus religiosa*	Bo	NE	I	114	7
Moraceae	*Ficus religiosa*	Bo	NE	I	118	8
Moraceae	*Ficus religiosa*	Bo	NE	I	115	8
Moraceae	*Ficus religiosa*	Bo	NE	I	162	10

Appendix XX. Number of plants that are potentially impacted by the proposed LRT by the six sections

Abbreviations Used:

E- Endemic, **N** - Native, **I** - Introduced, alien or Exotic, **IAS** - Invasive Alien Species, **NCS** - National Conservation Status, **EN**- Endangered, **VU**- Vulnerable, **NE** - Not Evaluated, **NT** - Near Threatened, **DD** - Data Deficient, **LC** - Least Concern, **1** - Section from LRT Depot to Malabe, **2** - Section from Malabe to Koswatta, **3** - Section from Koswatta to Battaramulla, **4** - Section from Battaramulla to Borella Junction, **5** - Section from Borella Junction to Fort, **6** - Section from Fort to Slave Island

Family	Scientific Name	Common name	NCS	Origin	Value	1	2	3	4	5	6	TOTAL
Anacardiaceae	*Mangifera indica*	Amba	NE	I	Fruit	1	27	6	9	7	11	61
Anacardiaceae	*Spondias dulcis*	Amberella	NE	I	Fruit		2		1			3
Anacardiaceae	*Lannea coromandelica*	Hik	LC	N	Timber	2	1					3
Annonaceae	*Annona muricata*	Katu Atha	NE	I	Fruit	1						1
Annonaceae	*Annona glabra*	Wel Atha	NE	IAS		1		2				3
Annonaceae	*Polyalthia longifolia*	Devadaru	LC	N			1		12	28	2	43
Apocynaceae	*Cerbera odollam*	Gon Kaduru	LC	N			2					2
Apocynaceae	*Alstonia macrophylla*	Havari Nuga	NE	IAS	Timber	3						3
Apocynaceae	*Alstonia scholaris*	Ruk-Attana	LC	N	Timber			1		2		3
Apocynaceae	*Plumeria obusta*	Araliya	NE	I	Ornamental		3			3	2	8
Arecaceae	*Areca catechu*	Puwak	NE	I	Multiple		1					1
Arecaceae	*Caryota urens*	Kithul	LC	N	Timber				1			1
Arecaceae	*Palm sp.*			I	Ornamental		1				1	2
Arecaceae	*Cocos nucifera*	Pol	NE	I	Multiple		13	2	5	1	12	33
Bignoniaceae	*Tabebuia rosea*	Rosa Tabobia	NE	I	Ornamental		1	1	4	1	8	15
Calophyllaceae	*Mesua ferrea*	Na	LC	N	Timber		3		2			5
Cannabaceae	*Trema orientalis*	Gedumba	LC	N	Timber	1	1	5				7
Casuarinaceae	*Casuarina equisetifolia*	Kasa	NE	I				1				1
Combretaceae	*Terminalia bellirica*	Bulu	LC	N	Medicine		1		1	1		3
Combretaceae	*Terminalia arjuna*	Kumbuk	LC	N	Timber	17		25	3			45
Combretaceae	*Terminalia catappa*	Kottamba	NE	I	Fruit	2	19	15	14	10	26	86
Dilleniaceae	*Dillenia suffruticosa*	Para	NE	IAS				4				4

Family	Scientific Name	Common name	NCS	Origin	Value	1	2	3	4	5	6	TOTAL
Dipterocarpaceae	*Dipterocarpus zeylanicus*	Hora	NT	E	Timber		1					1
Ebenaceae	*Diospyros ebenum*	Kaluwara	EN	N	Timber		1			1		2
Elaeocarpaceae	*Elaeocarpus serratus*	Weralu	LC	N	Fruit			1				1
Euphorbiaceae	*Macaranga peltata*	Kenda	LC	N	Timber	9	2	8				19
Fabaceae	*Cassia fistula*	Ehela	NE	I	Ornamental		4		2	2		8
Lamiaceae	*Tectona grandis*	Thekka	NE	I	Timber	1	2		1	10	1	15
Lauraceae	*Persea americana*	Ali-pera	NE	I	Fruit				1			1
Lauraceae	*Litsea glutinosa*	Bomi	LC	N				2				2
Lecythidaceae	*Couroupita surinamensis*	Sal	NE	I	Ornamental		1					1
Lecythidaceae	*Barringtonia asiatica*	Diya midella	LC	N							3	3
Lecythidaceae	*Barringtonia acutangula*	Ela midella	LC	N					8			8
Leguminosae	*Leucaena leucocephala*	Ipil Ipil	NE	IAS	Fodder	1						1
Leguminosae	*Acacia auriculiformis*		NE	I	Fodder		1					1
Leguminosae	*Gliricidia sepium*	Wetamara	NE	I	Timber	1						1
Leguminosae	*Pericopsis mooniana*	Nadun	VU	N	Timber		1					1
Leguminosae	*Erythrina sp*			N					1			1
Leguminosae	*Sesbania grandiflora*	Kathuru Murunga	NE	I	Vegetable		2					2
Leguminosae	*Tamarindus indica*	Siyambala	NE	I	Multiple		2	1				3
Leguminosae	*Delonix regia*	Mei- Mara	NE	I	Timber			1	3			4
Leguminosae	*Pithecellobium dulce*	Pinikaral	NE	I				2	3	2	1	8
Leguminosae	*Albizia saman*	Pini Mara	NE	I	Timber				1	4	4	9
Leguminosae	*Bauhinia purpurea*	Rath koboleela	NE	I	Ornamental					11		11
Leguminosae	*Peltophorum pterocarpum*	Ayawaka	NE	I		44			3	11	6	64
Leguminosae	*Pterocarpus indicus*	Wal Ehela	NE	I		2	1	62	1	2	2	70
Lythraceae	*Lagerstroemia speciosa*	Murutha	NT	N	Timber	17						17
Malvaceae	*Sterculia foetida*	Telabu	LC	N	Timber			1				1
Malvaceae	*Berrya coridifolia*	Halmilla	LC	N	Timber		1	1		2		4
Malvaceae	*Microcos paniculata*	Kohu Kirilla	LC	N	Timber	1						1
Malvaceae	*Ceiba pentandra*	Kotta Pulun	LC	N	Multiple	1	1					2

Family	Scientific Name	Common name	NCS	Origin	Value	1	2	3	4	5	6	TOTAL
Meliaceae	*Azadirachta indica*	Kohomba	NE	I	Timber			1	1	1	1	4
Meliaceae	*Swietenia macrophylla*	Mahogani	NE	I	Timber				6	1	1	8
Moraceae	*Artocarpus incisus*	Rata-Del	NE	I	Fruit		1					1
Moraceae	*Ficus exasperata*	Bu Deliya	LC	N	Timber		1					1
Moraceae	*Ficus elastica*		NE	I							1	1
Moraceae	*Ficus callosa*	Gonna	LC	N			2					2
Moraceae	*Ficus racemosa*	Attikka	LC	N						2	3	5
Moraceae	*Ficus benjamina*	Walu Nuga	NE	I			5		4			9
Moraceae	*Ficus benghalensis*	Maha Nuga	LC	N					4	4	5	13
Moraceae	*Artocarpus heterophyllus*	Kos	NE	I	Vegetable	2	3	1	3	4	4	17
Moraceae	*Ficus religiosa*	Bo	NE	I	Religeous		1		7	7	11	26
Moringaceae	*Moringa oleifera*	Murunga	NE	I	Vegetable		1					1
Muntingiaceae	*Muntingia calabura*	Jam	NE	I	Fruit			4			2	6
Myrtaceae	*Psidium guajava*	Pera	NE	I	Fruit	1						1
Myrtaceae	*Syzygium caryophyllatum*	Dan	LC	N	Fruit			1				1
Myrtaceae	*Syzygium aromaticum*	Karambu	NE	I	Spice		1					1
Myrtaceae	*Syzygium cumini*	Ma-Dan	LC	N	Fruit				2	1	2	5
Myrtaceae	*Eucalyptus* sp.	Eucalyptus	NE	I	Timber				8			8
Phyllanthaceae	*Phyllanthus acidus*	Rata nelli	NE	I	Fruit			1				1
Phyllanthaceae	*Bridelia retusa*	Keta kela	LC	N	Timber		1	1				2
Phyllanthaceae	*Glochidion zeylanicum*	Hunukirilla	LC	N	Timber			2				2
Pinaceae	*Pinus sp.*		NE	I	Timber		1					1
Rhizophoraceae	*Carallia brachiata*	Dawata	NT	N	Timber			1				1
Rubiaceae	*Morinda citrifolia*	Ahu	LC	N	Timber		1					1
Rubiaceae	*Nauclea orientalis*	Bak Me	LC	N	Timber	1		1			1	3
Rutaceae	*Aegle marmelos*	Beli	NE	I	Fruit			1				1
Rutaceae	*Limonia acidissima*	Divul	LC	N	Fruit				1			1
Sapindaceae	*Schleichera oleosa*	Kon	LC	N	Timber				1			1
Sapindaceae	*Pometia pinnata*	Bulumora	LC	N						1		1

Family	Scientific Name	Common name	NCS	Origin	Value	1	2	3	4	5	6	TOTAL
Sapindaceae	*Nephelium lappaceum*	Rambutan	NE	I	Fruit	1	2	1				4
Sapindaceae	*Filicium decipiens*	Pihimbiya	LC	N	Ornamental		6	5	3	5	2	21
Sapotaceae	*Chrysophyllum cainito*	Kos-eta-lawalu	NE	I						1		1
Sapotaceae	*Madhuca longifolia*	Me	NT	N	Timber		6		1	11	1	19
					TOTAL	110	128	161	117	136	113	765

Appendix 4. List of fauna observed in the LRT trace from Malabe to Kollupitiya

Abbreviations Used:

E- Endemic, **N** - Native, **I** - Introduced, alien or Exotic, **M** - Migrant or Winter visitor

N**CS** - National Conservation Status, **GCS** - Global Conservation Status, **CR**- Critically Endangered, **EN**- Endangered, **VU**- Vulnerable, **NT**- Near Threatened, **NE** - Not Evaluated, **DD** - Data Deficient, **LC** - Least Concern

Family	Scientific Name	Common English Name	NCS	Origin
BUTTERFLIES				
Papilionidae	*Graphium agamemnon*	Tailed Jay	LC	N
Papilionidae	*Pachliopta aristolochiae*	Common Rose	LC	N
Papilionidae	*Pachliopta hector*	Crimson Rose	LC	N
Papilionidae	*Papilio clytia*	Mime	LC	N
Papilionidae	*Papilio demoleus*	Lime Butterfly	LC	N
Papilionidae	*Papilio polytes*	Common Mormon	LC	N
Pieridae	*Catopsilia pomona*	Lemon Emigrant	LC	N
Pieridae	*Catopsilia pyranthe*	Mottled Emigrant	LC	N
Pieridae	*Catopsilia scylla*	Orange Migrant	NE	I
Pieridae	*Delias eucharis*	Jezebel	LC	N
Pieridae	*Eurema hecabe*	Common Grass Yellow	LC	N
Pieridae	*Leptosia nina*	Psyche	LC	N
Nymphalidae	*Acraea violae*	Tawny Coster	LC	N
Nymphalidae	*Danaus chrysippus*	Plain Tiger	LC	N
Nymphalidae	*Danaus genutia*	Common Tiger	LC	N
Nymphalidae	*Elymnias hypermnestra*	Common Palmfly	LC	N
Nymphalidae	*Euploea core*	Common Indian Crow	LC	N
Nymphalidae	*Euthalia aconthea*	Baron	LC	N
Nymphalidae	*Ideopsis similis*	Blue Glassy Tiger	VU	N
Nymphalidae	*Junonia almana*	Peacock Pansy	LC	N
Nymphalidae	*Junonia atlites*	Grey Pansy	LC	N
Nymphalidae	*Junonia iphita*	Chocolate Soldier	LC	N
Nymphalidae	*Melanitis leda*	Common Evening Brown	LC	N
Nymphalidae	*Mycalesis perseus*	Common Bushbrown	LC	N
Nymphalidae	*Neptis hylas*	Common Sailor	LC	N
Nymphalidae	*Orsotriaena medus*	Medus Brown	LC	N
Nymphalidae	*Parantica aglea*	Glassy Tiger	LC	N
Nymphalidae	*Phalanta phalantha*	Leopard	LC	N
Nymphalidae	*Tirumala limniace*	Blue Tiger	LC	N
Nymphalidae	*Ypthima ceylonica*	White Four-ring	LC	N
Lycaenidae	*Arhopala amantes*	Large Oakblue	LC	N
Lycaenidae	*Castalius rosimon*	Common Pierrot	LC	N

Family	Scientific Name	Common English Name	NCS	Origin
Lycaenidae	*Chilades lajus*	Lime Blue	LC	N
Lycaenidae	*Chilades pandava*	Plains Cupid	LC	N
Lycaenidae	*Everes lacturnus*	Indian Cupid	LC	N
Lycaenidae	*Jamides bochus*	Dark Cerulean	LC	N
Lycaenidae	*Jamides celeno*	Common Cerulean	LC	N
Lycaenidae	*Prosotas nora*	Common Lineblue	LC	N
Lycaenidae	*Rathinda amor*	Monkey-puzzle	LC	N
Lycaenidae	*Spalgis epeus*	Apefly	LC	N
Lycaenidae	*Tajuria cippus*	Peacock Royal	LC	N
Lycaenidae	*Zizina otis*	Lesser Grass Blue	LC	N
Lycaenidae	*Zizula hylax*	Tiny Grass Blue	LC	N
Hesperiidae	*Ampittia dioscorides*	Bush Hopper	LC	N
Hesperiidae	*Borbo cinnara*	Wallace's Swift	LC	N
Hesperiidae	*Cephrenes trichopepla*	Yellow Palm Dart	NE	I
Hesperiidae	*Iambrix salsala*	Chestnut Bob	LC	N
Hesperiidae	*Parnara bada*	Smallest Swift	NT	N
Hesperiidae	*Potanthus confuscius*	Tropic Dart	LC	N
Hesperiidae	*Suastus gremius*	Indian Palm Bob	LC	N
Hesperiidae	*Taractrocera maevius*	Common Grass Dart	LC	N
Hesperiidae	*Telicota bambusae*	Dark Palmdart	VU	N
DRAGONFLIES				
Coenagrionidae	*Onychargia atrocyana*	Marsh Dancer	VU	N
Coenagrionidae	*Ischnura senegalensis*	Common Bluetail, Marsh Bluetail	LC	N
Coenagrionidae	*Ceriagrion coromandelianum*	Yellow Waxtail	LC	N
Coenagrionidae	*Pseudagrion microcephalum*	Blue Sprite	LC	N
Platycnemididae	*Copera marginipes*	Yellow Featherleg	LC	N
Gomphidae	*Ictinogomphus rapax*	Rapacious Flangetail	LC	N
Libellulidae	*Orthetrum luzonicum*	Marsh Skimmer	NT	N
Libellulidae	*Orthetrum pruinosum*	Pink Skimmer	NT	N
Libellulidae	*Orthetrum sabina*	Green Skimmer	LC	N
Libellulidae	*Acisoma panorpoides*	Asian Pintail	LC	N
Libellulidae	*Brachythemis contaminata*	Asian Groundling	LC	N
Libellulidae	*Crocothemis servilia*	Oriental Scarlet	LC	N
Libellulidae	*Diplacodes trivialis*	Blue Percher	LC	N
Libellulidae	*Neurothemis intermedia*	Paddyfield Parasol	NT	N
Libellulidae	*Neurothemis tullia*	Pied Parasol	LC	N
Libellulidae	*Rhodothemis rufa*	Spine-legged Redbolt	NT	N
Libellulidae	*Rhyothemis variegata*	Variegate Flutterer	LC	N
Libellulidae	*Pantala flavescens*	Wandering Glider	LC	N
Libellulidae	*Urothemis signata*	Scarlet Basker	LC	N

Family	**Scientific Name**	**Common English Name**	**NCS**	**Origin**
FRESH WATER FISH				
Aplocheilidae	*Aplocheilus dayi*	Day's killifish	E	EN
Belontiidae	*Trichogaster pectoralis*	Snake skin gourami	I	NE
Cichlidae	*Oreochromis niloticus*	Tilapia	I	NE
Cichlidae	*Oreochromis mossambicus*	Tilapia	I	NE
Cyprinidae	*Dawkinsia singhala*	Filamented barb	E	LC
Cyprinidae	*Puntius bimaculatus*	Redside barb	N	LC
Cyprinidae	*Rasbora dandia*	Striped rasbora	N	LC
Cyprinidae	*Rasbora microcephalus*	Thin line Rasbora	N	LC
AMPHIBIANS				
Bufonidae	*Duttaphrynus melanostictus*	Common house toad	N	LC
Dicroglossidae	*Euphlyctis hexadactylus*	Sixtoe green frog	N	LC
Dicroglossidae	*Fejervarya syhadrensis*	Common paddy field frog	N	LC
REPTILES				
Bataguridae	*Melanochelys trijuga*	Black turtle	LC	N
Agamidae	*Calotes calotes*	Green garden lizard	LC	N
Agamidae	*Calotes versicolor*	Common garden lizard	LC	N
Gekkonidae	*Gehyra mutilata*	Four-claw gecko	LC	N
Gekkonidae	*Hemidactylus frenatus*	Common house-gecko	LC	N
Gekkonidae	*Hemidactylus parvimaculatus*	Spotted housegecko	LC	N
Scincidae	*Eutropis macularia*	Bronzegreen little skink	LC	N
Varanidae	*Varanus bengalensis*	Land monitor	LC	N
Varanidae	*Varanus salvator*	Water monitor	LC	N
Natricidae	*Amphiesma stolatum*	Buff striped keelback	LC	N
Natricidae	*Xenochrophis piscator*	Checkered Keelback	LC	N
Colubridae	*Dendrelaphis schokari*	Schokari's bronze back	LC	E
Colubridae	*Ptyas mucosa*	Rat snake	LC	N
BIRDS				
Accipitridae	*Haliastur indus*	Brahminy Kite	LC	BrR
Alcedinidae	*Halcyon smyrnensis*	White-throated Kingfisher	LC	BrR
Alcedinidae	*Alcedo atthis*	Common Kingfisher	LC	BrR
Anatidae	*Dendrocygna javanica*	Lesser Whistling-duck	LC	BrR
Apodidae	*Cypsiurus balasiensis*	Asian Palm-swift	LC	BrR
Ardeidae	*Ardea cinerea*	Grey Heron	LC	BrR
Ardeidae	*Ardea purpurea*	Purple Heron	LC	BrR
Ardeidae	*Ardeola grayii*	Indian Pond-heron	LC	BrR
Ardeidae	*Bubulcus ibis*	Cattle Egret	LC	BrR
Ardeidae	*Casmerodius albus*	Great Egret	LC	BrR
Charadriidae	*Vanellus indicus*	Red-wattled Lapwing	LC	BrR
Cisticolidae	*Cisticola juncidis*	Zitting Cisticola	LC	BrR

Family	Scientific Name	Common English Name	NCS	Origin
Cisticolidae	*Prinia inornata*	Plain Prinia	LC	BrR
Columbidae	*Ducula aenea*	Green Imperial-Pigeon	LC	BrR
Columbidae	*Stigmatopelia chinensis*	Spotted Dove	LC	BrR
Corvidae	*Corvus splendens*	House Crow	LC	BrR
Cuculidae	*Centropus sinensis*	Greater Coucal	LC	BrR
Cuculidae	*Eudynamys scolopaceus*	Asian Koel	LC	BrR
Dicruidae	*Dicrurus caerulescens*	White-bellied Drongo	LC	BrR
Nectariniidae	*Nectarinia lotenia*	Long-billed Sunbird	LC	BrR
Nectariniidae	*Nectarinia zeylonica*	Purple-rumped Sunbird	LC	BrR
Oriolidae	*Oriolus xanthornus*	Black-hooded Oriole	LC	BrR
Phalacrocoracidae	*Phalacrocorax niger*	Little Cormorant	LC	BrR
Phalacrocoracidae	*Phalacrocorax fuscicollis*	Indian Cormorant	LC	BrR
Psittacidae	*Psittacula krameri*	Rose-ringed Parakeet	LC	BrR
Pycnonotidae	*Pycnonotus cafer*	Red-vented Bulbul	LC	BrR
Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen	LC	BrR
Rallidae	*Porphyrio porphyrio*	Purple Swamphen	LC	BrR
Ramphastidae	*Megalaima zeylanica*	Brown-headed Barbet	LC	BrR
Sturnidae	*Acridotheres tristis*	Common Myna	LC	BrR
Sylviidae	*Orthotomus sutorius*	Common Tailorbird	LC	BrR
Threskiornithidae	*Threskiornis melanocephalus*	Black-headed Ibis	LC	BrR
Timalidae	*Turdoides affinis*	Yellow-billed Babbler	LC	BrR
MAMMALS				
Cercopithecidae	*Semnopithecus vetulus*	Sri Lanka Purple-faced langur	EN	E
Felidae	*Prionailurus viverrinus*	Fishing cat	EN	N
Hystricidae	*Hystrix indica*	Porcupine	LC	N
Scuiridae	*Funambulus palmarum*	Palm squirrel	LC	N

Annex I

Cabinet Memorandum on the Adoption of LARC System for the LRT Project

රහසිගතයි

අමාත්‍ය මණ්ඩල කාර්යාලය
அமைச்சரவை அலுவலகம்
OFFICE OF THE CABINET OF MINISTERS

CABINET DECISION අමාත්‍ය මණ්ඩල තීරණය அமைச்சரவைத் தீர்மானம்

පිටපත් : ජනාධිපති ලේකම්.
අග්‍රාමාත්‍ය ලේකම්.
ජාතික ප්‍රතිපත්ති හා
ආර්.ක. ලේකම්.
මුදල් හා ජනමාධ්‍ය ලේකම්.
විගණකාධිපති.

මගේ අංකය: අමප/17/1654/724/064
2017 අගෝස්තු මස 09 දින.

ක්‍රියා කළ යුතු : ප්‍රවාහන හා සිවිල් ගුවන්සේවා අමාත්‍යාංශයේ ලේකම්.
මහානගර හා බස්නාහිර සංවර්ධන අමාත්‍යාංශයේ ලේකම්.
ඉඩම් සහ පාර්ලිමේන්තු ප්‍රතිසංස්කරණ අමාත්‍යාංශයේ ලේකම්.

සැහැල්ලු දුම්රිය සංක්‍රමණ ව්‍යාපෘතිය නිසා පීඩාවට පත් පාර්ශ්වයන් සඳහා වන්දි ගෙවීමට ඉඩම් අත්පත් කරගැනීමේ හා නැවත පදිංචි කිරීමේ කමිටු (LARC/SUPER LARC) ක්‍රමවේදයන් අදාළ කරගැනීම

(මහානගර හා බස්නාහිර සංවර්ධන ගරු ඇමතිතුමා ඉදිරිපත් කළ 2017-07-19 දිනැති සංදේශය)

2017 අගෝස්තු මස 01 දින පැවැත්වුණු අමාත්‍ය මණ්ඩල රැස්වීමේදී එළඹි තීරණයක් අවශ්‍ය කටයුතු සඳහා මේ සමඟ එවා ඇත.

ඩබ්ලිව්.එම්.ඩී.ජේ.ප්‍රනාන්දු
අතිරේක ලේකම්.

අ.කළේ/එස්.අබේසිංහ
අමාත්‍ය මණ්ඩලයේ ලේකම්.

(ආ) න්‍යාය පත්‍රයේ විෂයයන්:

(II) අමාත්‍ය මණ්ඩල පත්‍රිකා - ප්‍රසම්පාදනයට අදාළ කරුණු :

53. අමාත්‍ය මණ්ඩල පත්‍රිකා අංක 17/1654/724/064 වූ, "**සැහැල්ලු දුම්රිය සංක්‍රමණ ව්‍යාපෘතිය නිසා පීඩාවට පත් පාර්ශ්වයන් සඳහා වන්දි ගෙවීමට ඉඩම් අත්පත් කරගැනීමේ හා නැවත පදිංචි කිරීමේ කමිටු (LARC/SUPER LARC) ක්‍රමවේදයන් අදාළ කරගැනීම**" යන මැයෙන් මහානගර හා බස්නාහිර සංවර්ධන ඇමතිතුමා ඉදිරිපත් කළ 2017-07-19 දිනැති සංදේශය - (අමප අංක 16/1175/724/047 පිළිබඳව වූ 2016-06-28 දිනැති අමාත්‍ය මණ්ඩල තීරණයට අදාළව) ඉහත සඳහන් සංදේශය මුදල් හා ජනමාධ්‍ය ඇමතිතුමාගේ නිරීක්ෂණ සමඟ සලකා බලන ලදී. මේ පිළිබඳව සාකච්ඡා කිරීමෙන් අනතුරුව, සංදේශයේ 4.0 ඡේදයෙහි සඳහන් යෝජනාව සඳහා අනුමැතිය ලබා දීමට තීරණය කරන ලදී.

→ 2

ක්‍රියා කළ යුතු:

ප්‍රවාහන හා සිවිල් ගුවන්සේවා අමාත්‍යාංශය - සංදේශයේ පිටපතක් හා ඉහත නිරීක්ෂණ යා කොට ඇත.

මහානගර හා බස්නාහිර සංවර්ධන අමාත්‍යාංශය - ඉහත නිරීක්ෂණ යා කොට ඇත.

ඉඩම් සහ පාර්ලිමේන්තු ප්‍රතිසංස්කරණ අමාත්‍යාංශය - සංදේශයේ පිටපතක් හා ඉහත නිරීක්ෂණ යා කොට ඇත.

පිටපත්:

ජනාධිපති ලේකම් - සංදේශයේ පිටපතක් හා ඉහත නිරීක්ෂණ යා කොට ඇත.

අග්‍රාමාත්‍ය ලේකම් - සංදේශයේ පිටපතක් හා ඉහත නිරීක්ෂණ යා කොට ඇත.

ජාතික ප්‍රතිපත්ති හා ආර්ථීක කටයුතු අමාත්‍යාංශය - සංදේශයේ පිටපතක් හා ඉහත නිරීක්ෂණ යා කොට ඇත.

මුදල් හා ජනමාධ්‍ය අමාත්‍යාංශය

(B) Agenda Items :

(II) Cabinet Papers - Procurement Related Matters

53. Cabinet Paper No.17/1654/724/064, a Memorandum dated 2017-07-19 by the Minister of Megapolis and Western Development on "**Adoption of Land Acquisition and Resettlement Committee (LARC/SUPER LARC) Systems for the affected parties of the Light Rail Transit (LRT) Project**" - (Cabinet decision dated 2016-06-28 on CP No.16/1175/724/047 refers) the above Memorandum was considered along with the observations of the Minister of Finance and Mass Media. After discussion, it was decided to grant approval to the proposal in paragraph 4.0 of the Memorandum.

Action by: **My/Transport and Civil Aviation** - copy of Memorandum and above observations annexed.
My/Megapolis and Western Development - above observations annexed.
My/Lands and Parliamentary Reforms - copy of Memorandum and above observations annexed.

Copied to: **Secretary to the President** - copy of Memorandum and above observations annexed.
Secretary to the Prime Minister - copy of Memorandum and above observations annexed.
My/National Policies and Economic Affairs - copy of Memorandum and above observations annexed.
My/Finance and Mass Media

Annex J

Summary of Stakeholder Meetings

1. Information Dissemination and Notification

Information dissemination and notification regarding the stakeholder engagement events vary depending on the type of engagement required. Awareness and consultation meetings for government offices have been coursed through official invitations released by MMWD to relevant offices. Public engagement meetings have been publicly announce through newspaper announcements, leaflets and posters at DS/GN offices in all three official languages – Sinhala, Tamil and English (see Photos below). For project affected persons like paddy land owners, tenant farmers and business owners, they were contacted individually and were invited to meetings. For the Thalangama EPA Meeting, identified organizations were also contacted directly and invited to MMWD for the meeting.

Colombo Light Rail Transit (LRT) Project

COMFORTABLE

SAFE

RELIABLE

Conceptual image of LRT system in Colombo

New elevated railway system will connect:
- ✓ *Malabe*
- ✓ *Battaramulla*
- ✓ *Borella*
- ✓ *Fort / Pettah*
- ✓ *Kollupitiya*

Conceptual image of train station (platform)

PUBLIC ENGAGEMENT MEETING

Thimbirigasyaya Divisional Secretariat Area

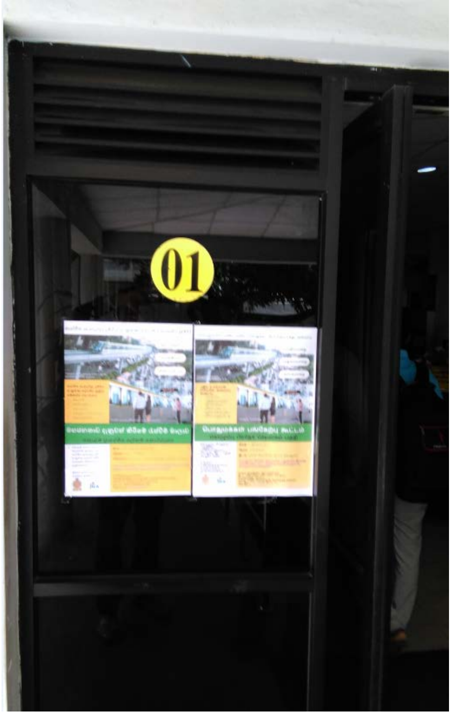
- ✓ Learn more about the proposed LRT Project in Colombo Metropolitan Area.
- ✓ Voice out your opinions and concerns.

WHO? Everyone from Thimbirigasyaya DS is invite

WHEN? July 12, 2017 (1pm)

WHERE? DS Auditorium

For more information, contact:
Project Director, Light Rail Transit Project
Ministry of Megapolis & Western Development
Tel. No.: +94-11-2870589 ext. 252
Email: lrtjica@gmail.com



Public Engagement Meeting Posters in local languages posted at the DS/GN office in Kotte

Colombo Light Rail Transit (LRT) Project

BACKGROUND

- In the "Western Region Master Plan - 2030", developed by the **Ministry of Megapolis and Western Development (MMWD)**, traffic congestion in Colombo Metropolitan Area is identified as a priority concern.
- According to the Colombo Urban Transport Survey (CoMTrans), among seven major corridors towards city center, Malabe Corridor is observed to have the highest density of private cars and the lowest travel speed at peak hours.
- The **Megapolis Transport Master Plan**, based on ComTrans, identified the Rapid Transit System as an option to improve public transportation.
- **MMWD** is in the process of examining the necessity and feasibility of establishing the new **Light Rail Transit (LRT)** System with technical cooperation from the **Japan International Cooperation Agency (JICA)**.

PROPOSED LRT SYSTEM

- The proposed LRT system will be implemented in **Colombo Fort-Maradana** (RTS 1) and **Borella –Malabe** (RTS4) corridors.
- It is an elevated railway system that will mainly utilize existing roads.
- The proposed LRT route covers both inner Colombo city and suburb area from Kollupitiya to Malabe with a total of 21 stations.
- The total length is approximately 21 km, covering 4 Divisional Secretariats' areas (Colombo, Thimbirigasyaya, Kotte, and Kaduwela).
- The depot area is planned to be built in Malabe for maintenance and parking of trains.

CONNECT

The LRT system will link
locations & transpor

ECONOMIC BENEFITS

- ✓ Improve local/regional eco
- ✓ Reduce travel time & traffic resulting in considerable sa
- ✓ Maintain productivity of co

SOCIAL BENEFITS

- ✓ Improve social infrastructure & services
- ✓ Safer commute
- ✓ Diversify modes of public transportation

ENVIRONMENTAL BENEF

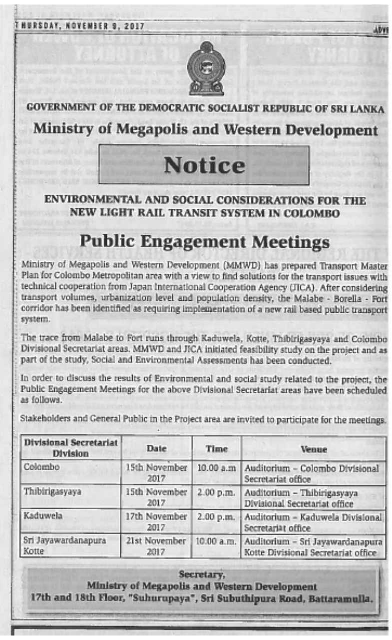
- ✓ Reduce vehicle emissions
- ✓ Improve air quality
- ✓ Improve urban landscape

For more information, contact
Project Director, Light Rail Transit Project,
Megapolis & Western Dev't.
Tel. No.: +94-11-2870589 ext. 252
Email: lrtjica@gmail.com

Design of leaflets distributed to the public. Sinhalese and Tamil version are also available. Copies were also provided in the DS/GNs offices.

Newspaper announcements (Sinhala and Tamil versions) for the Public Engagement Meeting

(EIA Scoping)



THURSDAY, NOVEMBER 9, 2017

GOVERNMENT OF THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

Ministry of Megapolis and Western Development

Notice

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS FOR THE NEW LIGHT RAIL TRANSIT SYSTEM IN COLOMBO

Public Engagement Meetings

Ministry of Megapolis and Western Development (MMWD) has prepared Transport Master Plan for Colombo Metropolitan area with a view to find solutions for the transport issues with technical cooperation from Japan International Cooperation Agency (JICA). After considering transport volumes, urbanization level and population density, the Malabe - Borella - Fort corridor has been identified as requiring implementation of a new rail based public transport system.

The trace from Malabe to Fort runs through Kaduwela, Kotte, Thibirigasyaya and Colombo Divisional Secretariat areas. MMWD and JICA initiated feasibility study on the project and as part of the study, Social and Environmental Assessments has been conducted.

In order to discuss the results of Environmental and social study related to the project, the Public Engagement Meetings for the above Divisional Secretariat areas have been scheduled as follows.

Stakeholders and General Public in the Project area are invited to participate for the meetings.

Divisional Secretariat Division	Date	Time	Venue
Colombo	15th November 2017	10.00 a.m	Auditorium - Colombo Divisional Secretariat office
Thibirigasyaya	15th November 2017	2.00 p.m.	Auditorium – Thibirigasyaya Divisional Secretariat office
Kaduwela	17th November 2017	2.00 p.m.	Auditorium – Kaduwela Divisional Secretariat office
Sri Jayawardanapura Kotte	21st November 2017	10.00 a.m.	Auditorium – Sri Jayawardanapura Kotte Divisional Secretariat office

Secretary,
Ministry of Megapolis and Western Development
17th and 18th Floor, "Suhurupaya", Sri Subuthipura Road, Battaramulla.

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බත්තරමුල්ල.

Newspaper announcements (English and Sinhala versions) for the Public Engagement Meeting

(EIA Disclosure)

2. Stakeholder and Public Engagement Activities

Several stakeholders have been conducted by the PMU to ensure an open, inclusive and consultative engagement process. The approach employed takes into account dynamics across the horizontal and vertical spectrum of the government in order to gather support from relevant government agencies and local governments before reaching out to the public.

Thus, awareness meetings were separately conducted for relevant government agencies (including municipal councils), (Kaduwela) Agrarian Services Department, DS and GNs. Targeted awareness meetings were also held for the people who may be affected by the Project, such as paddy land owners, tenant farmers, property owners, and business owners. Also, four focus group discussions were held targeting specific groups that the Project may have an impact on. For the EIA process, 4 public engagement meetings were conducted per DS during for both the scoping phase and report disclosure. Besides these, a special stakeholder meeting was conducted to discuss Thalangama EPA. The summary of all engagement meetings conducted with the corresponding responses on how these have been considered in the Project, is shown in below.

SUMMARY OF STAKEHOLDER ENGAGEMENT MEETINGS

No.	Date & Time	Purpose (Target Audience)	Venue	No. of Pax	Concerns/Issues Raised	Consideration in the LRT Project
1	May 16, 2017 10:00-13:00	Initial Stakeholder Consultation Meeting	MMWD Office	50	• RDA: Traffic during construction period (need for traffic management plan); Impact on existing roads (need for road widening); Combine LRT with proposed improvement of the Kelani-Valley railway line; Affordability (budget); Potential positive impacts; • UDA: Extension of the LRT to Kaduwela instead of stopping at Malabe; visual impact of elevated structure; facilities for maintenance and repairs at the end point; hydrological impacts of the LRT (proposed trace is on flood inundation area) • LECO: Possibility of underground construction; Impacts on power distribution lines along existing roads; Power requirements of the LRT • JICA Study Team: Issues regarding the construction of depot on paddy fields; Issues regarding crossing of Thalangama EPA • Department of Irrigation: Impact on paddy fields within the EPA (outside of our scope; consult CEA); Location of LRT Cotta Station may impact a proposed housing development in the area (land is owned by the department) • Sri Lanka Transport Board: inclusion of parking facilities (e.g. park and ride)	• Inclusion of traffic management plan development in the EMMP • Design of the elevated structure that would minimize impact on existing roads • Coordination with RDA in terms of road widening at Malabe area • Visual impact of elevated structure included in the Impact Assessment; Provision of mitigation/ management measures • Avoidance of the Thalangama EPA; Conduct of Stakeholder Meeting to discuss issues
2	May 24, 2017 10:30-12:00	Awareness Meeting for Colombo DS and GNs	Auditorium, Colombo DS	45	• GN-Grandpass: Impact on existing railway tracks; Impact on religious places • GN- Keththarama: Land acquisition in Colombo; Impact on existing buildings • Development Officer: Direction of tracks; Ticket price; Passenger capacity	• Avoidance of Gangaramaya Temple and road in front of Altair • Alter route alignment to minimize land acquisition as much as

No.	Date & Time	Purpose (Target Audience)	Venue	No. of Pax	Concerns/Issues Raised	Consideration in the LRT Project
						possible
3	May 26, 2017 11:30-13:00	Awareness Meeting for Thimbirigasyaya DS and GNs	Auditorium Thimbirigasyaya DS Office	31	• Development Officer: Extension of proposed LRT; Potential environmental and social impacts and assessment • GN- Wellawatta: Length of the proposed LRT; Structures (buildings) that may be affected; Passenger capacity; Ticket price	• Conduct of EIA process and development of RAP
4	May 31, 2017 10:15-12:00	Awareness Meeting for Kotte DS and GNs	Auditorium Kotte DS Office	35	• Divisional Secretary: Land acquisition in the Rajagiriya flyover area • Development Officer 1: Road developments around LRT stations; Traffic impact (from Pagoda Road to Nawala Road) and proposed solution • Deputy Director, Planning: Awarding of contract (Japanese company?) • Development Officer 2: Consideration of comments during Monorail Project consultation (extension of the route to Malabe); Parking facilities • Development Officer 3: Express trains; Ticket purchase mechanism; Technical training program for locals	• Propose a cantilever design that would fit within the ROW of the flyover so that no additional acquisition will be necessary • Operation of express and local trains are incorporated in the O&M Plan
5	June 14, 2017 10:20-11:40	Awareness Meeting for Kaduwela DS and GNs	Auditorium, Kaduwela DS Office	58	• GN-Pore: Ticket cost • GN- Muththettugoda: Maintenance of LRT engines • Development Officer 1: Traffic during construction period (traffic management); Employment during construction and operation; Frequency of trains (operation); Implementation issues (like Monorail) • Development Officer 2: Plan for train stations; End to end travel time	
6	June 7, 2017 11:00-12:30	Awareness Meeting for Kaduwela Agrarian Service	Kaduwela Agrarian Centre	30	• ARPA-Malabe West: Leakage of waste/wastewater to surface water (e.g. Kelani River); Impact of depot area on water holding capacity of the swamp (water catchment); Flood mitigation measures • ARPA-Taldiyawala: Compensation for tenant	• Provision of options for wastewater disposal. • Design of the wastewater treatment

No.	Date & Time	Purpose (Target Audience)	Venue	No. of Pax	Concerns/Issues Raised	Consideration in the LRT Project
					farmers and land owners (gap between government valuation and market value); • ARPA-Thunandahena: Hydrological impacts of the depot area (flood mitigation plan); Grievance redress mechanism of MMWD/PMU; Target users • ARPA- Ihala Bomiriya: Construction of structures over a wetland/swamp	plant that would be compliant with standards set by CEA for wastewater • Conduct of flood modelling in the EIA Report to know project impact on wetlands and catchment areas • Adoption of LARC System for compensation to project affected people
7	July 1, 2017 15:00-16:30	Awareness Meeting for Paddy Land Owners and Tenants	Auditorium, Sanasa Development Bank	23	• Land Owner 1: Impact on existing roads • Land Owner 2: Station at Battaramula area; parking/park-and-ride facilities • Land Owner 3: JICA guidelines regarding compensation for land acquisition (Experienced inadequate compensation for a road widening project); Noise impacts in depot area • Tenant Farmer 1: Compensation for impact of geological survey for monorail (bore hole); Filling of paddy lands; Wastewater impact on surrounding paddy lands; Impact of depot elevated structure (light, stagnant water, agricultural activities); Alternative depot area • Tenant Farmer 2: Feasibility of agricultural activities under elevated structures; ROW along LRT route; Impact of construction of depot; environmental impact of wastes from the depot area (risks of leakage and contamination); Plan for sewerage	• Adoption of LARC system for compensation to project affected people
8	July 11, 2017 10:00-11:10	Public Engagement Meeting (Kotte)	Auditorium Kotte DS Office	14	• Operation (travel time, frequency of trips; operating hours) • Project schedule (start of operation)	

No.	Date & Time	Purpose (Target Audience)	Venue	No. of Pax	Concerns/Issues Raised	Consideration in the LRT Project
					• Training of staff (drivers) • Details of LRT structure • Other proposed LRT projects	
9	July 12, 2017 10:15-11:20	Public Engagement Meeting (Colombo)	Auditorium, Colombo DS	34	• Similarity with a tram • Cost; Financing mechanism (loan, grant) • Land acquisition in Colombo • Ticket payment methods • Connectivity with Maradana; Connectivity of stations • Ensure implementation	• Connectivity with Maradana through proposed Transport Station
10	July 12, 2017 13:30-15:00	Public Engagement Meeting (Thimbirigasyaya)	Auditorium Thimbirigasyaya DS Office	29	• Impact of LRT operation on other forms of transportation; Consultation with SLTB, private bus unions, railway department, 3-wheel drivers (alternative income generating program) • Training for LRT staff • Project schedule • Ticket price • Operation (availability of express trains, frequency of trips, emergency exits) • Project cost; Compensation cost • Land acquisition and compensation	• Inclusion of 3-wheel drivers in the focus group discussion; Consultation with the SLTB, National Transport Commission, Western Province Road Passenger Transport Authority at the Initial Stakeholder Meeting
11	July 18, 2017 10:30-12:00	Public Engagement Meeting (Kaduwela)	Auditorium, Kaduwela DS Office	69	• Operation (ticket price, insurance for train users) • Impact on Water Edge • Impact on traffic during construction period; • Opportunities for people of Kaduwela DS • Extension of the LRT Route to Katunayake • Project financing (interest rate for the loan) • Alternative power supply • Compensation for land acquisition and impact on businesses/employment • Impact on Thalangama EPA • Project schedule	• Development of RAP and adoption of LARC System for compensation to project affected people • Avoidance of the Thalangama EPA; Conduct of Stakeholder Meeting to discuss issues

No.	Date & Time	Purpose (Target Audience)	Venue	No. of Pax	Concerns/Issues Raised	Consideration in the LRT Project
					• Associated facilities (park-and-ride facility) • Impact of change in government to project implementation	
12	August 31, 2017 14:30-16:30	Awareness Meeting for Affected Business Owners	18th floor "Suhurupaya"	17	• P&S Manager, Noritake, Regal Theater, People's Bank, Peugot & Mazda: Extent of potential damage to our building; Potential impact to our operation; Compensation; Schedule of construction • CMC: Income restoration program for around 250 small businesses in Borella Supermarket; Extent of potential damage to our building	• Avoidance of Borella Supermarket
13	September 6, 2017 14:20-16:30	EPA Stakeholder Meeting	11th Floor, Sethsiripaya Stage II	3	• Farmers' Organization: Land fillings during construction stage; No considerable impact on the EPA; Demarcations to prevent encroachers; Impact on anicut; • Environmental Foundation Ltd.: Pillars within the EPA boundaries (number and location); Height of the LRT; LRT as a physical boundary (prevent encroachment in EPA); Communication with landowners who may be potentially be affected; Frequency of trips • Centre for Environmental Justice: Exact LRT route; land filling in the depot area; Hydrological impacts of the LRT (risks to flooding along the route and in the depot area); Power supply; Travel time; Maintenance and services	• Avoidance of Thalangama EPA and use of existing roads at Koswatta Junction • Hydrological modelling at the depot area
14	September 2017	FGD: Three wheeler drivers	Borella	7	• Better to introduce luxury trains for a comfortable ride • The system need to be double tracked • Implementation period need to be planned properly with minimal impacts to public	
15	September 2017	FGD: Parents and students of	Malabe	7	• LRT will reduce the travel time and traveling will be comfortable • Project will reduce traffic and land prices will	• Incorporation of barrier free concept in the LRT design

No.	Date & Time	Purpose (Target Audience)	Venue	No. of Pax	Concerns/Issues Raised	Consideration in the LRT Project
		Ananda Vidyalaya - Malabe			increase • There need to be equal opportunity for adults, children and differently abled people • Alternative routes needs to be proposed or the use during construction period • Wetlands need to be protected as those are essential to reduce floods.	• Consideration of traffic and hydrological (flooding) impacts during construction period
16	September 2017	FGD: Pedestrians	Town Hall	6	• The development is good as it will reduce the existing traffic situation. • LRT system needs to be efficient and productive better than existing rail system. • Already, the lands were acquired from the road side of Rajagiriya and Battaramulla areas, therefore, the land acquisition need to be minimal. • There need to be equal opportunity for adults, children and differently abled people to use the LRT • Security and proper maintenance is necessary at operational stage.	• Design of the LRT structure at Rajagiriya ensures that no additional land acquisition will be required in the area. • Incorporation of barrier free concept in the LRT design
17	September 2017	FGD: School van drivers	Maradana	6	• Railway development is essential for Sri Lanka. • The traffic congestion will be reduced and the travel time of commuters will be reduced. • Travel safety will be increased with the Project. • There will be temporary issues during implementation but the project will ultimately benefit the people. • Land prices will be increased. • There needs to be a special entrance for elders.	• Incorporation of barrier free concept in the LRT design
18	September	FGD: Bo Tree Devotees	Borella	5	• Avoid impact/damage on Bo trees • Trimming and cutting of branches is acceptable only if religious activities are properly performed	
19	November 11, 2017 10:35-12:00	Public Consultation Meeting: EIA	Auditorium, Colombo DS Office	35	• Concrete mitigation measures to reduce environmental impacts • Project timeline	• Development of EIA Report and RAP • Conduct of awareness

No.	Date & Time	Purpose (Target Audience)	Venue	No. of Pax	Concerns/Issues Raised	Consideration in the LRT Project
		Disclosure (Colombo)			• Impact on shops close to the proposed LRT route (Olcott Mawatha) • Informing the management of an impacted business enterprise	meetings to potentially affected persons/businesses
20	November 11, 2017 14:45-16:00	Public Consultation Meeting: EIA Disclosure (Thimbirigasyaya)	Auditorium, Thimbirigasyaya DS Office	19	• Route selection; Additional LRT route • Impact on Borella supermarket • Impact on transfer of business premises, land acquisition and resettlement • Compensation to project affected persons and businesses	• Avoidance of Borella Supermarket • Development of RAP and adoption of LARC System for compensation to project affected people
21	November 17, 2017 14:00-15:30	Public Consultation Meeting: EIA Disclosure (Kaduwela)	Auditorium, Kaduwela DS Office	60	• Extent of land acquisition for the proposed depot area • Project timeline (start of construction) • Proposed LRT route; additional route (extension to Kaduwela) • Similarity to the Monorail • Passenger capacity • Planned train station in Battaramulla	•
22	November 21, 2017 10:20-12:00	Public Consultation Meeting: EIA Disclosure (Kotte)	Auditorium, WP/ Jaya/ Sirihada Vidyalaya, Rajagiriya	12	• Plan for the Rajagiriya flyover area • Impact on marshlands caused by illegal constructions (apartments) in Rajagiriya • Need for behavioral change in people to solve traffic issue • Compensation for PAPs and need for political will • Construction impacts	• Propose a cantilever design that would fit within the ROW of the flyover so that no additional acquisition will be necessary • Development of RAP and adoption of LARC System for compensation to project affected people

Focus Group Discussions

1. Group Discussion with Three wheel drivers @ Boralla on LRT Project

It was revealed that the Three-Wheeler Drivers around Borella were extremely positive towards the Light Rail Transit (LRT) project. Their views and suggestions are listed below;

- Implementing stage of this project must be done diligently.
- A **double-track** railway must be designed as it involves running one track in each direction.
- Must include **Luxury trains** that are specifically designed to offer an elegant train ride with comfortable traveling options.
- Implementation stage could be planned with the minimal effects towards the public.
- As a suggestion, Borella Police Station must be taken off and let Light Rail move across that way.
- At the developing stage, if the Bo Tree lay as a barrier, cut it down and continue with the process.

2. Group Discussion with Parents of the students in "Malabe Ananda Vidyalaya"

It was revealed that the parents of the children in Ananda College, Malabe were extremely positive towards the Light Rail Transit (LRT) project. Their views and suggestions are as shown below;

- This project should be actualized effectively and productively.
- It encourages the community to reduce time on transportation and at meanwhile, they can have a comfortable ride.
- On the off chance, if the school children are influenced at the development phase of this project, particular moves must be made to avoid such impacts.
- Upturning the price of the lands would be another ideal reality through this undertaking.
- This project would help to diminish traffic clog around Colombo City.
- There should be alternative streets to be utilized during the construction stage of the LRT project keeping in mind the end goal to decrease traffic.
- Adults, Children as well as disabled persons must be given equal opportunity to use the light rail.
- There shouldn't be any harm towards the wetlands as this undertaking must be executed with zero harm towards the environment. Particularly it will affect possible flood situations inside Colombo District.

3. Group Discussion with devotees @ Boralla "BoTree"

Discussed with the devotees of the respected Boralla Bo Tree. The premises belongs to Colombo Municipal Council. People in surrounding area perform religious activities. The people is believing that the Bo Tree is very important for the Buddhist Community and the Bo Tree is having a miracle power. If it is removed it may come harm to the people who involved. Their thought is not to be any damage to the Bo Tree.

After the explanation of the project and the type of the impact to this Bo Tree they accepted the smooth trimming . But before the trimming It should be performed all religious activities should be properly performed.

The perception of these people regarding LRT is very positive. According to them proposed Light Rail will provide more comfortable travel mode to the commuters.

4. Group Discussion with pedestrians @ Town Hall

Discussions had with the pedestrians surrounding area of the Town Hall were happy with the proposed Light Rail Transit (LRT) project. They expressed their views very positive manner. Their views and suggestions are as follows

- This project should be designed effectually and productively.(To be avoid all bad things of Sri Lanka Railway)
- The end goal of the LRT should be to reduce the traffic jam.
- The land owners in either sides of the existing road (specially Rajagiriya,Batteramulla area) has already sacrificed their valuable property for the widening of the route. Therefore it should be taken necessary actions to avoid land acquisition as possible.
- The LRT will reassure the community to reduce time on transportation and at meanwhile, they can have a comfortable ride.
- Elderly people , Children as well as disabled persons must be given equal opportunity to use the light rail.
- Security and the proper maintenance is essential at the operational stages.

5. Group Discussion with school Van Drivers in Maradana area.

After the interview had with the school van drivers, it was revealed that they were extremely positive towards the Light Rail Transit (LRT) project. Few of their views and suggestions could be listed down as follows;

- Road development is one of the most essential fact for developing countries like Sri Lanka. Therefore, this project needs to be implemented actively and fruitfully.
- This would assist to reduce traffic congestion around Colombo City.
- It helps the travelers to reduce time on transportation thus, can have a cozy ride.
- There will be an impact towards the economic ailments at the implementation stage. However, people will have to bare this condition until the project is been done since, it is only them who will be ultimately benefited through this project.
- Community could travel safely.

- Increase the lands prices either sides of the road, in future would be another favorable fact through this project.
- There must be special entrance facilities for elderly people.

Meeting minutes of SHM

Ministry of Megapolis and Western Development (MMWD)

New Light Rail Transit System from Kollupitiya to Malabe

STAKEHOLDERS PARTICIPATION AND INFORMATION DISCLOSURE

Minutes of Initial Stakeholder Consultation Meeting

Date:	16th May 2017 from 10:00AM-13:00PM
Venue:	Auditorium, 11th Floor, Sethsiripaya Stage II, Battaramaulla
Organized by:	Ministry of Megapolis and Western Development

Participating Institutions:

1. *Secretary of the Ministry of Megapolis and Western Development*
2. *Representatives from JICA Study Team*
3. *Representatives from JICA Sri Lanka Office*
4. *Representative from DS office of Kaduwela & Sri Jayawardenapura – Kotte*
5. *Representatives from Municipal Councils of Colombo, Kaduwela & Sri Jayawardenapura – Kotte*
6. *Officials from Ministry of Higher Education and Highways*
7. *Officials from Ministry of Megapolis and Western Development*
8. *Ministry of Provincial Councils and Local Government*
9. *Ministry of Law and Order and Southern Development*
10. *Representatives from Urban Development Authority*
11. *Road Development Authority*
12. *Ceylon Electricity Board*
13. *Lanka Electricity Company (Pvt) Ltd*
14. *National Water Supply and Drainage Board*
15. *Sri Lanka Telecom, Department of Motor Traffic*
16. *Sri Lanka Transport Board, National Transport Commission*
17. *Western Province Road Passenger Transport Authority*
18. *Department of Railways*
19. *National Physical Planning Department*
20. *Department of Irrigation*
21. *Department of National Planning*

(List of Participants given in Attachment- A)

Speeches & Presentations

- Eng. Chaminda Ariyadasa (Project Director – Light Rail Transit Project) welcomed all participants for the Initial stakeholder meeting.
- Project Director then made the Opening Remarks regarding information disclosure followed by a presentation on the LRT.
- After the tea break all participants were invited to state their views on the project and ask for clarifications.

Details of Discussions

Table 01: *Comments and Questions by Participants of Initial Stakeholder Meeting-16th May 2017*

Raised by	Comments and/ or Questions	Answered by	Answer
Mr. T.L.M. Fernando (Project Director, Port Access Elevated Highway, Road Development Authority)	- Need to mitigate traffic jams during the construction period. - Since some main roads will get affected, roads may have to be widened to reduce the impacts. - There should be a proper traffic management plan.	Ms. Kalyani Dias (Environmental Specialist-WRMPP) Dr. Dimantha de Silva (Transport Specialist-WRMPP)	- Existing roads will be widened to reduce the impact of traffic congestion after discussion with RDA. - Alternative roads will be identified and developed to reduce the traffic congestion during the construction period.
Mr. K.D.L. Chandradasa (Deputy Director-Planning) Urban Development Authority	- Why it is not extended up to Kaduwela instead of Malabe? - Kaduwela is fast developing as a residential area and this will help to cater to existing development as well as encourage new developments. - Kaduwela is also a gateway to Colombo from Badulla/Rathnapura/Awissawella (A04) and Biyagama, Pugoda areas.	Mr. Chaminda Ariyadasa (Director - LRT project)	- There will be provision to continue up to Kaduwela in the future. - But at this stage it will be only up to Malabe due to financial constraints.
Mr. K.D.L. Chandradasa (Deputy Director-Planning)- (UDA)	- Will it be a visual barrier due to the elevated structure?	Ms. Kalyani Dias and Dr. Dimantha de Silva	- In Sri Lankan Context, Different sizes of buildings have different colours. - However, the LRT will be designed aesthetically to blend with the landscape.
Dr. Narendra Silva (Electrical Engineer) Lanka Electricity Company (Pvt) Ltd (LECO)	- Has the option for underground construction been explored?	Dr. Dimantha de Silva	- Lot of countries select underground as an option but the cost would be very high. - In the construction area the water table is high and need to use special construction techniques, therefore construction cost would be high. - Going underground can be considered generally cost is the factor.
Mr. K.D.L.Chandradasa (Deputy Director-Planning)- (UDA)	- Are there facilities for maintenance/ repairs at the end point?	Maintenance Engineer, JICA Study Team	- LRT system includes a depot which provides operations such as daily cleaning of interior and exterior, regular services and maintenance.

Mr. Yohei Suzuki, JICA Study Team	- The proposed depot area near Chandrika Kumarathunga Mawatha consists of paddy fields and all those are private lands. Will it be a problem?	Mr. K.D.L. Chandradasa (Deputy Director-Planning)- (UDA)	- Paddy lands are not being cultivated currently in most of the Malabe area and other urban areas. - People's living patterns have changed and farming is an occupation practiced by only a few.
Mr. Yohei Suzuki, JICA Study Team	- The proposed main route runs across the Talangama Environmental Protection Area (EPA). Will it be a problem?	Dr. Dimantha de Silva, Ms. Kalyani Dias, Ms. Ramani Ellepola	- We are still in the process of finalizing the trace. - Since this particular area is declared as an environmental protection area of Talangama tank, there are certain activities which are not permitted. Need to consult with Central Environment Authority and see what permissions are required. - If they don't allow we can go for the alternative options which runs across Koswatta junction or along the boundary of EPA.
Mr. T.L.M. Fernando (Project Director, Port Access Elevated Highway, RDA)	- There is a proposal to improve the Kelani Valley railway line as a double line. Is it possible to combine this LRT line with the Kelani Valley railway line?	Dr. Dimantha de Silva	- Kelani valley line and LRT have different routes. - When developing the Transport Master plan whole network has been considered based on network analysis and traffic demand. If station locations are away from business/ commercial centers or residential areas then people will not be attracted to LRT. If we consider coastal railway line main problem is some parts of the line going away from residential areas and commercial/ business centers. Therefore people need to get support from other transport modes. Therefore the route has been selected which closer it to main roads and commercial centers.
	- Is LRT affordable?	Dr. Dimantha de Silva	- LRT is an alternative new transport mode. Due to the usage of three-wheelers and motor cycles and due to the discomfort of existing public transport modes, usage of the public transport have decreased. This LRT project is proposed to attract people back to public transport. - Ex- The share of the public transport was 65%. It decreased to 50% during last few years. The balance of 15% shifted to three-wheelers and motor cycles. People pay Rs. 40.00 per 1 km for three wheels and

			cost for 1 km for motor bike is around Rs. 12.00. The cost of using LRT will be much cheaper, convenient, more comfortable and safer.
	- Positive impacts of proposed LRT system	D.D Pathmasiri (Representative from Kaduwela Divisional Secretariat)	- The proposed LRT will attract more people to the public transport system. It will reduce existing traffic congestion, emissions and will have many positive impacts. However, government should enforce new laws to prohibit entrance to the tracks.
Dr. Narendra Silva (Electrical Engineer)-LECO	- 11kv or 33kV power distribution lines run along the side of the road. Maintenance of these lines will be a problem during the construction period of LRT structures and also during the operations. Therefore going underground is ideal. - Or, otherwise can we hang the power distribution lines along LRT structures? - And also what is the power requirement for LRT?	Mr. Chaminda Ariyadasa	- We need to have detailed discussions with CEB about the power supply for LRT after the route is finalized. We should have some backup in addition to the existing power supply.
		Dr. Dimantha de Siiva	- Undergrounding of LRT can be considered generally the high cost is the factor, Undergrounding of electricity cables will be the best option. - Hanging utilities and street lights along LRT structures is possible. - We planned to go for third rail option not the overhead supply connectivity. - Now, Third rail option for providing power is common in the world and aesthetically it is not ugly since we don't have overhead cables. - As power requirement is same for LRT and monorail, we can get more details from the study done for monorail.
Mr. G.K Pathmakeerthi Director (Colombo Region), Department of Irrigation	- We are in charge of Talangama tank. The proposed route is outside our command area. You need to contact CEA and Agrarian services department, since there are some paddy fields across the proposed route.	Mr. Chaminda Ariyadasa (Director-LRT project)	- Yes, we need to have discussions with CEA and Agrarian Services department, regarding the Talangama EPA issue. (There were no representatives from CEA, Agrarian Services department, SLLRDC at the meeting).

Mr. T.L.M. Fernando (Project Director, Port Access Elevated Highway, RDA)	- It will be better if you can use pre-cast constructions as much as possible for the structures. Then we can speed up the construction and impact to the traffic will be lower.	Mr. Chaminda Ariyadasa (Director-LRT project)	- Thank you very much for your idea. Anyway, Construction methodology should be such that we have to finish the construction within the least possible time with minimum disturbance to the public.
Mr. P.D.Balasooriya Chief Executive Officer, Sri Lanka Transport Board	- Do you have any parking facilities near stations and any park and ride arrangements?	Dr. Dimantha de Silva	- Park and ride facilities will be provided for all stations outside the city (beyond Battaramulla). And we should focus on cyclists, motorcyclists and three-wheelers. Also need to create new bus routes and shuttle services to connect stations to main towns such as Kaduwela.
		Mr. Chaminda Ariyadasa (Director-LRT project)	- We will make provisions to create new bus routes from Kaduwela, since a large crowd commuting from Avissawella, Hatton, Ratnapura, Balangoda areas will get benefits. We will arrange Park and Ride facilities in all stations where we can acquire lands at reasonable cost.
G.K Pathmakeerthi Director (Colombo Region), Department of Irrigation	- Where is the exact location of cotta road LRT station? There is a land belonging to Department of Irrigation near the proposed station. We have planned a new housing development there and we need to know whether it will get affected or not?	Mr. Chaminda Ariyadasa (Director-LRT project)	- No, the proposed route is along the other side of the road. So, your lands will not get affected. - The proposed cotta road station should be integrated with the railway station, because there will be passengers transferring from railway to LRT. Exact location is not finalized. - After the feasibility study affected land owners will be consulted.
Mr. K.D.L.Chandradasa (Deputy Director-Planning)- (UDA)	- The proposed trace is almost along a flood inundation area. Did you consider this when selecting the trace or have you done any hydrology study?	Mr. Chaminda Ariyadasa (Director - LRT project)	- There will be new pumping station in Ambatale to pump excess flood water to Kelani River under the Metro Colombo Urban Development Project. Now, that project is under tender stage and flood impacts will be reduced after the project is implemented.
		Ms. Kalyani Dias	- Hydrological study need to be covered during the Environmental Impact Assessment (EIA) process.

		Mr. D.A.J.Ranwala- Team Leader- Environmental Impact Assessment Team	- According to the previous investigations, only the depot area is susceptible to flood impacts. Chandrika Kumarathunga Mawatha flooded up to 6 feet during the 2016 floods. Therefore the depot should be elevated and should be higher than that level. - However, we will do a detailed hydrological study and after that we can say whether there is an impact or not. There will be impacts mainly during the construction period not in the operational stage. - By discussing with Irrigation Department and Sri Lanka Land Reclamation and Development Corporation (SLLRDC), we can estimate the major flood possibilities of the Kelani River.
Ms. Aloka Karunarathne (National Transport Council)	- Now, there are some bus routes with over-supply in Colombo especially during the daytime. After the proposed LRT project, impact will increase and it will adversely affect to private bus owners.	Dr. Dimantha de Silva	- Bus rescheduling and rerouting will be planned as a part of the Transport master plan. Bus routes which has oversupply will be rearranged and new bus routes will be created from LRT stations to main towns.
		D.D Matharaarchchi, Senior Programme (Director, Ministry of Higher Education and Highways)	- We should give priority for proposed LRT to improve our public transport system. Then all other issues in other public transport modes (buses, three wheelers) will be automatically resolved.
		Mr. Chaminda Ariyadasa	- New bus routes such as Kaduwela-Pittugala, Biyagama-Malabe, Hanwella - Pittugala will be identified through the project itself and existing buses will be rerouted.
Mr. Yohei Suzuki, JICA study team	- The proposed trace is along the Perahara mawatha. Will it disturb the cultural events of Gangarama temple?	Mr. Chaminda Ariyadasa and Dr.Dimantha de Silva	- If we have columns along the center line of road, it will be a disturbance to the perahara event. Still, we are in the feasibility stage and we need to have discussions with the chief priest of Gangarama temple and come to a conclusion. If it is not possible we can divert the route over the Beira Lake.
Mr. K.D.L. Chandradasa (Deputy Director-Planning)- (UDA)	- Will the Port city development project will get benefits from proposed LRT project?	Mr. Chaminda Ariyadasa	- We had a discussion with officials of the Port city development project last week. We will make a provision for a dedicated line from Port city.

Questions raised and answers given during the discussion was summarized on a white board by officials of WRMPP and JICA study team. Extract of that table is given below.

Environmental	Social	Technical	Other
1. Visual barrier by elevated structure.	1. Integrated development around Malabe area?	1. Improvement of roads. (Discussion with RDA) (Alternative routes)	1.Why is it not extended to Kaduwela instead of Malabe?
2. Functions at the depot. (The Malabe end cleaning maintenance etc.)	2. Park and ride facilities.	2. Intersection with KV line. (From Colombo to Narahenpita.	2. Law enforcement on safety. (No entrance to the tracks)
3. Thalangama Environmental sensitive area. (Discussion with CEA)	3. Cotta road station (Proposed project by Dept. of Irrigation for a housing development)	3. Utility line maintenance. (Discussion with Utility State holders and provisions)	
4. Broken part disposal.	4. Over supply of local bus service.	4. Power supply for LRT.	
5. Floods associated with LRT development. (During and after construction)	5. Identification of new bus route from the project.	5. Transient load calculation.	
	6. Port city connection.	6. Using precast techniques during construction.	

Closing Remarks

Eng. Chaminda Ariyadasa, Project Director-Light Rail Transit Project thanked all the stakeholders for their participation during this discussion. He informed there will be further information sessions in future for stakeholders and public. He further invited all stakeholders to continue their support and requested to ask any clarifications through e-mail and over the phone.

Attachment A - List of Participants

Initial Stake Holder Consultation Meeting
Auditorium, 11th Floor, Sethsiripaya Stage II, Battaramaulla
16th May 2017 from 10:00 AM-13:00 PM

No	Name	Position	Agency	Contact Details
1.	N.Rupasinghe	Secretary	Ministry of Megapolis and Western Development	
2.	K.A.S Walpola	Senior Assistant Secretary	Ministry of Provincial Councils and Local Government	071-4114735
3.	D.D Matharaarchchi	Senior Programme Director	Ministry of Higher Education and Highways	077-3258483
4.	N.A Weerasinghe	Senior Assistant Secretary	Ministry of Law and Order and Southern Development	077-7377966
5.	Namal Relapanawa	Project Specialist	JICA- Sri Lanka Office	
6.	Tatsuk Kiaiaua		JICA- Sri Lanka Office	
7.	Tomohiko Kozono		JICA Study Team	
8.	Kamhiro Tauaka		JICA Study Team	
9.	Yohei Suzuki		JICA Study Team	
10.	Mr. Yoshihisa Asada		JICA Study Team	
11.	Kalyani Dias	Environmental Specialist	WRMPP	071-9556742
12.	Ramani Ellepola	Environmental Specialist	WRMPP	071-8163376
13.	Dr.Dimantha de Silva	Transport Specialist	WRMPP	
14	P.C.C Peauz	Additional General Manager	Ceylon Electricity Board	071-4298147
15.	S.A.K Subasinghe	Deputy Director	Colombo Municipal Council	077-1093126
16.	D.A.J Ranwala	Team Leader-EIA	Consulting Engineers & Architect Associated (Pvt) Ltd	077-6026479
17.	S.K.K Ranasinghe	Project Manager	Consulting Engineers & Architect Associated (Pvt) Ltd	077-0129014
18	Deshan Gamage	Engineer	Consulting Engineers & Architect Associated (Pvt) Ltd	077-0351470
19.	G.K Pathmakeerthi	Director (Colombo Reigion)	Department of Irrigation	071-4880354
20.	J.A.S Jayaweera	Assistant Commisioner(Technical)	Department of Motor Traffic	071-4499600
21.	U.N.Mallawaarachchi	Director(Road and Ports)	Department of National Planning	077-7947953
22.	D.D Pathmasiri	Admin-Grama Niladharis	Kaduwela Divisional Secretariat	071-0350112
23.	M.M Mifrah		Kaduwela Municipal Council	071-8335131
24	N.A.N.S Gunarathna	Electrical Engineer	Lanka Electricity Company (Pvt) Ltd(LECO)	071-5337642
25.	C Kularatna	Director(Engineering)	National Physical Planning Department	071-8029048
26.	Aloka Karunarathna	Assistant Director	National Transport	071-6562071

No	Name	Position	Agency	Contact Details
			Commission	
27.	M.A.P Hemachandra	Chairman	National Transport Commision	077-7892525
28.	A Munasinghe	Assistant General Manager	National Water Supply and Dranaige Board	077-3856725
29.	T.L.M Fenando	Project Director(Port Access Elevated Highway)	Road Development Authority	077-7234157
30.	Piyal Warnakulasooriya	Project Director(Three Flyovers Project)	Road Development Authority	077-7585677
31.	J.A.D.H.A Jayalath	Project Engineer	Road Development Authority	071-8615466
32.	Janaka Abeysinghe		Sri Lanka Telecom	071-4222240
33.	N.K. Hidallarachchi		Sri Lanka Transport Board	077-1056044
34.	P.D Balasooriya	Chief Executive Officer	Sri Lanka Transport Board	077-1056190
35.	P.H.R.T Chandrasiri		Sri Lanka Transport Board	077-1056036
36.	J Thivahar	Municipal Engineer	Sri Jayewardenepura - Kotte Municipal Council	077-7258385
37.	K.D.L.Chandradasa	Deputy Director Planning	Urban Development Authority	
38.	Kumara Wijerathnayake		Western Province Road Passenger Transport Authority	071-8457941
39.	S.M.N Subasinghe	Assistant Director	Department of Local Government	071-8420410
40.	N.L.S. Tharanga			070-2597268
41.	Dr Narendra de silva	Electrical Engineer	Lanka Electricity Company (Pvt) Ltd(LECO)	071-5337601
42.	W.M.D.I Jayawardhana	Transport System Analyst	Road Development Authority (Planning Division)	077-3411900
43.	S.A.L Subasinghe	Assistant Director	Ministry of Transportation and Civil Aviation	071-6571777
44.	E.M.S.P.K Deegala	Deputy Chief Engineer	Sri Lanka Railways	071-5310309
45.	K.A.D Chandana	Deputy Director General(Planning)	Urban Development Authority	071-1357579
46.	Bandara Ratnajeewa	Director(Planning)	Ministry of Higher Education and Highways	077-7441117
47.	R.M.J.B Rathnayaka	Deputy Director	Urban Development Authority	071-8056116
48.	R.L Suveetha	ADG(Planning)	Sri Jayewardenepura – Kotte Divisional Secretariat	071-2886264
49.	U.K.D.M Thilani	Assistant Director	Ministry of Lands	011-2797527
50.	Nilantha Wattage	Area Engineer - Battaramulla	National Water Supply and Drainage Board	077-7891328

The Awareness Meeting for the Introduction of New Light Rail system held at Colombo Divisional secretary Division

Venue: Auditorium (D.S office Colombo)

Date : 24th May 2017

Time : 10.30 am – 12.00pm

Ms. Kanchana Gunawardana (Assistant D.S) welcomed all the participants for the DS level awareness creation meeting organized by the Ministry of Megapolis and Western Development.

Mrs. K. Ranasingha (Projects Manager-CEAA), on behalf of EIA team of the proposed Light rail, stated the purpose of the meeting and invited to Ms. W. Abewickrama (Transport Engineer-WRMPP) to explain the need for the development of transport alternatives for achieving the national development targets.

Ms. Abeywickrama further explained the benefits of the proposed light rail project, with a power point presentation that includes,

1. Requirement of the traffic management plan for the Colombo and suburbs
2. Main corridors considered to introduce alternate transport solutions in Colombo and suburbs
3. Selected corridors to implement the proposed light rail
4. Reasons for select Light rail instead of other transport modes.

Then she presented the proposed light rail trace and affected GN divisions due to proposed project. She further stated that there are 21 stations along the light rail trace runs from IT Park, Malabe to Kollupitiya via Colombo Fort. She also presented some Light rail projects in various countries with some photographs and a video.

Mrs. Ranasingha explained about the socio- Economic Study that will be carried out to identify and minimize any adverse impacts to people due to the project and propose remedial steps to overcome any hardships caused by the project.

The discussion was opened to questions and comments.

Raised by	Question	Answer
G.N Ekanayake (Grama Niladhari- Grandpass)	Will the existing railway tracks get affected with proposed light rail?	No. Proposed light rail runs through a trace which is not covered by existing railway.
H.A.D Harsha (Grama Niladhari - Keththarama)	Are there any land acquisition occurs in Colombo area?	Light rail tracks will be constructed as elevated over the existing roads. Therefore land acquisition may be minimal. But there may be certain impacts on some nearby buildings and

		lands. After the feasibility study affected land owners will be consulted.
G.N Ekanayake (Grama Niladhari- Grandpass)	Will this project affect religious places?	Still there is no confirmed information about religious places that might get affected as a result of this project. However there will be an impact to Navam perahara event of Gangarama temple, since the proposed trace is along the Perahara mawatha. Still, we are in the feasibility stage and we need to have discussions with the chief priest of Gangarama temple and come to a conclusion.
H.A.D Harsha (Grama Niladhari - Keththarama)	Are there any impacts on existing buildings?	Some buildings and lands will get affected during the construction period as well as the operational phases of the project. However we will try to design the route with minimal damages to nearby structures.
K.G.V Gunarathne (Development Officer)	Are there two tracks in Light rail for both directions?	Yes. There are two tracks separately towards Colombo and outwards Colombo.
K.G.V Gunarathne (Development Officer)	What is the ticket price for a single journey from Malabe to Fort?	The ticket price will be affordable and it is not calculated yet. However, the cost of using LRT will be much cheaper than using Motorbikes and Three wheelers.
K.G.V Gunarathne (Development Officer)	What is the capacity of the train? At once how many people can travel?	It will depends on the number and the type of compartments we used. As an example with 02 compartments train can carry about 6600 PPHPD. With 03 compartments it can carry about 10000 PPHPD.

Eng. Chaminda Ariyadasa (Project Director of the LRT Project) further explained more details about the commencement date of the construction and how project finance. He stated that the proposed light Rail project will be funded by the Japanese Government with a lowest interest such as 0.1% per Annum. He further stated that the feasibility report should be submitted before the next year and negotiations to be held around February 2018. He convinced the need of the transport alternatives like LRT project to achieve national development goals and requested that the support of all Grama Niladharis and field officers to achieve the project's success. He further requested to contact him over the phone or through e-mail for any suggestions or clarifications.

Project Director thanked all participants and meeting was adjourned.

List of participants for the Awareness meeting and their contact details are presented below. (Attachment A)

Attachment A- List of Participants

No.	Name	Designation	GN Division	Contact No.
1	M.A.S Kanchana Gunawardana	Assistant Divisional Secretary		071-4962028
2	J.P.A.L Weerasinghe	Assistant Divisional Secretary		071-4971848
3	A.D Sriya Kanthi	Administrative Grama Niladhari		071-3487300
4	A.W Hasmathulla	Development officer	Kotahena East	077-3072328
5	E.A.D.N.C Weerasekara	Development officer	Aluthkade East	077-9495054
6	F.R.Rasheed	Development officer	Aluthmawatha	071-3871776
7	B.G.A Priyadarshani	Development officer	Nawagampura	071-3871804
8	P.G.T.S Gunarathna	Development officer	Maligawatta	071-1822901
9	K Neluka Nadini	Development officer	Keththarama	071-1111050
10	A.M.Shehabtee	Development officer	Mattakkuliya	077-3329148
11	N.K Alexanden	Development officer		077-5409779
12	M.A.D.T Wickramasinghe	Development officer	Maligakanda	075-9271417
13	P.N Dilrukshi	Development officer	Grandpass North	070-2569001
14	K.G.U Gunasena	Development officer	Masangas Veediya	071-8185637
15	H.M.T.A Ekanayake	Grama Niladhari	Grandpass South	071-0550305
16	H.A.D Harsha	Grama Niladhari	Kettarama	071-0550234
17	H.K Premasiri	Grama Niladhari	Maligakanda/Maradana	072-5782305
18	B.L.M Maxel	Grama Niladhari	Slave Island/Fort	072-1663650
19	D.W Premathilaka	Grama Niladhari	NCE Bazaar	071-0185820
20	Ashoka Muhandiramge	Grama Niladhari	Grandpass North	077-6592989
21	W.L Mapatuna	Grama Niladhari	Aluthkade East	077-7966006
22	N.F.Ariffan	Grama Niladhari	Modara	078-6277238
23	S.K Nihal Suranvi	Grama Niladhari	Ibbanwala/Suduwella	072-3349404
24	A.A.L Chathuranga	Grama Niladhari	Mattakkuliya	077-0770813
25	S.Urutharan	Grama Niladhari	Kotahena West	072-5440110
26	Shanthan J Mohan	Grama Niladhari	Bluemendhal	071-3487754
27	P.S Weerasinghe	Grama Niladhari	Kochchikade South	077-1744020
28	L.K.O Karandhana	District Child Protection Officer	Colombo	071-2852349
29	Y.A Thamara	Child Rights Protection Officer	Colombo	071-8182120
30	M Wickrama	Women Development officer	Colombo	071-8602688
31	Janaki Thalpawila	Early childhood Development Assistant	Colombo	077-2943010
32	K.D.L Pradeep Kumara	National integrated Co-ordinator	Colombo	071-0737628
33	N.P.G.Krishna	Land use planning officer	Colombo	071-7943386
34	M.H.R Tharaka	Grama Niladhari	Colombo	071-0549531
35	K.A.Y Antani	Grama Niladhari	Colombo	071-0550345
36	W.D Anusha Mayurani	Sports officer	Colombo	071-4404957
37	M.S Kumara	Grama Niladhari	Aluthmawatha	
38	K.L.C.N Perera	Grama Niladhari	Maligawatta E/W	071-8436013

39	H.G.T Dilhara	Grama Niladhari	Wekanda	072-8730280
40	G Latha Rangani	Grama Niladhari	Kochchikade North	077-8339066
41	S.Susiltaram	Grama Niladhari	Hunupitiya	077-9000486
42	H.A.A.P Perera	Grama Niladhari	Ginthupitiya	071-0550299
43	H.P.C Caldera	Grama Niladhari		071-6473698
44	W.N.N.P Kumara	Irrigation Engineer		071-7215479
45	A.P.C.T Amarasinghe	Science & Technology officer		077-7289317

Attachment B- Photographs

Awareness Meeting on Proposed Light Rail Transit system held at Thibirigasyaya Divisional secretary Division

Venue: Auditorium (D.S office- Thibirigasyaya)

Date : 26th May 2017

Time : 11.30 am – 1.00pm

Ms. Erandi Chamila (Asst. Director Planning) welcomed all the participants for the DS level awareness creation meeting for the Introduction of New Light Rail system from Malabe to Kollupitiya.

Eng. Chaminda Ariyadasa (Project Director-Light Rail Project), explained the purpose of the meeting and the need for the development of alternative transport modes to reduce existing traffic congestion.

Eng. Ariyadasa further explained,

- Main corridors considered and proposed transport networks under Transport Master Plan
- Need of a Rail based public transport system to reduce traffic congestion
- Reasons for selecting Malabe corridor to implement LRT
- Reasons for selecting Light rail instead of other public transport modes such as Monorail

With a power point presentation.

He also explained the features of Light Rail with some photographs of light rail transit systems in other countries.

Then He explained the design concept of LRT system and space requirement for Light Rail structures. He stated that proposed light rail trace runs above the center median of existing roads with the support of RDA.

Then He presented the proposed trace of LRT system from Malabe to Kollupitiya and affected GN divisions due to the LRT project. He also presented the proposed route, stations and depot area using Google Earth. He stated that Depot area will be constructed as elevated near Chandrika Kumaratunga Mawatha, Malabe.

Then he explained the expected social and environmental impacts of the Project and proposed mitigation measures. He stated that Environmental and Social Impact assessment and Resettlement Action Plan will be carried out to estimate those impacts.

Finally, He explained the communication mechanism and schedule of the project activities.

He further requested to contact him over the phone or through e-mail for any suggestions or clarifications.

The discussion opened to questions and further clarifications.

The questions raised and answers given during the session is presented below.

Raised by	Question	Answer
K. Wijewardana (Development officer)	Can't we use these trains for long distances?	This train cannot use for long distance journeys. The purpose of introducing light rail is to minimize the traffic congestion in Colombo area and to cover a trace that is not covered by the present railway system.
Saman perera (Grama Niladhari- Wellawatta)	What is the length of proposed LRT system?	The total distance is about 26kms from Malabe to Kollupitiya. There will be 21 stations in between.
K. Wijewardana (Development officer)	Has the project focused on the environmental impact as well?	Yes. Environmental Imapct Assessment (EIA) will be carried out by a consulting company as a part of the Feasibility Study.
K. Wijewardana (Development officer)	Though there's an environmental and social study conducted for the Uma oya project, there were so many issues arose from that project. Can something similar happen by this project as well?	When implementing a project there may be some environmental and social issues which can't be omit completely. However our expectation is to implement the project with minimum environmental and social impacts.
Saman perera (Grama Niladhari- Wellawatta)	Have you identified the buildings that might get affected as a result of this project?	Proposed LRT will be constructed as elevated over the existing roads. Therefore land acquisition may be minimal. But there may be certain impacts on some nearby buildings and lands. Still there are no confirmed information about buildings that might get affected as a result of this project. After the feasibility study affected land owners will be consulted.
Saman perera (Grama Niladhari-Wellawatta)	At once how many can travel in a train?	It will depends on the number of compartments. A train with 02 vehicles at 02 min frequency can carry about 10000 PPHPD.
Saman perera (Grama Niladhari- Wellawatta)	How much is the ticket price from Malabe to Fort?	The ticket price is not calculated yet. However, One way ticket from Malabe to Colombo will cost about 100-150 LKR.

Mr. D.A.J. Ranwala (Team Leader-EIA team) joined the Discussion and explained about the Environmental impact assessment mechanism and how to mitigate potential environmental impacts of the project.

Project Director showed a video of Light rail project to the audience before adjourning the meeting.

List of participants for the Awareness meeting and their contact details are presented below. (Attachment A)

Attachment A- List of Participants

No.	Name	Designation	GN Division	Contact No
1	A.K Erandi Chamila	Asst. Director Planning	Divisional Secretariat	071-8616901
2	Chandani Rathnayaka	Grama niladhari	Narahenpita	075-2464433
3	K.H.A.G Wijewardhana	Development Officer	Wellawatta south	071-7430957
4	Damayanthi Liyanagedara	Samurdhi Development Officer	Wellawatta south/ Wellawatta North	071-3074040
5	W.C Amalka Wijerathna	Technical Assistant	Divisional Secretariat	071-6898018
6	M.N Wasantha Sanjaya	Samurdhi Development Officer	Kirula/ Gothamipura	071-6363800
7	Daya Ranjani Wijesinghe	Grama niladhari	Kuppiyawatta West/ Wanathamulla	071-4434358
8	M.A.C Dinesh	Grama niladhari	Dematagoda	075-5313921
9	H.L Sanjaya	Grama niladhari	Kuppiyawtta East	071-8428756
10	J.P.M.Piyal Jayawickrama	Grama niladhari	Havelock Town	070-0706824
11	U.N Wasana	Grama niladhari	Wellawatta south	071-8428765
12	K.W.I Udeni	Grama niladhari	Borella South	071-8265668
13	H.K Lakshami	Grama niladhari	Borella North	071-8647917
14	K.N Jayasiri	Grama niladhari	Kuruduwatta	078-5298521
15	R.H.G Fonseka	Development Officer	Kirulapone	071-6099433
16	Sugath Liyanage	Development Officer	Gothamipura/ Wanathamulla	071-8149686
17	H.D.D Vishaka	Development Officer	Bambalapitiya/Kollupitiya /Milagiriya/ Wellawatta North	077-0657299
18	N.T Amarasinghe	Development Officer	Dematagoda/Borella South	071-3940137
19	W.W. Chamari Nisansala	Development Officer	Borella/Kuppiyawatta	071-3986554
20	Y.P.S Ranasinghe	Development Officer	Thibirigasyaya/ Kuruduwatta	071-5558922
21	W.A.A Harshani	Development Officer		077-8273956
22	D.M Nisansala	Development Officer	Pamankada East	071-6857218
23	R Amila Sandaruwan	Development Officer		071-3544674
24	R.M.M Rathnayake	Development Assistant	Thibirigasyaya	
25	Rohini Abeysundara	Sports Officer	Thibirigasyaya	
26	W.C Amalka Wijerathne	Technical Assistant	Thibirigasyaya	
27	M.M Mangala	Development Officer		
28	Kamani Eroshani	Development Officer	Kirulapana	
29	Ven. U.Saranapala	Development Assistant	Thibirigasyaya	
30	C.N.B Ekanayaka	Grama niladhari	Kollupitiya	
31	H.A Indika Warnasiri	Samurdhi Development Officer	Milagiriya/Bambalapitiya	

Attachment B- Photographs

Awareness Meeting on Proposed Light Rail Transit system held at Kotte Divisional secretariat Division

Venue: Auditorium, Sri Jayewardenepura Kotte Divisional Secretariat Office, Rajagiriya

Date: 31.05.2017

Time: 10.15 am - 12.00 pm

Mr. Amal Edirisooriya, Divisional Secretariat welcomed all the participants for the awareness programme and invited Mr. Chaminda Ariyadasa, Project Director to present the proposed project to the participants.

Mr. Ariyadasa explained the need of social and environmental assessment for the proposed LRT Project and the importance of holding consultation meetings with the field officers and Grama Niladharis to obtain their views and suggestions. He then presented about the proposed LRT project with a power point presentation. His presentation included following points;

- Need of an alternative transport mechanism to reduce existing traffic congestion
- Need of a Rail based public transport system like LRT to reduce traffic congestion
- Proposed LRT system and the proposed transport Network in Colombo Megapolis Region
- How the project to be financed
- Reasons for selecting Malabe corridor to implement LRT
- Design concept of LRT system and space requirement for Light Rail structures
- Proposed trace of LRT from Malabe to Kollupitiya and affected GN divisions due to the LRT project
- Expected Impacts of the proposed project and the future steps to be taken

He also explained the features of Light Rail with some photographs of light rail transit systems in other countries. He also presented the proposed route, stations and depot area using Google Earth.

He further stated that Environmental and Social Impact Assessment and Resettlement Action Plan will be carried out to estimate impacts of the project.

Mr. Yohei Suzuki (JICA study team) joined the discussion and invited everyone to share their views as it will be helpful for the success of the proposed project.

Presentation was ended by showing a video on operation of LRT and the floor was opened for questions, queries and suggestions of the participants.

Raised by	Question raised/Suggestion	Answer/Respond
Mr. Amal Edirisooriya, Divisional Secretariat	The current flyover project in Rajagiriya has acquired lands in the area, Do we need to acquire more lands for this proposed project?	We don't expect to acquire more lands for the LRT project but we will try to accommodate within the available space. Light rail tracks towards Colombo and towards Malabe will be

		constructed separately along the sides of flyover.
Mr. Sirimal Silva (Development Officer)	Will there be road developments around LRT stations parallel to the project? There is a huge traffic congestion from Pagoda Road to Nawala Road during the peak hours. The solution for that would be to build a temporary bridge across Kolonnawa Canal along the Ananda Balika Mawatha. There is a similar temporary bridge constructed in Aththidiya area about 20 years ago and it was helpful to reduce traffic congestion.	Yes, Existing roads will be widened to reduce the impact of traffic congestion after discussions with RDA. Alternative roads will be identified and developed to reduce the traffic congestion during the construction period. Building such a bridge would be cost effective compared to the budget of the proposed LRT project which will cost about 1.4 billion USD.
Ms. R.L.Suneetha (Deputy Director Planning)	Is it a must to award the contract for the construction of LRT system to a Japanese company?	No. it is not a must. We can award the contract for construction to any company selected by the Ministry. But we have to purchase 30% of the construction materials from Japan.
Mr. Dumindu Thushan (Development Officer)	In 2014, JICA conducted a similar consultation programme for the Monorail project. In that programme we suggested to extend the trace beyond Malabe up to Chandrika Kumaratunga Mawatha. I am happy to say that our suggestions were included in the proposed LRT system. I would also like to suggest to consider establishing parking facilities for LRT users at every station. Moreover, I have noticed that about 60% of the road space is occupied by private cars carrying 1 or 2 persons. This is one of the major reason for existing traffic	We will arrange Park and Ride facilities in all stations including at the depot to be established at Chandrika Kumarathunga Mawatha. For the park and ride facilities, We will try to use government lands as much as possible. We do not try to obtain lands belongs to private owners. If owners of private lands are willing to give their lands as an investment, we will consider that too. We have further planned to develop these parking facilities as business ventures with shopping complexes especially in the depot area. Owners of those

	congestion. Introducing a system like car Pooling in Sri Lanka would help to solve this issue. In addition to that a dedicated bus lane should be introduced to systemize the public transport.	agricultural lands could obtain permanent shops from the shopping complexes for their businesses. In addition to that we will introduce a mechanism to make use of the already dedicated bus lanes under transport development project.
Mr. Sajeewa Ekanayake (Development Officer)	Is it possible to introduce an express Light Rail from Malabe to Fort? What is the ticket purchasing mechanism for LRT? What mechanisms would be used to familiarize this system to locals?	We have already planned to introduce an express LRT after every two trains in the peak hours. We are still in the process of studying about that under the feasibility study. The ticket price is not calculated yet. However, we expect to charge 100 – 150 LKR for a single journey from Fort to Malabe. We do not expect to cover the project cost from the ticket price. Only the operation and maintenance cost will be covered through ticket price. Japanese instructors and the engineers will train local LRT staffs for few months.

Mr. Amal Edirisooriya, Divisional Secretariat thanked all the participants for their attendance and their valuable comments and suggestions.

The meeting was adjourned at 12 noon.

List of participants for the Awareness meeting and their contact details are presented below.
(Attachment A)

Attachment A- List of Participants

No.	Name	Designation	DS Division	Contact No
1	Amal Edirisooriya	Divisional Secretary		071-4468524
2	R.L Suneetha	Assistant Director-Planning		011-2883207
3	D.N.Vijitha Kumara	Social Service Officer		071-1732353
4	M Amarasiri Perera	Administrative Grama Niladhari		071-8098655
5	J.A.S Sriyantha Christopher	Samurdhi Development officer	Divisional Secretariat Office	071-9922848
6	M.T Sisira Kumara	Samurdhi Development officer	Pitakotte	033-4900769
7	T.M.P.H Thennakoon	Grama Niladhari	EthulKotte	077-8305410
8	S.M Welege	Grama Niladhari	Welikada North/ Welikada East	078-5126798
9	H.D.C Yamuna Rangani	Grama Niladhari	Rajagiriya	072-3506966
10	N.G. Sarath Mahinda	Samurdhi Development officer	Pitakottte East/ Gangodawila East	071-8123928
11	A.T.S Abegunawardana	Development Officer	Nawala East	077-7793520
12	G.W.G.M.P Abeyrathne	Development Officer		071-8822458
13	K.P Pradeepa	Development Officer		077-5476715
14	A.G Chandanie	Grama Niladhari	EthulKotte West	071-4486561
15	I.H Gamage	Samurdhi Development officer	Divisional Secretariat Office	
16	R.A.D Ashoka	Samurdhi Development officer	EthulKotte West	072-3819986
17	Shironi Dayas Disanayake	Samurdhi Development officer	Nugegoda West/Pagoda East	071-8021043
18	Deepa Himali	Samurdhi Development officer	Gangodawila South/ Gangodawila North	071-4486570
19	D Subhashini Hewage	Samurdhi Development officer	Nawala West	071-1293574
20	P Shyamalee Wasanthimala	Samurdhi Development officer	Rajagiriya/ Welikada North	072-2668964
21	K Ramani Perera	Samurdhi Manager	D.S Office	011-2886624
22	H.A Dammika Kalyani	Development officer	Ethulkotte	071-2439617
23	Udhani Perera	Development officer	Welikada West	077-9947883
24	E.M.S.B Ekanayake	Development officer	Welikada North	071-1855310
25	Rohan Abeywickrama	Development officer	Nugegoda West	077-7873911
26	D Ravindra Lakmal	Samurdhi Development officer	Welikada East	071-8079863
27	K. Sirimal De Silva	Development officer	Ethulkotte West	071-4397322
28	N.D.D Thushara	Development officer	Rajagiriya	071-8783985
29	Shanthi Dissanayake	Agrarian research officer	Pitakotte	071-3253598

30	A Sirimalee	Agrarian research officer	Nawala	071-5352463
31	Chathurika Nishadi Amarasinghe	Samurdhi Development officer	Koswatte	072-9436781
32	Champika Siriwardana	Samurdhi Development officer	Pagoda/ Pitakotte West	071-2829457
33	M.J.P.K Perera	Samurdhi Development officer	Ethulkotte	071-1703910
34	M Jagath Perera	Samurdhi Development officer	Divisional Secretariat Office	
35	A.A.I Priyanthi	Samurdhi Development officer	Divisional Secretariat Office	071-6436962

Attachment B- Photographs

Awareness Meeting on Proposed Light Rail Transit system held at Kaduwela Divisional Secretariat

Venue: Auditorium, Divisional Secretariat, Kaduwela

Date: 14.06.2017

Time: 10.20 am to 11.40am

Participants:

- Mr. Chaminda Ariyadasa – Project Director -LRT Project – Ministry of Megapolis and Western Development
- Mr. R. Pushpakumara – Deputy Project Director -LRT Project-MMWD
- Ms. K. S. Dilhani, Assistant Divisional Secretariat - Kaduwela
- Mr. Anura Ranwala, Team Leader, EIA Team - LRT Project
- Representatives of the Consulting Engineers and Architects Associated (Pvt) Ltd
- Grama Niladharis and Development Officers attached to the Divisional Secretariat, Kaduwela (List of Grama Niladharis and Development Officers participated is given in Attachment A)

Ms. K. S. Dilhani, Assistant Divisional Secretariat of Kaduwela Divisional Secretariat welcomed all the participants for the awareness programme on LRT. She explained the importance of a new public transport system from Malabe to Fort considering the new Administrative city coming in Battaramulla/Malabe area with the new government offices such as Sethsiripaya Stage II and III, Suhurupaya and Sri Lanka Army Headquarters in Akuregoda.

Population in the area will be increased due to these development projects and there is a need for improved transport systems to facilitate public. Assistant Divisional Secretariat invited Mr. Chaminda Ariyadasa, Project Director to explain the proposed project and its importance to the Field officers.

Mr. Ariyadasa explained the need of social and environmental assessment for the proposed LRT Project and the importance of holding consultation meetings with the Development officers and Grama Niladharis to obtain their views and suggestions. He then presented the proposed LRT project with a power point presentation. His presentation included following points;

- Need of an alternative transport mechanism to reduce existing traffic congestion
- Need of a Rail based public transport system like LRT to reduce traffic congestion
- Proposed LRT system and the proposed transport Network in Colombo Megapolis Region
- How the project to be financed
- Reasons for selecting Malabe corridor to implement LRT
- Design concept of LRT system and space requirement for Light Rail structures
- Proposed trace of LRT from Malabe to Kollupitiya and affected GN divisions due to the LRT project
- Expected Impacts of the proposed project and the future steps to be taken

Mr. Ariyadasa's presentation was ended after showing a virtual demonstration of the proposed LRT route from Malabe to Kollupitiya and Participants were invited to state their views on the project and ask for clarifications.

Name and Designation	Question raised / suggestion	Answer / Respond
Mr. W.P.P. Perera Grama Niladhari	How much a LRT ticket will cost from Malabe to Fort?	The ticket price is not calculated yet. However, we expect to charge 100 – 150 LKR for a single journey from Fort to Malabe. We do not expect to cover the project cost from the ticket price. Only the operation and maintenance cost will be covered through ticket price.
Mr. Indika Perera, Grama Niladhari	In the past we removed some of the train engines imported from Japan as the engines could not performed after some time. Will this happen to the LRT engines if we buy them from Japan?	I am not aware about those engines you mentioned. Though the agreement is to purchase 30% of construction materials from Japan we have not yet decided what to purchase from them. However LRT is driven by electricity and does not require an engine.
Mr. M.P. Jayantha, Development Officer	There will be heavy traffic during the construction period of light rail structures. Do you have a Traffic Management mechanism to introduce alternative ways to bypass these routes? It will be helpful for the employees in the battaramulla area. Do we have to hire foreign experts and labour for the Construction and operation of LRT? What is the frequency of those trains? In 2014, there was a similar project proposal called Monorail. They also had some meetings but	Yes, we have planned to develop a traffic management plan with the support of the Police and RDA. We will introduce alternative routes as much as possible. At the moment Transport Engineering Division of University of Moratuwa is studying about possible Traffic management mechanisms. No, We can use local labour force for the construction as much as possible. But we might have to obtain technical expertise from Japan as we do

	the project did not executed. Will the same thing happen to this project?	not have our own experts for this subject. Japanese instructors and the engineers will train local LRT staffs for few months during the operation stage. During peak hours there will be a train for every 4 minutes and in night time trains will be available at 10 min frequency. Monorail system is outdated now and some developed countries have removed their monorail systems. LRT is more cost effective compared to Monorail and it is more suitable for Sri Lanka.
Mr. D.M.W.Uyangoda, Development Officer	Are the proposed stations elevated or underground? The route of the previous Monorail project is same and at that time they said that it will take only about 15 minutes to travel from Malabe to Pettah in the same route.	Elevated. Undergrounding of LRT can be considered generally the high cost is the factor. Elevated railway tracks and platforms are cost effective. Monorail is a more fast technology and the time taken to reach Pettah is lesser may be because it had lesser number of stations planned.

Project Director thanked all the participants for their attendance and their valuable comments and suggestions. He invited them to share their ideas and suggestions with the Project Team via phone and the website that will be launched at the end of June.

The meeting was adjourned at 11.40 am.

List of Grama Niladharis and Development Officers participated for the Awareness meeting and their contact details are presented below. (Attachment A)

Attachment A- List of Participants

No.	Name	Designation	GN Division	Contact No
1	D.D Pathmasiri	Administrative Grama Niladhari	Kaduwela	071-6350112
2	H.M.D Herath	Development Officer	Sri Subhoothipura	071-8353512
3	W.A.D Rangika	-do-	Kaduruwela	070-2402069
4	V.N.T Godamanna	-do-	Avarihena	077-8149512
5	M.P Jayantha	-do-	Arangala, Malabe East	071-7507663
6	D.M.W Uyangoda	-do-	Bategoda	071-2356090
7	D.G.D.C Amarasekara	-do-	Thalangama North A	071-5617828
8	N.W.A.N Hemachandra	-do-	Malabe North	072-3860564
9	P.D Priyanka	-do-	Nawagamuwa South	071-4998754
10	A.B Kushani Lasanjali De Silva	-do-	Kotuwegoda	077-2245483
11	N Priyanga	-do-	Muttettugoda	077-0383585
12	M Lahiru Sanathana	-do-	Wickramasinghepura	071-4036624
13	K.P.S Dilrukshi	-do-	Thunandahena	071-1474079
14	H.A Duleeka Sudarshani	-do-	Boralugoda	072-6666365
15	S.A.P.D Wasanthi	-do-	Talahena South	070-2608994
16	W.M Surangi Priyadarshani	-do-	Walipillawa	076-6178952
17	W.G.D Bandara Manike	-do-	Batapotha	072-5160990
18	G.D Shanika Dilrukshi	-do-	Asiri Uyana	071-7885532
19	H.A Sadhana Priyadarshani	-do-	Walpola	071-6513015
20	V.A.T Lakmali	-do-	Athurugiriya	070-2691945
21	K.G.A.D. Gamage	-do-	Kumaragewatta	071-4487836
22	S.M.T Shyamal	-do-	Shanthalokagama	070-2691947
23	H.A Premani Jeewanthika	-do-	Athurugiriya South	071-9553864
24	U.L.C Priyanthi	-do-	Battaramulla North	071-2886063
25	Upul Senachandra	-do-	Wellangiriya	077-6756232
26	D.A.U.H Wickramaarachchi	-do-	Potuarawa	077-3914497
27	M.D.A Shyamali	-do-	Battaramulla South	077-6214055
28	M.A.S Gamini	-do-	Mahadeniya	071-8269311
29	V.A Surajini	-do-	Embilladeniya	077-1593285
30	G.P Sujith Amalka Piris	-do-	Hokandara North	071-8152502
31	G.D.N.C Garusinghe	-do-	Wekewatta	071-8462785
32	E.B.N.D Wimalasiri	-do-	Hokandara South	070-2691944
33	Chanaka Gamage	-do-	Kothalawala	070-2736105
34	D.G.A.P Kumara	-do-	Aruppitiya	071-5394620
35	Kapila Widanapathirana	-do-	Jayawadanagama	077-6001083
36	U.G Senarathna	Grama Niladhari	Pahala Bomariya	072-7415315
37	R.A.S Premarathna	-do-	Nawagamuwa South	071-3804048
38	A.M.G Jayathissa	-do-	Welipillawa	072-6773270
39	W.S.I Perera	-do-	Muththettugoda	077-9040683
40	B.T.S Cooray	-do-	Walpola	071-8965600
41	A.M Lakmini Nisansala	-do-	Thunandahena	071-8410624
42	W.G.L Deepani	-do-	Mahadeniya	072-5837760
43	I.N Liyanagunawardana	-do-	Battaramulla South	077-2309022
44	A.M.U Ishani	-do-	Thaldiyawa, Boralugoda	072-2186192
45	K.A.G Udeshika	-do-	Awarihena, Vallangiriya	071-9417832
46	K.A.G.S Katuwawala	-do-	Athurugiriya South	077-9481277

No.	Name	Designation	GN Division	Contact No
47	R.A.S Ranaweera	-do-	Thalangama North B	071-9887289
48	D.M.D.B Disanayake	-do-	Asiri Uyana	071-4484438
49	G Somarathna	-do-	Battaramulla North	072-4264202
50	R.A.S Somaratne	-do-	Rajamalwatta	071-9854380
51	M.N Shyamali Amarasingha	-do-	Ihala Bomariya	071-8180471
52	J.D Sunil	-do-	Thalangama North A	078-5119573
53	P Chulitha	-do-	Thalahena North	072-3212364
54	K.W.D.U Kalyanatissa	-do-	Hewagama	075-6587828
55	T Nimal Pathmasiri	-do-	Athurugiriya	072-4034091
56	B.R Renuka Perera	-do-	Pore	078-6951371
57	P.S Vasundara	-do-	Kovathota	072-4883004
58	W.P.P Perera	-do-	Kalapaluwawa	071-6933515

Attachment B- Photographs

Awareness Meeting on Proposed Light Rail Transit system held at Kaduwela Agrarian Centre

Venue: Auditorium, Agrarian Service Centre, Kaduwela

Date: 07.06.2017

Time: 11.00 am to 12.30 pm

Participants:

- Mr. Chaminda Ariyadasa – Project Director -LRT Project – Ministry of Megapolis and Western Development
- Ms. Wanuji Abeywickrama-Transport Engineer-LRT Project
- Representatives of the Consulting Engineers and Architects Associated (Pvt) Ltd
- Agriculture Research and Production Assistants (ARPA) attached to the Agrarian Service Center, Kaduwela (List of ARPA's participated is given in Attachment A)

An officer from the Agrarian Service Center, Kaduwela welcomed all the participants for the awareness programme and invited Mr. Chaminda Ariyadasa, Project Director to explain the proposed project to the Agrarian Officers.

Mr. Ariyadasa explained the importance of holding consultation meetings with ARPA's to obtain their views, suggestions before approaching to the paddy land owners. He then presented about the proposed LRT project with a power point presentation. Following main points were included in his presentation;

- Proposed LRT system and the proposed transport Network in Colombo Megapolis Region
- Reasons for selecting Malabe corridor to implement LRT
- Design concept of LRT system and space requirement for Light Rail structures and Depot Area
- Proposed depot location and tentative depot plan
- Typical functionalities and maintenance activities of the depot area
- Expected Impacts of the depot and LRT project
- Project Schedule and the future steps to be taken
- Opportunities for paddy land owners in Depot area
- Importance of the support from ARPA's in community consultation

Photographs of Light Rail systems in other countries and Light rail depots in Japan was also shown during the presentation.

Mr. Ariyadasa's presentation was ended after showing a virtual demonstration of the proposed LRT route from Malabe to Kollupitiya and Participants were invited to state their views on the project and ask for clarifications.

Name and Designation	Question raised / suggestion	Answer / Respond
Mr. Deeptha Panagoda, ARPA (Malabe West)	The sludge, oil, grease and other waste might get mixed with the waterways in the depot area, when cleaning the trains. Most of these waterways in the depot area lead to the Ambatale (Kelani River), which provides drinking water for the most parts of Colombo. Therefore, special attention needs to be paid during the planning stage of project. This depot will be constructed on columns in a swamp area. Though the swamp will not be filled, the columns might occupy a considerable area from the swamp. This might have an impact on the accumulation of rain water, which may lead to flooding.	We have already planned a proper waste water management system for LRT depot and it was presented here today. Thank you for your valuable feedback regarding that matter. We will consider more reliable mechanisms to dispose waste water properly. This has already been discussed. The plan is to construct columns with 40m span between two columns. Therefore area occupied by columns will be very insignificant. In addition to that, under MCUDP, there will be a new pumping station constructed at Ambatale to pump excess rain water to Kelani River.
Mr. Manjula Prasanna, ARPA (Taldiyawala)	We discussed about the proposed project with farmers earlier and they did not expressed their objections for the project. However, farmers who will release lands for this project should get a reasonable compensation for their lands. At present, one perch in Malabe area worth about 2 million LKR but the government valuation is only 5,000 LKR per perch. This is not reasonable at all. Moreover, the tenant farmers who work in those paddy lands will also lose their income, if these lands are	We are aware of the actual market value of these lands and we will make sure that the owners will be compensated reasonably. We have also made plans to provide compensation for tenant farmers. In addition to that, if anyone has any grievance, they could also share that with the grievance redress committee which will be formed to obtain public concerns. ARPA's can help us to identify such cases and solve those issues.

	acquired for the project. They should also get a compensation for losing their income and the tenancy. When obtaining lands for the project, there should be a proper mechanism to provide compensation for actual owners of lands. In the Outer Circular Highway Project, there are poor farmers who are still litigating to get the allocated compensation for their lands. This should not happen in this project and it is important to make sure that farmers who release their lands will be treated with due recognition.	JICA has its own policies to sort-out such matters. They will not release any grants for the construction until we provide proper compensation for the properties that to be acquired for the project. We will make sure that the land owners will be compensated properly. We might also consider providing special facilities to them to use LRTs, such as free life time passes for them and their immediate family members. In addition to that, the project will facilitate them in having new business opportunities as well as employment opportunities in the depot, for suitable young members of their families.
Mr. Chaminda Thuduhewa, ARPA (Thunandahena)	This depot will be constructed at a swamp where excess rain water in Colombo gets accumulated**.** This area was also flooded twice within the recent past. A flood mitigation plan should be prepared before the implementation of any development project. Earlier there were similar projects carried out in this area by the Ministry of Megapolis and Western Development but we have negative experience working with them. They are not ready to listen to our grievances and nor even respected our concerns. What guarantees that	Flooding is definitely an issue that should be considered and there are few other projects taking place to address this issue. Therefore, we will be able to mitigate flooding in the future. But if we wait till planning a flood mitigation mechanism, we will not be able to carry out any development projects. I cannot agree with this suggestion as an engineer, because climate changes are unpredictable. Projects should not depend on that. I am not aware about other projects carried out by the Ministry and I am not in a

	this project will not treat us in the same way? Do you think that the luxury vehicle owners would like to use LRT? We assume that only the Public who uses the public transport system presently will use this facility.	position to give any comments on that. However, I could assure that I also have personally experienced flooding in this area. Therefore, this project will have a special focus on the environment and social concerns and will listen to public grievances. When people recognize the ease of using LRT and the comfortable facilities available in this system they will start using it. Of course, we will have to develop infrastructure such as park and ride facilities etc. to attract them. It will take some time for people to get used to this system but it will be a great investment for the country.
Ms. Indranie Manike, ARPA (Ihala Bomiriya)	Does the Ministry of Megapolis and Western Development allow to fill swamps for construction projects? There was a housing project planned to construct over a swamp and we objected to that activity.	I am not aware about the particular incidence you mentioned.

Project Director further invited all Agrarian officers to continue their support during the public consultation and requested to ask any clarifications through e-mail and over the phone.

Agriculture Research and Production Assistants agreed to organize a meeting with affected paddy land owners to obtain their views on the implementation of this project.

Mr. Deeptha Panagoda, ARPA (Malabe West) thanked all the participants for their attendance and valuable feedback.

The meeting was adjourned at 12.30 pm.

List of Agriculture Research and Production Assistants participated for the Awareness meeting and their contact details are presented below. (Attachment A)

Attachment A- List of Participants

No.	Name	Designation	GN Division	Contact No
1	K.B Asoka Malkanthi	Agriculture Research and Production Assistant	Hokandara East	071-4487231
2	K.N Darshani	-do-	Pahala Bomiriya	071-9686299
3	D.M.N Sudasinghe	-do-	Hokandara North	011-2412539
4	Bandula Srinath Botheju	-do-	Malabe North	071-8369091
5	G Mallika	-do-	Oruwala	077-5853480
6	S.J.W Prabodhani	-do-	Talangama North	078-3874542
7	Kalum Hettiarchchi	-do-	Dadigamuwa	071-6512865
8	R.A Manjula	-do-	Taldiyawala	071-6364251
9	K.A Rajapakse	-do-	Walpola	072-6112423
10	S.D Kanthie	-do-	Aturugiriya	075-2576948
11	H Vajira Damayanthi	-do-	Welihinda	071-4487054
12	N.L. Indranie Manike	-do-	Ihala Bomariya	071-4487232
13	Chaminda Thuduhena	-do-	Thunandahena	071-7957126
14	Deeptha Panagoda	-do-	Malabe West	071-4487311
15	Sisil Madawalarachchi	-do-	Thorathota	077-6285255
16	K.D.P.Jayampathi	-do-	Batewala	071-4487220
17	W.L.D Upali	-do-	Boralugoda	071-4405022
18	R.A.C Perera	-do-	Nawagamuwa	078-9681677
19	Niranjala Weerasinghe	-do-	Batapotha	070-2214176
20	Suranjith Rohitha	-do-	Raggahawatta	071-6301375
21	N.G Pandula Prabath	-do-	Abilladeniya	071-8024847

22	G.N.D Senanayake	-do-	Battaramulla North	071-4404950
23	Kanthi Priyangika Matharage	-do-	Ranala	071-7031736
24	K.A Dammika Gunasoma	-do-	Wellangiriya	071-8027977
25	M.R Niroshan Dias	-do-	Aruppitiya	071-6369376
26	W.M Malani	-do-	Kaduwela	071-8193214
27	S. Sujeewa Rajaratna	-do-	Athurugiriya	071-4889936
28	M.H Shamsul Luha Amin	-do-	Pore	075-0787611
29	D Bhagya Udayawati	-do-	Thalahena	071-4487061
30	R.H.M.K.A Shantha	-do-	Malabe East	077-7275191

Attachment B- Photographs

Meeting with Paddy land Owners - Kaduwela

An awareness program on the Light Rail Transit (LRT) System in Colombo for affected paddy land owners was held at the Sanasa Development Bank Auditorium in Malabe.

Venue: Auditorium, Sanasa Development Bank Building, Malabe

Date: 01.07.2017

Time: 03.00pm to 04.30pm

Participants:

- Mr. Chaminda Ariyadasa – Project Director -LRT Project(JICA) – Ministry of Megapolis and Western Development
- Ms. Wanuji Abeywickrama – Transport Planning Engineer-LRT Project(JICA)
- Ms. Catherine Diomampo-JICA Study Team
- Mr. Deeptha Panagoda - Agriculture Research and Production Assistant-Malabe West
- Representatives of the Consulting Engineers and Architects Associated (Pvt) Ltd
- Paddy land owners and Tenant farmers of the lands in the proposed depot area
  (List of land owners and tenant farmers participated for the meeting is given in Attachment A)

Mr. Chaminda Ariyadasa, welcomed land owners for the awareness meeting and briefed about the objective of the meeting. He explained the need of holding consultation meetings with general public and affected people to obtain their views, suggestions and support during the feasibility studies.

He then presented a powerpoint presentation about the proposed LRT project. His presentation included following information;

- Proposed LRT system and the proposed transport Network in Colombo Megapolis Region
- Reasons for selecting Malabe corridor to implement LRT
- Need of an alternative transport mechanism to reduce traffic
- Design concept of LRT system and space requirement for Light Rail structures and Depot Area
- Proposed depot location and tentative depot plan
- Typical functionalities and maintenance activities of the depot area
- Expected Impacts of the depot and LRT project
- Project Schedule and the future steps to be taken
- Funding of the Project and the Grant repaying system
- Opportunities for paddy land owners in Depot area

Mr. Ariyadasa's presentation was ended after showing a virtual demonstration of the proposed LRT route from Malabe to Kollupitiya and Participants were invited to state their views on the project and ask for clarifications.

Name and Designation	Question raised / suggestion	Answer / Respond
Mr. Mahinda Arangala	If you construct concrete pillars on the center median of the road for the LRT the available road space will be narrowed.	Size of a concrete pillar will be about 1.5mx1.5m. Existing roads will be widened to reduce the impact of traffic congestion after discussion with RDA. But, It will narrow roads where we could not provide additional space. We might consider making some roads as one way routes as a mean of addressing your concern. Though there might be side issues arising from the project, we should consider this project as addressing a national need.
Mr. K.A. Sunimal Kumara	Is there a station planned for the Battaramulla junction?	Yes, we have planned a station for Battaramulla and it is planned in the Battaramulla-Pannipitiya Road (174).
	Do you plan any parking facilities near that station or any park and ride arrangements? I have a bare land suitable for parking in that area.	We have not planned any parking facilities yet. However, if the landowners are willing to provide free lands for parking, they could approach us with business proposals.
Mr. Arjuna Perera	There was a similar project implemented in the Chandrika Kumarathunga Mawatha to widen the road. For that project we have to sacrifice our lands and we were not properly compensated for that. We were forced to sign for a paper and we didn't received any opportunity to speak. Even the government Agent (GA) could not provide answers for our queries. People who have power and authority obtained compensations but we did not receive anything. We have heard that JICA will not start a project without providing proper compensation for people. Can you confirm this?	Yes, I can confirm that JICA will not start the construction without sorting out the matters related to compensation. This same question was raised during the meeting held at the Agrarian Services Center and I explained the officers about the JICA projects.

	What is the noise impact of this project in the depot area?	There will not be a huge impact from the noise in the depot area as we have already planned mechanisms to control the noise. However in open areas in the rail track there will be a noise. We have started collecting 24 hour noise measurements along the project route. We did baseline noise measurements in Depot area and Malabe boys college for the Malabe area. We will decide appropriate noise control mechanisms during the feasibility studies.
Mr. G.P. Gunadasa	Monorail track was also planned to build through our paddy lands along the Chandrika Kumarathunga Mawatha. For that project they did some geotechnical investigations by drilling the land (Bore Hole). The machinery were running through my paddy field and destroyed the cultivation. I did not compensated for the loss incurred. Therefore, we prefer the intervention of the Agrarian Service Officers for this project.	I could personally guarantee that LRT will not affect your cultivations during the pre-construction period. However, we have already discussed with the Agrarian Service Officers and we will continuously coordinate with them for this project.
	Will you fill the paddy lands?	No, we will not fill the land as it is a flood retention area.
	I have been cultivating 2 Acres of land beyond the proposed depot area. Will that be affected from the waste water of the depot?	No. As I have explained in my presentation, the depot area will be elevated. We have also planned a proper mechanism to remove waste water into tanks and even a single drop of waste water will not be released to the ground. The mechanism will planned with the technical support of the Japanese team.
	Will there be a sufficient gap between the pillars of the depot area? Will these pillars block the sun light that should fall to the ground? What if the water is stagnated without any sunlight and flows to the cultivated lands down the depot area?	There will be gaps between pillars. We are still doing the environment impact assessment and we cannot provide a definite answer for your question yet. But I hope that there will not be such impacts from proposed elevated depot area.

	There is a concern about the proposed depot location. It is a paddy land where we are cultivating. I propose that it would be better if you could change the location where the land is not occupied for agriculture purposes. Moreover, you have said in your presentation that you expect to extend this rail track to the Kaduwela area in the near future. May be you could construct the depot area near Kaduwela somewhere closer to the Expressway.	We have already considered the option that you have suggested. However there are no other suitable locations where we can find the space that we need for the depot area.
Mr. G.P. Piyadasa	Can we cultivate these lands even if the rail road is built above the lands?	If the government and law permits we can consider that. We still cannot confirm anything as we are doing the feasibility studies at the moment.
	How much space do you need for the reservation of the rail track? Will these constructions affect the houses and buildings in the depot area?	We need only 2m per side. Contractors are responsible for damages during the construction period and you will be protected through third party insurance. If your building was damaged you could claim compensation from the Contractors.
	Dust and the sludge of the trains will flows to the ground in rainy season. Will that affect the environment?	There are certain limitations that we should understand. We could manage the waste water in the depot area but we cannot control this situation in the rail tracks. Yes, during the rainy seasons we might not be able to avoid dust and sludge of the trains releasing to the land. But when compared to the current vehicle waste that is being released to the environment this is much lesser.
	What is the plan for sewerage?	Sewerage recycling or a treatment plant might be established. However we are still doing our environmental and social assessment and we can provide a solid answer to this after that study.

Mr. Ariyadasa thanked all the participants for their attendance and valuable feedback. He invited them to share their ideas and suggestions with the Project Team via telephone and the website.

The meeting was adjourned at 4.30 pm.

Attachments

List of participants for the awareness Meeting and their contact details - Attachment A
Photographs of the Meeting - Attachment B

Attachment A

No	Name	Address	Land Name	Landowner / Tenant Farmer	Contact No
1	G P Gunadasa	498/1 Halbarawa, Malabe	Wave Kumbura	Tenant Farmer	077-6909281
2	S D J Jayasiri	340/4 Robert Gunawardhana Mawatha, Malabe	Wave Kumbura	Tenant Farmer	011-2562561
3	K D Somapala	220/1 Thalahena, Malabe		Landowner	011-2790913
4	K D L Renuka	220/1 Thalahena, Malabe		Landowner	011-2790913
5	Mahinda Arangala	390/3,Kaduwela rd, Malabe.	Indigaha Kumbura	Landowner	077-3277961
6	S Pushpakumara Perera	396/5 Robert Gunawardhana Mawatha, Malabe	Delgaha Kumbura	Landowner	077-3746739
7	Chandima Nawagamuwa	389/1 Kaduwela Rd, Malabe	Delgaha Kumbura	Landowner	071-4561935
9	S D Rohitha	339/1 Robert Gunawardhana Mawatha, Malabe	Wave Kumbura	Tenant Farmer	077-7181839
10	Arjuna Perera	39/8 Edwantan Rd	Wave Kumbura	Landowner	071-4743528
11	G Marthelis		Wave Kumbura	Tenant Farmer	071-6372439
12	K A Sunimal Kumara	576 "Sri Kantha", Thalangama Baththaramulla North	Kumbura	Landowner	077-7236914
13	M M Silawathi	139/2/41 Thalahena	Ambarellagaha Kumbura		
14	E T Austin	136A Wanaguru mawatha, Arangala	Nadu Kumbura	Landowner	011-2485064
15	H G Premadasa	905/1/A Udawatta Rd,Malabe	Indigaha Kumbura	Landowner	071-8977412
16	M Nimal Perera	522 Susilarama,Malabe	Thalagaha Kumbura	Landowner	011-5640879
17	G P Piyadasa	164/1 Thalahena, Malabe	Athapaththu Kumbura	Tenant Farmer	077-8462012
18	Vijith Kumara Jayasekara	104/2/A Thalahena,Malabe	Mela Athapaththu Kumbura	Landowner	077-7381471
19	S Jeewandara	35/A Salamulla,Kolonnawa	Veyan pahala Kumbura	Landowner	011-2532699
20	Hariyam Mayadunna	334/2 Robert Gunawardhana Mawatha, Malabe		Tenant Farmer	072-8496784
21	B D Peeter	332 Robert Gunawardhana Mawatha, Malabe	Ambarellagaha Kumbura	Tenant Farmer	011-562634
22	E A Senaratne	33 Robert Gunawardhana Mawatha, Malabe	Veyan pahala Kumbura	Landowner,Tenant Farmer	011-2790327
23	K T Fonseka	871/1 Kaduewela Rd,Malabe	Wave Kumbura	Landowner	076-6055872

Attachment B

Minutes of the Public Engagement Meeting – Sri Jayawardanapura Kotte

Venue: Auditorium, Divisional Secretariat Office, Sri Jayawardanapura Kotte

Date: 11.07.2017

Time 10.00am – 11.10am

Participants:

- Mr. Chaminda Ariyadasa – Project Director -LRT Project – Ministry of Megapolis and Western Development
- Mr. R. Pushpakumara – Deputy Project Director -LRT Project-MMWD
- Mr. Herath- Financial Manager- LRT Project-MMWD
- Mr. Yohei Suzuki-JICA Study Team
- Mr. Amal Edirisooriya – Divisional Secretariat - Sri Jayawardanapura Kotte
- Representatives of the Consulting Engineers and Architects Associated (Pvt) Ltd
- Grama Niladharis and Public from Sri Jayawardanapura Kotte DS Division
  (List of Grama Niladharis and Public participated for the meeting is given in Attachment A)

Mr. Amal Edirisooriya (Divisional Secretariat) welcomed participants for the public engagement meeting and briefed about the objective of the meeting. He invited Project Director to address the public.

Mr. Chaminda Ariyadasa, explained the importance of holding consultation meetings with public in the vicinity of proposed LRT route to obtain their views, suggestions and support.

He started the programme by presenting a computer-generated video about light rail transit and LRT systems around the world. He then presented a power point presentation about the proposed LRT project. His presentation included following information;

1. Proposed LRT system and the proposed transport Network in Colombo Megapolis Reigion
2. Reasons for selecting Malambe Corridor for the project
3. Other planned LRT routes in the island
4. Need of an alternative transport mechanism to reduce traffic
5. Expected Environmental and Social impacts of the LRT project
6. Benefits of a cost effective alternative transport system to Sri Lanka
7. Examples of LRT systems used in other regional countries
8. Design concept of LRT system and space requirement for Light Rail structures
9. Funding of the Project and the Grant repaying system
10. Land acquisition and the route of the proposed project
11. A map with connections of the proposed Malabe LRT route
12. Expected Impact of the proposed project
13. Opportunities available for public
14. Project Schedule and the future steps to be taken
15. Issues that might arise during the construction period and the mitigation measures planned

Mr. Ariyadasa presented a video created for the proposed LRT project which described the use of the new transportation system for the locals.

Questions, queries and suggestions of the participants were answered after the presentation.

Name and Designation	Question raised / suggestion	Answer / Respond
Mr. D.D. Gamini Perera	How long will it take to reach Kollupitiya from Malabe?	Train will stop at 21 stations and it will take 40 minutes to reach Kollupitiya.
Mr. Gamini Kulasinghe	When are you planning to begin this project?	We are still doing the feasibility study and it will hopefully be completed by the end of 2017. The detail designs will be planned after that and it will take about 1 years' time to complete. The project is planned to start its construction in the end of 2019. It will take about 3 years to complete the constructions.
Mr. Fayek	How are you planning to train our local drivers to use these trains?	Japanese instructors will operate these trains for the first 3 months' time. After that Japanese instructors and the engineers will train local LRT staffs for few months.
	Is this a completely elevated route?	Yes, entire rail track will be constructed over the pillars.
	How many seats are there in a compartment?	The capacity of a compartment is about 150. There are several train models with different capacities.
	What is the frequency of these trains?	In peak hours there will be a train in every 4 minutes. This will be increased according to the demand.
	Is this a 24*7 service?	It will depend on the demand. We might stop this service for few hours between mid-night and 4.00 a.m.
	Will you be starting the designs for other proposed 5 LRT projects as well?	That depends on the interest of the funding agencies and public. Though this is a lucrative business opportunity, investors might have to conduct feasibility studies before involve in this project.

Mr. Amal Edirisooriya, Divisional Secretariat thanked all the participants for their attendance and their valuable comments and suggestions.

The meeting was adjourned at 11.10 a.m.

Attachments

List of participants for the Public Engagement Meeting and their contact details	- Attachment A
Photographs of the Meeting	- Attachment B

Attachment A

No	Name	Address	Occupation	Contact No
1	Mrs H D D Y Ranjani	DS Office,514 B,Rajagiriya	Grama Niladhari	072-3506966
2	Mrs A G Chandani	521 A, Ethul Kotte,West	Grama Niladhari	071-4486561
3	Mrs T M P H Thennkoon	521 Ethul Kotte,DS Office	Grama Niladhari	077-8305410
4	Mr.Farook	10/B,Elibank Road,Colombo 05	Executive,MAC Group	077-1973737
5	Mrs Kalani Vithanage	196K,Millenium City,Athurugiriya	Executive, MAC Group	072-2550424
6	Mr Gamini Perera	57/1,Jayaweera Mw,Etulkotte	Retired	071-8323434
7	Mr G Kulasinghe	248/189,Lotos Grove.Hill St ,Dehiwala	Retired Accountant	077-7973389
8	Mr K A Maithripala	215/35,Rajaketha Obeysekarapura	Self Employed	011-2888045
9	Mr S H Welege	DS Office,514 B,Rajagiriya	Grama Niladhari	078-5126798
10	H.A Dammika Kalyani	DS Office,514 B,Rajagiriya	Development officer	071-2439617
11	A Sirimalee	Nawala	Agriarian research officer	071-5352463
12	D Ravindra Lakmal	Welikada East	Samurdhi Development officer	071-8079863
13	H.D.C Yamuna Rangani	DS Office,514 B,Rajagiriya	Grama Niladhari	072-3506966
14	A.T.S Abegunawardana	DS Office,514 B,Rajagiriya	Development Officer	077-7793520

Attachment B

Minutes of the Public Engagement Meeting - Colombo

Venue: Auditorium, Divisional Secretariat Office, Colombo.

Date: 12.07.2017

Time 10.15am – 11.20am

Participants:

- Mr. Chaminda Ariyadasa – Project Director -LRT Project – Ministry of Megapolis and Western Development
- Mr. R. Pushpakumara – Deputy Project Director -LRT Project-MMWD
- Mr. Herath- Financial Manager- LRT Project-MMWD
- Mr. Yohei Suzuki-JICA Study Team
- Representatives of the Consulting Engineers and Architects Associated (Pvt) Ltd
- Grama Niladharis and Public from Kaduwela DS Division
  (List of Grama Niladharis and Public participated for the meeting is given in Attachment A)

Mr. Chaminda Ariyadasa, welcomed participants for the public engagement meeting and briefed about the objective of the meeting. He explained the need of holding consultation meetings with public in the vicinity of the proposed LRT route to obtain their views, suggestions and support.

He started the programme by presenting a computer-generated video about light rail transit systems around the world. He then presented a power point presentation about the proposed LRT project. His presentation included following information;

1. Proposed LRT system and the proposed transport Network in Colombo Megapolis Reigion
2. Reasons for selecting Malabe Corridor for the project
3. Need of an alternative transport mechanism to reduce existing traffic congestion
4. Environmental and Social impacts of the LRT project
5. Benefits of a cost effective alternative transport system to Sri Lanka
6. Examples of LRT systems used in other countries
7. Design concept of LRT system and space requirement for Light Rail structures
8. Funding of the Project and the Grant repaying system
9. Land acquisition and the route of the proposed project
10. Opportunities available for public (Business opportunities, environment protection, job opportunities, compensation for affected)
11. Project Schedule and the future steps to be taken
12. Issues that might arise during the construction period and the mitigation measures planned

Mr. Ariyadasa presented a video created for the proposed LRT project which described the use of the new transportation system for the locals.

Questions, queries and suggestions of the participants were answered after the presentation.

Name and Designation	Question raised / suggestion	Answer / Respond
Ms.K.K.Perera	Is this something similar to tram cars that Sri Lana used to have earlier?	Trams moved on the ground with hanging cables. But this is slightly different than that. The proposed system will be elevated and will not use hanging cables to provide power. Electric power rails will be constructed on the elevated structure running parallel to the rails. (3rd rail option)
	Will this be too expensive?	No. The fares will be slightly higher compared to the current bus fares. However, ticket prices will be affordable for the public. We might consider introducing a Monthly season pass and a special senior citizen pass system.
Mr. S.Nijar	Are you planning to acquire lands for the project from Colombo?	We will be acquiring very limited number of lands and buildings where it is difficult to avoid damaging those. Most of the time the rail track will be constructed on the center median of main road as an elevated structure. We might acquire more space from the pavements to widen the road. We do not hope to acquire private lands for this project. We will be using government facilities as much as possible.
	Is this a loan or a grant?	This is a loan. The interest rate is 0.1% per annum. We are given 40 years' time to repay this and the first 10 years is a concessionary period. Only condition is that we will have to purchase 30% of the construction materials from Japan.
Mr. Zainal Abdeen	How are you planning to charge the fee?	We will introduce an electronic card system so that people can pay through machines located at stations. We will also use a cash payment system at stations to make this easier for the locals.
Ms. Shanthi Mala	Can we get into this train from Maradana?	Yes. It is possible. There will be a station near St. Joseph college and Colombo Fort MMC.
Mr. G.H. Rupasinghe	There were similar discussions organized for similar projects. But they were never implemented. Will the same scenario will happen to this as well?	This is a long term project and we started the feasibility study in the year 2015. It takes lot of time to plan this type of massive project. This costs a similar amount as the Colombo Financial City

		Project. We are still doing the feasibility study and it will hopefully be completed by the end of 2017. The detail designs will be planned after that and it will take about 1 years’ time to complete. The project is planned to start its construction in the end of 2019. It will take about 3 years to complete the constructions.
Mr. Pradeep Hewage	Have you planned any public transport system from stations to the nearby cities for the users of these trains?	Yes. When the project starts, local buses will lose their income as many people will be using this system. We are planning to make use of buses to establish a well-organized shuttle service system from stations.
Mr. Premasiri	Currently it takes 1 hour to travel 20kms in a motor bike in this traffic. Therefore, LRT will be a very useful system for us. But can you guarantee that this project will implement and it will not be ended like the monorail project?	There are many different transportation models in the world and we will only introduce what is best for Sri Lanka. Earlier we thought that monorail is the best but later we understood that LRT will be much usable and practical for local usage.

Mr. Ariyadasa thanked all the participants for their attendance and valuable feedback. He invited them to share their ideas and suggestions with the Project Team via phone and the website.

The meeting was adjourned at 11.20 am.

Attachments

List of participants for the Public Engagement Meeting and their contact details	- Attachment A
Photographs of the Meeting	- Attachment B

Attachment A

No	Name	Address	Occupation	Contact No
1	Mr D N Wickramasinghe	12,Koswala Lane,Colombo 11	-	011-2336268
2	Mrs Liyanage Siriyawathi	155/4,Union Place,Colombo 02	-	011-2335156
3	Mr K K Perera	1/3A,Sooriyamalpura,Kumara Iratuwa,Colombo	-	070-2607364
4	A.R.Chaleen	104/8,Colombo		077-5186086
5	Mr H P C Amarasena	Grama Niladhari Office,Dam Street,Colombo 12	Grama Niladhari Keselwatta	077-8784877
6	Mrs H D T Dilhani	Grama Niladhari Office,Dam Street,Colombo 12	Grama Niladhari Wekanda	072-8730280
7	Mr. P. Lankeshwara	DS Office,Colombo 12		077-8339066
8	Mr H K Premasiri	DS Office,Colombo 12		072-5782305
9	Mrs R A Chamila Sanjeewani	132/10/1/5,Panchikawatta Rd,Maradana,Colombo 10	Self Employed	072-2828305
10	Mrs K Maheshwari	132/10/Q,Panchikawatta Rd,Maradana,Colombo 10	Self Employed	076-6572421
11	Mrs K D Disna Tharangani	132/10,Panchikawatta Rd,Maradana	Self Employed	075-8700742
12	Mr G H Rupasinghe	152/2/1,Panchikawatta Rd,Colombo 10	Mechanic	077-7949218
13	Mr.Saleem	15/3,Sri Swarna Mawatha,Modara		072-2270141
14	Mr T R Dewongso	177/24, Maradana,Colombo 10.		077-5777663
15	Mr B L M Manel	Dam street,Colombo 02	Grama Niladhari	072-1663656
16	Mr S Sasidaran	Dam street,Colombo 02	Grama Niladhari	077-9000986
17	Mr.S.N.Suranji	Dam street,Colombo 02	Grama Niladhari	072-3349404
18	Mr. A.C.M.Mahil	186/6Y Havelock Rd,Colombo 5	Project Coordinator	077-2223030
19	Mr Asanka Perera	86,Kurugala,Padukka	Development Officer	071-8161320
20	Mr.N.K.Alexender	DS Office, Colombo	Development Officer	
21	Mr M A D T Wickramasinghe	DS Office, Colombo	Development Officer	
22	Mr P G T S Gunaratne	DS Office, Colombo	Development Officer	
23	Mrs. Ainul Jarya	22,Dam street,Colombo		071-2868128
24	Mr.S.Manimeeji	67/16 J ,Flowers lane, Dematagoda		075-5967076

25	Mr Indran Mineer	67/46 A,Flowers Lane,Dematagoda Rd, Colombo 9		075-7898395
26	Mr Z M Zainolabdeen	189/62, Dematagoda Road, Colombo 09	Lab/Tech (Pensioner) Assistant	071-8280683
27	Mr S Nishar	97/24,Wajirajana Mawatha, Colombo 09	Businessman	071-9219449
28	Mrs J A S P Kumari	528/79,2nd Lane,Maradana, Colombo 10	Businessman	071-9970792
29	Mrs Shanthi Mala	158/43, Dematagoda Road, Colombo 09	Social Service	071-7156541
30	Mrs M G Anula Piyaseeli	87/23,Maligakanda,Colombo 09	Social Service	071-9412005
31	M M B Hafi	67/108,A.Q.M.L.D. Colombo 09	Self Employed	075-4615461
32	Mr G Balasubramaniam	133/6 Church St,Colombo 02		077-4057229
33	Mrs H R N Priyadarshani	66/5, Wekanda Rd,Colombo 02		077-8276618
34	Mrs Renuka Jayawardhana	B/G/5/ Mihindu Mw,Colombo 12	Businessman	077-4542129

Attachment B






Minutes of the Public Engagement Meeting - Thimbirigasyaya

Venue: Auditorium, Divisional Secretariat Office, Thimbirigasyaya

Date: 12.07.2017

Time: 1.30 p.m-3.00 p.m.

Participants:

- Mr. Chaminda Ariyadasa – Project Director -LRT Project – Ministry of Megapolis and Western Development
- Mr. R. Pushpakumara – Deputy Project Director -LRT Project-MMWD
- Mr. Herath- Financial Manager- LRT Project-MMWD
- Mr. Yohei Suzuki-JICA Study Team
- Representatives of the Consulting Engineers and Architects Associated (Pvt) Ltd
- Grama Niladharis and Public from Kaduwela DS Division
  (List of Grama Niladharis and Public participated for the meeting is given in Attachment A)

Mr. Chaminda Ariyadasa, welcomed participants for the public engagement meeting and briefed about the objective of the meeting. He explained the need of holding consultation meetings with public and land owners along the proposed LRT route to obtain their views, suggestions and support.

He started the programme by presenting a computer-generated video about light rail system and uses around the world. He then presented a powerpoint presentation about the proposed LRT project. His presentation included following information;

1. Proposed LRT system and the proposed transport Network in Colombo Megapolis Reigion
2. Reasons for selecting Malabe Corridor for the project
3. Need of an alternative transport mechanism to reduce existing traffic congestion
4. Environmental and Social impacts of the LRT project
5. Benefits of a cost effective alternative transport system to Sri Lanka
6. Examples of LRT systems used in other countries
7. Design concept of LRT system and space requirement for Light Rail structures
8. Funding of the Project and the Grant repaying system
9. Land acquisition and the route of the proposed project
10. Opportunities available for public (Business opportunities, job opportunities, compensation for affected)
11. Project Schedule and the future steps to be taken
12. Issues that might arise during the construction period and the mitigation measures planned

Mr. Ariyadasa presented a video created for the proposed LRT project which describes the use of the new transportation system for the locals.

Questions, queries and suggestions of the participants were answered after the presentation.

Name and Designation	Question raised / suggestion	Answer / Respond
Mr. M. Indika Tharanga	This project might affect the livelihood of three wheel drivers. Can you consider providing them with an alternative income generating programme?	Yes, we can consider providing them employment opportunities at LRT stations and in the depot if they are qualified. We have already planned to obtain services of local buses for a shuttle service from stations to nearby cities. We can consider similar programme for three wheel drivers as well.
	It is better if you could provide a certificated training for the staffs of the LRT programme.	Yes. We can consider that too. Japanese instructors will be operating these trains for the first 3 months' time. After that our drivers will be given a 3 month on the job training by the Japanese Instructors and Engineers. This can be a certificated training programme.
Mr. Milinda Senanayake	What is the proposed time duration for the project?	We are still doing the feasibility study. It will hopefully be completed by the end of 2017. The detail design will be planned after that and it will take about 1 years' time to complete. The project is planned to start its construction in the end of 2019. It will take about 3 years to complete the constructions.
	How much is the ticket from Malabe to Colombo Fort?	The ticket price is not calculated yet. However, we expect to charge 100 – 150 LKR for a single journey from Fort to Malabe. We do not expect to cover the project cost from the ticket price. Only the operation and maintenance cost will be covered through ticket price. Currently it will cost about 800 LKR to travel Colombo by a three wheel from Malabe. This train will cost lesser for the same distance and it will have comfortable AC compartments too.
	Is there a way to reduce the proposed travel duration from Malabe to Colombo?	Yes, we are planning to introduce an express train during the peak hours which will stop at limited number of stations.
	How many can travel in one compartment?	The capacity of a compartment is about 150. There are several train models with different capacities. We will select an appropriate model based on the demand.

	Is this proposed project cost covers compensations as well?	No. Compensations will be calculated separately.
	If this is a 100% elevated structure, have you planned emergency exits?	Yes, in every station there will be an emergency exit. In addition to that we will always have an emergency train ready.
	What is the frequency of these trains?	There will be a train every 4 minutes in peak hours and this will be increased according to the demand.
	Why did you decided that this will be an elevated route?	We cannot use electric power system on the ground for these trains. If we use electric cables hanging over the trains it would have been impacted the land scape of the city. Therefore, we decided to build an elevated rail track with an electric power system that runs parallel to the rails (3rd rail option). In addition to that, if we built this on the ground we will need more radius when taking bends. Elevated track is more practical when considering the difficulties, in acquiring lands.
Mr. Amila Perera	What is the process for land acquisition?	We have applied for cabinet approval for a LARC and superLARC for this project (showed the draft Cabinet Paper at the meeting). If we get the approval people will be benefitted. We hope to provide market values for the acquired lands.
	Currently there is a land acquisition taking place in Kollupitiya junction where this project has also planned to start. At the moment, we have filed a court case against that project as we are not properly compensated by the UDA. If you give us a reasonable compensation for our lands we will gladly give them for this project. What is your stand on this?	I am not aware about the other project or the land acquisition issue in Kollupitiya area until now. However, we will compensate according to the market value of the land if we are to acquire them. If the LARC and the super LARC is established people will be more benefitted.
Mr. Alfred Sampath	Before planning this project have you obtain views of the SLTB, private bus unions and the Railway department? This new project will definitely impact those services. If you have not discussed this with them before the project implementation, there will be problems in the future. That affects us as a country as this will be a loan	We have a steering committee with 34 member organizations. (showed the list of steering committee members at the meeting) Our first meeting will be held on 18th July. We will also form small groups with these members to address specific issues arising from the project.

	and we will be paying for it later whether we use this system or not.	
Mr. Tissa Gonagala	Will you be obtaining lands along Cotta Road? I am specifically asking this question because I have economic ventures in Cotta Road where you have planned the project.	No. At the moment there is no reason to acquire lands along the Cotta Road. We believe that we can manage within the available right of way. Sometimes we might obtain space from the pavement if we feel that the width of the road is not sufficient for vehicles after construction of pillars. However, this can be confirmed only after the completion of the feasibility study.

Mr. Ariyadasa thanked all the participants for their attendance and valuable feedback. He invited them to share their ideas and suggestions with the Project Team via telephone and the website.

The meeting was adjourned at 3.00pm.

Attachments

List of participants for the Public Engagement Meeting and their contact details	- Attachment A
Photographs of the Meeting	- Attachment B

Attachment A

No	Name	Address	Occupation	Contact No
1	Dr. A Edward	87/2/1 ,St Anthonys Mawatha,Kollupitiya,Colombo 03	President of Civil Defence Committee-Kollupitiya	072-4445464
2	Mrs Shyama Liyanage	Muhandiram Rd,Colombo 03	Samurdhi development officer	011-2386532
3	Mrs K W Iresha Udeni	12,Ruhunukala Mw,Colombo 08	Grama Niladhari-Borella South	071-8265668
4	Mr Indika Tharanga	70/5/2 Rodni Street,Borella	Community Leader	078-7777881
5	Mr Thissa Gonagala	66/9,Base Line Rd,Borella,Colombo 08	District Community Leader	071-3109584
6	Mr W K Amila Perera	32/C,Drapers hill,Kollupitiya,Colombo 03	Former Member of Colombo Municipal council	077-7886839
7	Mr R Chandrakumar	72/5/B Sri Darmakeerthirama Rd, Colombo 03		-
8	Mr C J B Ekanayake	Kollupitiya	Grama Niladhari	071-6236328
9	Mrs Malkanthi Perera	77/24,Casal Street,Borella	-	072-4378432
10	Mrs M Lalitha	77/40,Casal Street,Borella	-	072-2766842
11	Mr Milinda Senanayake	F-56, Government Flats, St. Anthony Mw, Kollupitiya	Architect	077-3580160
12	Mr H G A Sisira Kumara	F-39,Government Flats, St.Anthony Mawatha, Kollupitiya	-	071-6390468
13	Mr N T Amarasinghe	DS Office Thibirigasyaya	Development Officer	071-3940131
14	Mr Y P S Ranasinghe	DS Office Thibirigasyaya	Development Officer	071-5558922
15	Mrs H D D Vishaka	DS Office Thibirigasyaya	Development Officer - Kollupitiya	077-0657299
16	Mrs V A Manel Damayanthi Botheju	651/37 Ranveli Udyanaya,Alpitigala Mw,Colombo 05	Retired Teacher	011-2368620
17	Mr J M Kularathne	23N1/4,	Retired	077-3122038
18	Mr D B Malani De Silva	330/T/1/4,Borella	Retired	077-4177264
19	Mr Priyantha Hettiarachchi	1000/6/4 ,Wattala	Director & Architect	071-8893879
20	Mr Deshabandu Botheju	151/19 Dr NM Perera Mawatha,Borella	Priest-Sri Gambara Sidda Sunium Dewalaya	077-5220867
21	Mr Alfred Sampath	24/60,Gothamipura,Borella	Community Leader/Justice of Peace	071-0194170
22	Mrs K T Thushari Gunawardhana	DS Office ,Thibirigasyaya	Samurdhi development officer	071-1462407
23	Mrs W D Chamari	Borella North	President-Samurdhi	077-6168326

	Gunatilake			
24	Mrs K N G Sriyani	237/1,Ward Place	Community Leader	011-2678766
25	Mr S Jayasanka	8/3 Cameron Place,Colombo 3,Kollupitiya	Community Leader	071-5209696
26	H.S.Wanasi	80,Dematagoda		011-2682575
27	Mrs Nandani Gamage	D 2/9,Saranapala Mw,Borella	Self Employed	072-6533538
28	Mr K N Jayasiri	Kurunduwatta	Grama Niladhari	078-5298527
29	Malinga Perera	St.Anthony Mawatha, Kollupitiya	Presidents Citizens Industrial Program-Working Project Member	078-3259770

Attachment B

Minutes of the Public Consultation Meeting - Kaduwela

Venue: Auditorium, Divisional Secretariat Office, Kaduwela.

Date: 18.07.2017

Time 10.30am – 12.00pm

Participants:

- Mr. Chaminda Ariyadasa – Project Director -LRT Project – Ministry of Megapolis and Western Development
- Mr. R. Pushpakumara – Deputy Project Director -LRT Project-MMWD
- Mr. Herath- Financial Manager- LRT Project-MMWD
- Mr. Yohei Suzuki-JICA Study Team
- Mr. D.D.Pathmasiri-Administrative Grama Niladhari- Kaduwela DS
- Representatives of the Consulting Engineers and Architects Associated (Pvt) Ltd
- Grama Niladharis and Public from Kaduwela DS Division
  (List of Grama Niladharis and Public participated for the meeting is given in Attachment A)

Mr.D.D. Pathmasiri welcomed participants for the public engagement meeting and briefed about the objective of the meeting. He invited Project Team to address the public.

Mr. Chaminda Ariyadasa, explained the importance of holding consultation meetings with public and land owners along the proposed LRT route to obtain their views, suggestions and support.

He started the programme by presenting a computer-generated video about light rail transit and LRT systems around the world. He then presented a power point presentation about the proposed LRT project. His presentation included following information;

1. Proposed LRT system and the proposed transport Network in Colombo Megapolis Reigion
2. Reasons for selecting Malabe Corridor for the project
3. Need of an alternative transport mechanism to reduce existing traffic congestion
4. Environmental and Social impacts of the LRT project
5. Benefits of a cost effective alternative transport system to Sri Lanka
6. Examples of LRT systems used in other countries
7. Design concept of LRT system and space requirement for Light Rail structures
8. Funding of the Project and the Grant repaying system
9. Land acquisition and the route of the proposed project
10. Opportunities available for public (Business opportunities, job opportunities, compensation for affected)
11. Project Schedule and the future steps to be taken
12. Issues that might arise during the construction period and the mitigation measures planned

Presentation was ended by showing a video on operation of LRT and the floor was opened for questions, queries and suggestions of the participants.

Raised by	Question raised / suggestion	Answer / Respond
Mr. T.A.S. Thilakarathne	What is the ticket price from Malabe to Colpetty?	Currently it will cost about 100-150 LKR to travel Colpetty from Malabe by a motor cycle. We planned to charge a similar amount for the ticket of LRT. But this will be a more comfortable and convenient. We do not expect to cover the project cost from the ticket price. Only the operation and maintenance cost will be covered through ticket price.
Mr. Thissa Yapa	Does this rail route goes through the Buthgamuwa and how this will be built near the Water's Edge?	No. The proposed route will not go through Buthgamuwa. Rail track will be built on the pillars above Diyawanna lake and Diyatha uyana.
	Have you planned a station at Rajagiriya?	Yes, proposed station will be built near the HSBC building at Rajagiriya. However the exact location is not yet confirmed.
Mr. Nuwan Kumarathunga	There will be huge traffic congestion during the construction period. Will there be road developments around LRT stations parallel to the project?	Existing roads will be widened to reduce the impact of traffic congestion after discussion with RDA. Alternative roads will be identified and developed to reduce the traffic congestion during the construction period.
	Will you be providing any opportunities for the local people in the Kaduwela Division to involve in this project?	We need to hire international contractors since local contractors are not familiar with LRT construction technology. But we expect to provide opportunities for local labour force to work in these project sites.
	Will you be extending this to Katunayake area?	We have a plan but it will not be implemented soon. We need more time to attract investors for this kind of projects. The initial LRT track will be constructed between Malabe and Colpetty with the financial support of JICA.
	How much is the interest rate for the JICA loan?	It is 0.1% per annum. This is a very low interest rate compared to the other similar loans provided by the World Bank and the Chinese Government.
	Do you have a plan to use solar power system for these trains? We cannot rely on the Sri Lankan Electricity Board's service to	We have not planned to use solar power but we will have two backup systems to provide power at emergency situations.

	provide electricity without any failures.	
	Will you be providing an insurance for the public who uses these trains? It is available in other countries.	No. we have not yet considered providing such facility.
Mr. Mervin Shrilantha	Do you have any plans to reduce the number of private vehicles coming to the city after the implementation of this project?	That will depend on the attraction of the public to this new transport system. If the system is comfortable people will use it often. Government has not yet planned to limit the number of private vehicles that enters the city.
Mr. E.A. Jagath Kumara (0777375300)	I have a 4 storey building in the Battaramulla Junction. According to the proposed route plan it will be affected completely. I have a bare land and another building next to that. It was bought very recently. 1 perch is worth more than 5 million in that area.	You will be compensated properly. We are introducing LARC and Super LARC processes for such grievances. We will be in touch with you to discuss about that further.
Mr. P.K.S. Perera	What is the plan for the LRT route in the Talangama EPA area? From where are you planning to enter and leave this zone?	We will enter from a location near the Central Environmental Authority and will join the Battaramulla-Kaduwela road (B263) at a location near the Laughs Gas Station.
Ms. Ranjanie Weerasinghe	We have a paddy land near the 8th Mile Post (Near Koswatte Junction). Will that be damaged?	The exact route is not yet confirmed. You will be compensated for the damage if it is affected. However, We will not completely fill the paddy land. The LRT structure will be constructed on the concrete pillars. That will not affect any activities in the paddy area except the space that will be occupied by the pillars.
Mr. M.K. Kariyawasam	How long will it take to complete this project?	This is a long term project and we started the feasibility study in the year 2014. It takes lot of time to plan this type of massive project. The cost of the project is similar to the Port City Project. We are still in the feasibility study. It will hopefully be completed by the end of 2017. The detail design will be planned after that and it will take about 1 years' time to complete. The project is planned to start its construction in the end of 2019. It will more than 3 years to complete the constructions.

Mr. D.G.P. Kumara	Are you planning to establish park and ride facilities at every station?	We cannot confirm that yet. If private investors are interested to provide their lands we can consider providing that facilities.
Mr. S. Wickramasinghe	Will proposed LRT be stopped if the Government change?	I don't think this will be stopped. We are carrying out this project according to a long term plan. Change of government will not affect the project.

Mr. Ariyadasa thanked all the participants for their attendance and valuable feedback. He invited them to share their ideas and suggestions with the Project Team via telephone and the website.

The meeting was adjourned at 12.00pm.

Attachments

List of participants for the Public Consultation Meeting and their contact details	- Attachment A
Photographs of the Meeting	- Attachment B

Attachment A

No	Name	Address	Occupation	Contact No
1	Mr U.H Karunadasa	No 38/3, Battaramulla	-	077-8973335
2	Mr G H S Garusinghe	352 B, Thalangama South,Battaramulla	-	071-6350063
3	Mrs Ranjani Weerasinghe	No 227,Robert Gunawardhana Mw,Batapotha,Battaramulla	-	071-0616121
4	Mrs H A Pushpalatha Perera		-	077-6593479
5	Mrs K Hemawathi Perera	126,Ruhunupura,Thalangama South,Battaramulla	-	011-2073693
6	Mrs H A Priyani Pushpakanthi	28/4,Heenati Kumbura,Thalangama North	-	077-1526111
7	Mr S Wickramasinghe	292/B Thalangama North	-	077-5422202
8	Mr P K S Perera	368/2,Koswatta,Thalangama	-	071-8175649
9	Mr T G G Darmasena	343/4,Ekamuthu Mw, Thalangama North	-	071-0181347
10	Mr S A Chandrasena	289/4,Gamunu Mw,Kotuwegoda,Rajagiriya	Retired	011-2869958
11	Mr G K Darmasena	1166/4,Damwodaya Mw	Retired	011-2885545
12	Mr Kapila Yatiwala	776,Waruna Awesi,Malabe		011-2560330
13	Mr B Darmadasa	757/4,Thalangama North,Malabe	Retired	071-7247520
14	Mr T A Shantha Thilakarathna	767/6,Millagahawatta Rd,Thalangama North,Malabe	Retired	071-8174726
15	Mr H G Premadasa	905/1 A Udawatta Rd,Malabe		071-8977412
16	Mr Chandra Rathnayaka	108/1 Heenati Kumbura,Thalangama North		071-8977412
17	Mr M L M Vijethilaka	No 52,Vimukthi Mw,Palawatta,Thalangama South		077-7471003
18	Mr A W W Abesinghe	No 52,Vimukthi Mw,Palawatta,Thalangama South	Businessman	077-7350340
19	Mr D Nigsaya	292,Kotuwegoda,Rajagiriya	-	071-4695613
20	Mr H W Kaldera	112,Kotuwegoda,Rajagiriya	-	077-5118050
21	Mr K G Chandrawathi	630/B Aruppitiya,Thalangama South	-	077-9809016
22	Mr P N Priyanthi	633/A/1/4 Aruppitiya	-	071-9338027
23	Mr W S I Perera	Divisional Secretariat	Grama Niladhari 477/B	077-9040683
24	Mr J D Sunil	292/B,Samagi Mw,Thalangama North,Battaramulla	Grama Niladhari 477 Thalangama North	078-5119573
25	Mr A R Layanal	320,Kaduwela Rd,Malabe	Retired	072-4035728

26	Mrs S A P D Wasanthi	478/A,Thalahena South	Development Officer 478/A Thalahena South	070-2608994
27	Mrs. Sinnamma	T/101/3/1 Kotumeda,Udayakumar,Rajagiriya	-	077-2821221
28	S. Jasica	T 119/3/2 Kotumeda,Rajagiriya	labor	077-4281129
29	Mr Udayakumar	T 119/3/1 Kotumeda,Rajagiriya	-	077-2821221
30	Mrs Thangaswari	T 119/2 Kotumeda,Rajagiriya	-	076-7315734
31	Mr P Chulitha	-	-	-
32	Mr Piyadasa Vithanage	743/28 4th Lane,Muwangelawatta,Malabe	Retired	011-2789071
33	Mr O L Perera	204/4 Kotuwegoda,Rajagiriya	labor	
34	L B Karandawela	749/4 Swarna ,Thalangama North,Malabe	Retired	071-6587091
35	A.G.T.Gamwara	673/R "Sewwandi",Kaduwela,Battaramulla	Retired	071-2769978
36	Mr Lesli Kadanaarachchi	358,Thalangama,North	Businessman	077-7155784
37	Mr Darmasiri Kaldera	75,Heenati Kumbura	-	071-8867990
38	Mr Nuwan Kumarathunga	393/18 Dutugamunu Mawatha,Thalangama	Businessman	077-4321552
39	Mrs Manori Chandima Pieris	289/1,Samagi Mawatha,Thalangama North	-	078-6936478
40	Mr A W M B Vijekoon	852/44,Susithapura,Malabe	Retired	011-2561015
41	Mr Shelton Gunasekara	852/10/C Susithapura,Malabe		077-7070342
42	Mr S M Lal Gunasiri	868/2 Malabe		
43	Mr R A S Ranaveera	477 A,Thalangama,North B	Grama Niladhari	071-9887289
44	Mr E A Jagath Kumar	194,Main St,Battaramulla	Businessman	077-7375302
45	Mr S W Hirimuthugoda	279,Kaduwela Rd,Battaramulla	-	071-7001066
46	Mr J Ranasinghe	249/1,Kaduwela Rd,Battaramulla		077-4747170
47	Mr Jayasundara		Retired	011-2879111
48	H.N.S.D.Kaldera	No 141,Main St,Battaramulla	Proprietor	077-4957115
49	W. Jason Perera	671/1 Subodhi Mawatha,Battaramulla	Retired	071-3887905
50	M.K.Kariyawasam	654/5A,2nd lane, Thalangama North, Battaramulla	AIA	077-3296986
51	Mr K A K Perera	743/65,4th Lane, Muwangela watta,Malabe	Retired	071-4468049
52	Mrs Sriyani Liyanage	346/32,Wedagewatta Rd,Kotuwegoda,Rajagiriya		072-4064074
53	Mrs U P Chandrani	Divisional Secretariat Malabe	Manager Assistant	071-4556906
54	Mr P S Veerasekara	No 31,Thalangama South, Palawatta	-	076-6751459

55	Mr B Nawaratne	Divisional Secretariat Kaduwela		077-1389611
56	Mr D N A P kumara	Divisional Secretariat Kaduwela	Development Officer	071-5394620
57	Mr M Lahiru Sanathana	Divisional Secretariat Kaduwela	Development Officer	071-4036624
58	Mr N S Jayasinghe	491/B,kotuwegoda	Grama Niladhari	077-7197546
59	Mahin Srimantha		Architect	077-6169618
60	Mrs W D Indrani	479/F,Aruppitiya	Grama Niladhari	077-4232425
61	Mr P K Sisira Indralal Perera	368/2,Koswatta,Thalangama North,Battaramulla	Grama Niladhari	071-8012199
62	Mr C K Mayadunna	75/1 Mailangama Rd,Athurugiriya	Grama Niladhari 479/E Batapotha	072-9574575
63	Mr G Somaratne	217/E Pattiyawatta Rd,		072-4264202
64	Mr D M D B Disanayake	221/1,	Grama Niladhari 479/B Asiri uyana	071-4484438
65	Mr W A Aruna Shantha	337/4,Hokandara South	Grama Niladhari 476/A Malabe	072-3536312
66	Mr Balasooriya			011-2760877
67	Mr H M M G A Herath	145/3/C ,Thalahena,Malabe	Development Officer	077-2314473
68	Mrs Latha	673K,6/1,5th Lane,Nandawatta		072-3593212
69	Mr P Chulitha	478,Thalahena,North	Grama Niladhari	072-3212364

Attachment B

Colombo Light Rail Transit (LRT) Project – 31.08.2017

Minutes of the Meeting with Affected Business Owners due to the proposed LRT Project

Venue: 18th floor "Suhurupaya", Sri Subuthi Road, Baththaramulla, Sri Lanka.

Date: 31st August 2017

Time: 2.30 pm – 4.30 pm

Organized by: Ministry of Mega polis and Western Development

Participants:

- List of invitees – according to the proposed light rail trace around 40 – 50 structures may be affected. Most of them have not participated in the public engagement meetings, organized at the Divisional Secretariats. Before the commencement of Survey for RAP it is very important to increase awareness regarding the project activities and the impacts it will cause. PMU decided to contact the people who may be directly affected by the project. There were 18 people, who participated in the meeting. (Refer to Attachment A)
- Eng. Chaminda Ariyadasa, Project Director, Light Rail Transit (LRT), Mr. R. Pushpakumara – Deputy Project Director -LRT Project Mrs Irine and Representatives of the Consulting Engineers and Architects Associated (Pvt) Ltd were participated.

Eng. Chaminda Ariyadasa (Project Director – Light Rail Transit Project) welcomed all participants for the meeting. Project Director then made the Opening Remarks regarding information disclosure followed by a power point presentation about the LRT. His speech included following topics:

- The Megapolis Transport Master Plan foresees a significant increase in transport demand in Colombo and its suburbs. The government has proposed a transport network, composed of a rapid transit system within Central Business District (CBD) that is intended to operate seven (7) main lines covering a length of approximately 75 km.

- The LRT project will initially consist of approximately 21-km elevated railway structure that will connect Colombo with the Malabe suburb. The road corridors covered by the proposed LRT route have been identified as the most congested in the Colombo Metropolitan Region. The proposed LRT will have a capacity of 30,000 passengers per hour per direction and will cover the distance in 25 minutes, rather than one and a half hours by road today. The LRT will complement other modes of transport.

- The LRT will be operated through a public-private partnership and will have five more lines which will be ready to be advertised in parallel with the Japan International Co-operation Agency (JICA) feasibility study. Japan will provide a US$1.25 billion soft loan to fund the LRT.

After the tea break, all members were welcome to express their perspectives on the project and ask for clarifications.

Details of Discussions

Name and Designation	Question raised / suggestion	Answer / Respond
Mr. Y. A. Palliyaguruge, Deputy Manager, Perera & Sons	What is the extent of the possible damage to the Perera & sons buildings?	The building (Perera & Sons) situated at Kollupitiya junction will be totally affected. According to the CAD drawings the fully affected area would be around 601.57 m^2
Mr. T.M. Marzook, Manager, Noritake	Through CAD drawings show the extent of the possible damage to the building (Noritake)?	This building(Noritake) would be fully damaged and according to the CAD drawings the extent will be around 557.85 m^2
	Will it be possible to cause only half the building?	Can't give a direct answer as it might affect the structure/foundation of the building.
	Show how the columns/curves run over the building	The design team is still in the process of identifying the exact areas that the columns/curves would run. This will take another 2 months' time. If the curvature radius is reduced below 100, engineering will be more difficult and costs will be higher.
Mr. S. L. Niles, Director, Regal Theater	What is the extent of the possible damage to the building of Regal cinema?	Building won't be damaged but the parking area will be partially affected.
Mr. Yasas Rajapakse, Representative, Peoples' Bank	What is the extent of the possible damage to the building owned by CGR situated at Bastiam Mawatha? The Peoples Bank Branch is functioning at the building.	This particular building will be totally affected. However, there is another project going on related to the development of the port city by the Ministry of Megapolis and Western Development. Therefore, there is a possibility of this building being highly affected through either of these projects.
Mr. Manjula Senevirathna, Manager, Burger King	What are the possible damages to the building of Burger King? (Slave Island Junction) We are willing to support towards this project.	This building (Burger King) will be totally affected due to the bend and even the station will be located closer to this building.
Dr.I.V.P Dharmawardena (CMC)	Is there any income restoration program to be introduced? There are around 250 traders are doing their business activities inside the Boralla Super Market. The super Market is owned by the CMC. There may be an issue with the traders/vendors.	Yes, The Income restoration program will be included the compensation package.

Mr. Senake Amarasinghe, Chairman & Mr. Yasendra Amarasinghe, CEO, Carmart (pvt) Ltd. (Peugot & Mazda)	What is the extent of the possible damage to the building own by the Car Mart at Ibbanwala Junction?	This building will be partially affected.
	Other than for Peugeot car sale,(Car Mart) Mazda car sale (adjacent Car Mart) too belongs to us. Therefore, let us know the total area that will be affected?	According to the available drawings a total area of $119.46m^2$ will be affected.
	Show how the columns/curves run over the building	We are still in the process of identifying the exact areas that the columns/curves would run. This will take another 2 months' time.
	How about the height of the columns?	Column lay out also has not been finalized. Column height would be 6 m.
	What is the procedure for the compensation or how are the estimations to be done?	GOSL has given approval to pay the compensation, according to the LARC & Super LARC policies & regulations. Further Mrs. Irene explained (Acquisition Officer attached to the PMU) that the process of the acquisition procedure. Most probably value of the lands will be estimated according to the current Market Value. If the estimated amount of money is not sufficient for their properties acquired by the project, they can appeal for more compensation. The relevant Divisional Secretariats and the Project office will consider these grievances together.
	When is the construction activities are planned to commence?	It will be commenced in 2019. However, compensations will be paid before the commencement of the construction activities and hoping to complete the project by the end of 2023.

Attachment A- List of Participants

No	Name	Address	Contact No	Designation
01	Dr.I.V.P Dharmawardena	Colombo Municipal Council, C W W Kannangara Mawatha, Colombo 07.	0718021299	Chief Municipal Veterinary (Surgeon)
02	Eng.D.C.W. Vithanaarachchi	Colombo Municipal Council, C W W Kannangara Mawatha, Colombo 07.	0777313248	Traffic Engineer
03	Eng.Manjula Karunaratna	Colombo Municipal Council, C W W Kannangara Mawatha, Colombo 07.	0771093127	Traffic Engineer
04	Mr. S. C. Niles	Regal Cinema, Sir Chittampalam A Gardiner Mawatha, Colombo 02	0777726222	Director- Regal Cinema,
05	Ms. Hemali Ekanayake	Regal Cinema, Sir Chittampalam A Gardiner Mawatha, Colombo 02	0112432936	Representative- Regal Cinema,
06	Mr. Lal Perera	Lake House - Associated Newspapers of Ceylon Limited, 35 AC6, Colombo	0766884086	DGM - Associated Newspapers of Ceylon Limited
07	Mr. Amal Lokumana	Lak Viru Sevana, No. 1106, Palamthuna Junction, Major General Denzil Kobbekaduwa Road , Battaramulla	0112889899 0112691865	Representative- Lak Viru Sevana,(on behalf of Elle Gunawansa Thero)
08	Ms. ChampaGamage	People's Bank, No. 185, George R De Silva Mawatha, Colombo 13	0112344984 0112344985	Regional Manager- People's Bank,
09	Mrs. S. K. Kaatuwarachchi	People's Bank Head Office, No. 75, Sir Chittampalam A Gardiner Mawatha, Colombo 02	0777811250	
10	Mr. T. M. Marzook	Noritake City Store, No. 77 SrimathAnagarikaDharmapalaMawatha, Colombo 07	0114938932	Manager- Noritake City Store,
11	Mr. Manjula Seneviratna	Burger King, Slave Island, Colombo 02	0715596316	Manager
12	Mr. Yasendra Amarasinghe	Carmart Limited, No. 424 Union Place Colombo 2	0765500600	CEO
13	Mr. Senake Amarasinghe	Carmart Limited, No. 424 Union Place Colombo 2	0777366329	Chairman
14	Mr. S. A. P. Amarasekara	No. 04, Main Street, Baththaramulla	0777391340	Manager- Amerasekara Pawning
15	Mr. E. A. Jagath	No. 194, Main Street, Baththaramulla	0777375300	Owner
16	Mr. Yasas Rajapakse	People's Bank Head Office, No. 75, Sir Chittampalam A Gardiner Mawatha, Colombo 02	0773520198	Engineer
17	Mr. Y. A. Palliyaguruge	Perera & Sons (Bakers) Ltd, No. 122-124, M. D. H. Jayawardana Mawatha Madinagoda Rajagiriya	0777762934	Deputy Manager

Attachment B- Photographs

Ministry of Megapolis and Western Development (MMWD)

New Light Rail Transit System from Kollupitiya to Malabe

Minutes of EPA Stakeholder Meeting

Date:	6th September 2017 from 2:20PM-4:30PM
Venue:	11th Floor, Sethsiripaya Stage II, Battaramaulla
Organized by:	Ministry of Megapolis and Western Development

Participants:

- Mr. Chaminda Ariyadasa – Project Director -LRT(JICA)– MMWD
- Mr. Vinasithamby Ravi – Environmental Specialist -LRT(JICA)
- Mr. Anura Ranwala – Team leader(EIA) - CEAA
- Dr. Dewaka Weerakon – Ecologist(EIA) - CEAA
- Ms. Catherine Diomampo – Consultant- JICA Study Team
- Mr. Deshan Gamage – Project Coordinator – CEAA
- Mr. E. Percy Perera – Talangama farmer Organization
- Ms. Piyumi Kalyanawansha- Assistant Manager(Investigations) – Environmental Foundation Limited
- Mr. Ranjan Karunanayaka – Co-ordinator-Centre for Environmental Justice

Speeches & Presentations:

Eng. Chaminda Ariyadasa, Project Director–LRT(JICA) welcomed all participants for the EPA stakeholder meeting. Project Director then made the Opening Remarks with a brief introduction about the LRT project and explain the objective of the meeting.

Mr. Ariyadasa explained the need of Environmental Impact Assessment for the proposed LRT Project and the importance of holding meetings with the stakeholders to obtain their views and suggestions. He then presented the proposed LRT project with a power point presentation. His presentation included following points;

- Need of an alternative transport mechanism to reduce existing traffic congestion
- Need of a Rail based public transport system like LRT to reduce traffic congestion
- Proposed LRT system and the proposed transport Network in Colombo Megapolis Region
- Reasons for selecting Malabe corridor to implement LRT
- Design concept of LRT system and space requirement for Light Rail structures
- Three Optional routes through the EPA, bordering the EPA and through Koswatta junction (Out of the EPA)
- Pros and Cons of each alternative route
- Expected Impacts during the construction and operational stage
- Details of mitigation measures and conservative steps

Mr. Ariyadasa's presentation was ended after showing a video on Proposed LRT system. Participants were invited to state their concerns.

Details of Discussions

Table 01: *Comments and Questions by Participants of Talangama EPA Stakeholder Meeting-06th September 2017*

Raised by	Comments and/ or Questions	Answered by	Answer
Mr Percy Perera	- Are there any land fillings during the construction stage? If it runs above the ground there won't be a considerable issue to the EPA.	Mr. Chaminda Ariyadasa (PD)	- All the impacts to the environment will be rectified. There will be some temporary land fillings when preparing the pilot roads and facilitating the construction work. Those temporary fillings will be removed and we can guarantee that the site will be prepared as it was before. - JICA is ready to support with technology and financially for further protecting and rectification work. JICA does not allow to dig or fill if the client of contractor want to do so. We appreciate your suggestions for the safeguard work making least impact to the area.
	- Going through the Talangama EPA won't cause issues, as the area section to the project is less than 200m. There should be a proper demarcation of the acquired area, to avoid further encroachments to the EPA area.	Mr. Chaminda Ariyadasa (PD)	- Within the project there are no provisions for that still we will try for that.
Ms. Piyumi Kalyanawansha	- How many pillars will be located through Talangama EPA? - Do you have the GPS locations of the pillars (Columns for the LRT)?	Mr. Chaminda Ariyadasa (PD)	- The distance between two columns will be about 40m. - The locations of the columns are not finalized yet. - We will share the coordinates with you once they are finalized.
Mr. Ranjan Karunanayaka	- What will be the exact route of the LRT from Malabe to Kollupitiya?	Mr. Chaminda Ariyadasa (PD)	- Project Director described the route using Google Earth. - The new office will be at 8th floor of Suhurupaya. You are invited to come there, if there are any clarifications to be sorted out during the weekdays.

Mr. Percy Perera	- Does the route lie over the anicut or if not, what is the proximity to the anicut from the LRT route?	Mr. Anura Ranwala	- Route lies to the LHS of the anicut and it traverses close to the anicut. There is a large map displayed in the project office and anyone can come and see it during the week day at the project office at 8th floor of Suhurupaya. Can make clarifications regarding the route by visiting there.
Ms. Piyumi Kalyanawansha	- What will the height of LRT from the ground level?	Mr. Chaminda Ariyadasa (PD)	- Height of pillars (Clear height to the road) will be 5.5m from the existing ground level. Height of the platform will be around 2m.
	- Initially there were 44 acres in the EPA and now there are only 27 acres due to illegal land filling and encroachments in the area. Illegal fillings will be stopped after the project as the pillars lie as a boundary. It is very difficult to stop encroachments as there is no any hard boundary.		
Ms. Piyumi Kalyanawansha	- Are the affected lands in the EPA are private or public? - Are the private land owners aware about the land acquisition?	Mr. Chaminda Ariyadasa (PD)	- We will start the Socio-Economic survey next week. - The cutoff date is declared as 11th September.
Mr. Ranjan Karunanayaka	- Do land owners like land filling in depot area?	Mr. Chaminda Ariyadasa (PD)	- Most of the people have understood the increase in value of their existing lands and the importance of the project. The value of the neighboring other lands will be increased due to infrastructure development and the owners of the paddy land will be given attractive compensation packages.
Mr. Ranjan Karunanayaka	- What will be the solution for the flooding issue in Malabe depot area and along the rest of the LRT trace?	Mr. Anura Ranwala	- A separate study is going on with the collaboration of SLLRDC regarding the flooding levels. An analysis regarding the impact of temporary landfills will be done with the existing SLLRDC flood model. Effects for the future flooding and Kelani river high flood levels for 100 years return period will be studied. The construction will be done above the possible flood level. Also the flood risk will be reduced after the establishment of Ambathale pumping station. These things will be further studied under the basin investment plans of CRIP project. Those information will be also utilized for the study once it is

			finished.
Mr. Ranjan Karunanayaka	- How the new railway system will be powered? Will it require energy from the national grid and if so What will be the power requirement?	Mr. Chaminda Ariyadasa (PD)	- Power consumption will be 30MVA. There will be 3 feeding locations for LRT. That can be arranged from the national grid. This will be the highest electricity consumer in Colombo city when come to functioning. Special power arrangement will be obtained from CEB for the project and still they are being discussed.
Mr. Ranjan Karunanayaka	- What will be the travel time from Malabe to Kollupitiya?	Mr. Chaminda Ariyadasa (PD)	- The trains will be stopped at each station only for 30-40 seconds for passengers to get in and out. Total travel time from Malabe to Kollupitiya will be around 45 minutes.
Ms. Piyumi Kalyanawansha	- What will be the frequency or the number of train trips?	Mr. Chaminda Ariyadasa (PD)	- There will be trains in 3-5 min intervals in peak hours. Trains will consist of, 6 compartments and can occupy 165 persons per compartment.
Mr. Ranjan Karunanayaka	- Is the maintenance and services done by Ceylon Government Railway?	Mr. Chaminda Ariyadasa (PD)	- A new Organization will be recruited for operation and maintenance and they will be given a complete training in Japan. Further training institute will be established here by JICA funds. Operators will be initially deployed by JICA itself and the whole system will run by JICA for few months. By the end of training period, it will be gradually transferred to the trained staff.

Minutes of the Public Consultation Meeting (EIA Disclosure)

Colombo DS Division

An awareness program on the Light Rail Transits (LRT) System in Colombo was held at the Colombo Divisional Secretariat Office

Venue: Auditorium, Colombo Divisional Secretariat Office, Pettah

Date: 17.11.2017

Time: 10.35 am to 12.00 noon

Participants:

- Mr.H.M.J.J. Herath - Project Accountant , LRT Project
- Ms. Iyerin Nanayakkara – Consultant , LRT Project
- Mr.V.Ravi- Senior Environmental Officer , LRT Project
- 05 Grama Niladharis' from the Colombo DS Division
- 10 officers representing the Colombo DS office.
- 20 public representatives from Colombo area
- Members from the Consultant Engineers and Architects Associated (Pvt) Ltd

Mr.H.M.J.J. Herath, Project Accountant welcomed participants for the awareness programme and he explained the progress of the LRT project to the participants.

Mr.H.M.J.J.Herath's presentation was started by showing a video on use of LRT and he explained the social and environmental impacts, mitigation methods, management plan and monitoring plan for the LRT Project. He further explained the importance of holding consultation meetings with public to obtain their views and suggestions. His presentation included following matters;

- Proposed LRT System in Colombo Megapolis Region
- Proposed Transport Network in Colombo Megapolis Region
- Proposed LRT project for Feasibility study
- Selection of the Malabe Corridor
- Purpose of the Public Engagement Meeting
- Project Details
    - Proposed LRT Route
    - Alternative Route Analysis (Overview)
    - Proposed LRT Structure & Rolling Stock
    - Proposed LRT Train Station
    - Propose LRT Depot (Parking & Maintenance Area)
    - Power Supply
    - Proposed Project Schedule
    - Operation
    - Maintenance Activities

- Existing Environment

- Existing Land Use
- Social Environment
- Traffic Condition
- Noise (Sensitive Receptors)
- Bo Trees along the LRT Route
- Protected Areas
- Wetlands and Streams

- Anticipated Environmental and Social Impacts and Proposed Mitigation Measures
- Proposed Environmental and Social Monitoring Plan
- Items for Monitoring

Then floor was opened for questions, queries and suggestions of the participants.

Name and Designation	**Question raised / suggestion**	**Answer / Respond**
Ms. J.P.A.L. Weerasighe, Assistant Divisional Secretary, Assistant Divisional Secretariat Office-Colombo	According to this project, how many trains will be used? How do you plan to mitigate environmental impacts?	We have planned to use about 15 - 25 trains. There will be a train every 6 minutes. More trains will be used during peak hours. This will be a 24 hour service. Noise and vibration impact is expected. Therefore, we have conducted of noise and vibration monitoring. A waste water treatment plant will be established to treat the waste water produced at the Depot.
Mr. P.A. Podi Appuhami, A shop owner near the Gamini Hall, Suduwalla?	Why did you invite only me from the Suduwalla area?	We invited only you because your property will be affected by this project. We might have to acquire your premise but we will be providing a new business venture for you.
Mr. Govinda Pille	When do you plan to start constructions of this project? Will project affects shops located in the Olcott Mawatha (in front of the Ceylon Government Railway	In 2019 we plan to start constructions. No. LRT will not runs across this area (Olcott Mawatha).

	Market) during the construction period? Will there be any project impact for this place in future?	If any damage occurs, that will be definitely compensated according to calculations based on your income and your property. No. But in future another Ceylon Government Railway (CGR) Development projects will be implemented.
Mr. Krishan Somarathna	Osu Sala (a government pharmaceutical network) near Fort Railway Station is a branch of Rajya Osu Sala. Did the LRT project implementing party has officially informed the management of the Rajya Osu Sala? About this project? Is it the responsibility of the branch manager or the LRT project implementing party to inform about this to the management of the Osu Sala network?	It is a responsibility of the branch manager Branch should inform their management. After that they can contact us for further clarifications. The land is belonged to CGR. Therefore you must discuss the matter with CGR.

Mr.H.M.J.J. Herath thanked all the participants for their participation.

The meeting was adjourned at 12 noon.

Minutes of the Public Consultation Meeting (EIA Disclosure)

Thimbirigasyaya DS Division

An awareness program on the Light Rail Transits (LRT) System in Colombo was held at the Thibirigasyaya Divisional Secretariat Office

Venue: Auditorium, Thibirigasyaya Divisional Secretariat Office, Narahenpita.

Date: 16.11.2017

Time: 2.45 pm to 4.00 pm

Participants:

- Mr.H.M.J.J. Herath - Project Accountant , LRT Project
- Ms. Iyerin Nanayakkara – Consultant, LRT Project
- Mr. V.Ravi- Senior Environmental Officer , LRT Project
- Mrs. Priyantha Dissanayaka - Divisional Secretary , Divisional Secretariat Office Thibirigasyaya
- Grama Niladharis' from the Gothamipura, Kollupitiya, Kirula GN Divisions.
- 06 officers from the Thibirigasyaya DS office.
- 09 public representatives from Thibirigasyaya area
- Members from the Consultant Engineers and Architects Associated (Pvt) Ltd; Consultancy Team

Mr.H.M.J.J. Herath, Project Accountant welcomed participants for the awareness programme and explained the progress of the LRT project to the participants.

Mr.H.M.J.J.Herath explained the social and environmental impacts, mitigation methods, management plan and monitoring plan for the proposed LRT Project and the importance of holding consultation meetings with public to obtain their views and suggestions. He then presented a PowerPoint presentation about the proposed LRT project. His presentation included following matters;

- Proposed LRT System in Colombo Megapolis Region
- Proposed Transport Network in Colombo Megapolis Region
- Proposed LRT project for Feasibility study
- Selection of the Malabe Corridor
- Purpose of the Public Engagement Meeting
- Project Details
    - Proposed LRT Route
    - Alternative Route Analysis (Overview)
    - Proposed LRT Structure & Rolling Stock
    - Proposed LRT Train Station
    - Propose LRT Depot (Parking & Maintenance Area)
    - Power Supply
    - Proposed Project Schedule
    - Operation
    - Maintenance Activities

- Existing Environment
    - Existing Land Use
    - Social Environment
    - Traffic Condition
    - Noise (Sensitive Receptors)
    - Bo Trees along the LRT Route
    - Protected Areas
    - Wetlands and Streams

- Anticipated Environmental and Social Impacts and Proposed Mitigation Measures
- Proposed Environmental and Social Monitoring Plan
- Items for Monitoring

Then floor was opened for questions, queries and suggestions of the participants.

Name and Designation	Question raised / suggestion	Answer / Respond
Ms. D. Wijesighe GN officer – Wanaathamulla	According to my knowledge, traffic is higher near Kelaniya to Wanawasala area. Will this project plan a LRT route across the Kelaniya to Wanawasala?	We have already planned to introduce an express LRT between Colombo and Polgahawela.
Mr. M. Hazeem	I feel that LRT do not have the capacity to transfer a large amount of passengers. Peliyagoda, Highlevel Road, Malabe-Kaduwela are main entrance to Colombo city. What I understand is that more than 35000 passengers enters Colombo city during peak hours daily. Will this project be able to provide transport for 15000 passengers per hour? I feel that Ragama-Kotuwa and Kalaniwali Railway development was more useful than New LRT system. The main reason for high traffic in Peliyagoda is that long vehicles and private busses use this route I would also like to suggest to construct a dry deport in	We have already considered introducing an express LRT for Kalaniwali. We have already planned to introduce an express LRT between Borella and Peliyagoda. According to our traffic survey, we identified Malabe - Kotuwa route has high traffic due to many government offices are located in along this route. Therefore this route was selected.

	Paliyagoda. Hope you will consider my suggestion.	
Mr. Reid President of Trade Association – Borella super market	What is the mechanism to acquire Borella Super market premise?	We have planned to introduce two alternatives for Borella Super market land acquisition. As we have informed previous day.
Mr. Mangala Ariyadasa Manager- DFCC Banka Borella Branch	We have planned to move to an alternative place. But how do we find out that the new location is not affected by this project?	We have already planned to run this electrical Train up 9 meters. You will be compensated if your property is affected according to calculations based on your income and your property.
	What is the mechanism to acquire lands? Whom should we contact to obtain more information about this?	According to government regulations, an initial survey will conduct by the Survey Department. Then a public notice will be published about lands that will be acquiring. Finally, you will be given a chance to take necessary decisions.

Mr. H.M.J.J. Herath thanked all the participants for their participation. .

The meeting was adjourned at 4.00 pm.

Minutes of the Public Consultation Meeting (EIA Disclosure)

Kaduwela DS Division

An awareness program on the Light Rail Transits (LRT) System in Colombo was held at the Kaduwela Divisional Secretariat Office

Venue: Auditorium, Kaduwela Divisional Secretariat Office, Malabe.

Date: 17.11.2017

Time: 2.00 pm to 3.30 pm

Participants:

- Mr.H.M.J.J. Herath - Project Accountant , LRT Project
- Ms. Iyerin Nanayakkara – Consultant of Land Acquisition , LRT Project
- Mr. V.Ravi- Senior Environmental Officer , LRT Project
- 07 Grama Niladharis' (GN) from Kaduwela DS Division
- 26 officers from the Kaduwela DS Office.
- 27 public representatives from Kaduwela area
- Members from the Consultant Engineers and Architects Associated ((CEAA) Pvt) Ltd

Mr. H.M.J.J. Herath, Project Accountant welcomed participants for the awareness programme and he explained the progress of the LRT project to the participants.

Mr.H.M.J.J.Herath's presentation was started by showing a video on use of LRT and he explained the social and environmental impacts, mitigation methods, management plan and monitoring plan for the LRT Project. He further explained the importance of holding consultation meetings with public to obtain their views and suggestions. His presentation included following matters;

- Proposed LRT System in Colombo Megapolis Region
- Proposed Transport Network in Colombo Megapolis Region
- Proposed LRT project for Feasibility study
- Selection of the Malabe Corridor
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- Project Details
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    - Alternative Route Analysis (Overview)
    - Proposed LRT Structure & Rolling Stock
    - Proposed LRT Train Station
    - Propose LRT Depot (Parking & Maintenance Area)
    - Power Supply
    - Proposed Project Schedule
    - Operation
    - Maintenance Activities

- Existing Environment
    - Existing Land Use
    - Social Environment
    - Traffic Condition

  - Noise (Sensitive Receptors)
  - Bo Trees along the LRT Route
  - Protected Areas
  - Wetlands and Streams

- Anticipated Environmental and Social Impacts and Proposed Mitigation Measures
- Proposed Environmental and Social Monitoring Plan
- Items for Monitoring

Then floor was opened for questions, queries and suggestions of the participants.

Name and Designation	Question raised / suggestion	Answer / Respond
Mr. K.A.D. Premarathna	According to this project, what are the paddy lands that you will acquire near Chandrika Kumarathunga Mawatha, Malabe?	We cannot exactly confirm anything about paddy land acquisitions at the moment. We will provide more information on paddy land acquisitions in March 2018. According to government regulations, an initial survey will be conducted by the Survey Department. Then a public announcement will be published about lands that will be acquired If any damage occurs, that will be definitely compensated according to calculations based on your income and your property.
Mr. Wierathna	When do you plan to start constructions of this project? What are the economic advantages that we will be receiving? Will you be filling paddy lands for construction purposes?	In 2019. You can start vehicle parking system and it costs a fee. No. We have already planned to have a Green Buffer Zone in paddy lands.
Mr. Arjun Perera	Are there any connecting points planed between Malabe and Kaduwela. Will this project acquire paddy lands or lands in Chandrika Kumarathunga Mawatha, Malabe?	Yes. We have already planned to introduce an express LRT between Malabe and Kaduwela. We have planned to acquire paddy lands.
Mr. N.D.A.Kumara	Is this similar to Monorail system?	No. LRT is different than Monorail. It is

		a new technology.
Mr. Thissa Yapa GN- Kotuwegoda GN Division	Does this project runs through Kotuwegoda GN Division?	No The route will be the same as we have informed earlier. It will not be changed.
Mr. Waliwita	How many passengers can be transported by this train?	Approximately 400 passengers. We have planned to use about 15 - 25 trains. There will be a train every 6 minutes.
Mr. Sunimal Kumara	How have you planned to construct the Battaramulla LRT stations?	We have planned to establish stations near Sethsiripaya, Baththaramulla junction and Palam Thuna junction. These stations will be formed at bends along the route to slow down the speed of the train.

Mr.H.M.J.J. Herath thanked all the participants for their participation.

The meeting was adjourned at 3.30 pm.

Minutes of the Public Consultation Meeting (EIA Disclosure)

Sri Jayawardhanapura Kotte DS Division

An awareness program on the Light Rail Transits (LRT) System in Sri Jayawardhanapura Kotte was held at the WP/ Jaya/Sirihada Vidyalaya, Rajagiriya.

Venue: Auditorium, WP/ Jaya/Sirihada Vidyalaya, Rajagiriya

Date: 21.11.2017

Time: 10.20 am to 12.00 noon

Participants:

- Mr. H. M. J. J. Herath - Project Accountant and the Project Team, LRT Project
- Ms. Iyerin Nanayakkara –Consultant and the Project Team, LRT Project
- Mr. V.Ravi - Senior Environmental Officer and Project Team, LRT Project
- Five officers from Divisional Secretariat Office , Sri Jayawardhanapura Kotte
- Ms. S. M. Welege- Grama Niladhari from the Welikanda North GN Division
- Six public representatives from Sri Jayawardhanapura Kotte area
- Members from the Consultant Engineers and Architects Associated (CEAA) (Pvt) Ltd; Consultancy Team

Mr. H. M. J. J. Herath, Project Accountant welcomed participants for the awareness programme and He explained the proposed project to the participants.

Mr. H. M. J. J. Herath’s presentation was started by showing a video on use of LRT and explained the social and environmental Impacts, Mitigation methods, management plan and monitoring plan for the proposed LRT Project and the importance of holding consultation meetings with public participants to obtain their views and suggestions. He then presented a PowerPoint presentation about the proposed LRT project. His presentation included following matters;

- Proposed LRT System in Colombo Megapolis Region
- Proposed Transport Network in Colombo Megapolis Region
- Proposed LRT project for F/S study
- Selection of the Malabe Corridor
- Purpose of the Public Engagement Meeting
- Project Details
    - Proposed LRT Route
    - Alternative Route Analysis (Overview)
    - Proposed LRT Structure & Rolling Stock
    - Proposed LRT Train Station

  - Propose LRT Depot (Parking & Maintenance Area)
  - Power Supply
  - Proposed Project Schedule
  - Operation
  - Maintenance Activities

- Existing Environment
  - Existing Land Use
  - Social Environment
  - Traffic Condition
  - Noise (Sensitive Receptors)
  - Bo Trees along the LRT Route
  - Protected Areas
  - Wetlands and Streams

- Anticipated Environmental and Social Impacts and Proposed Mitigation Measures
- Proposed Environmental and Social Monitoring Plan
- Items for Monitoring

Then floor was opened for questions, queries and suggestions of the participants.

Name and Designation	Question raised / suggestion/ Ideas	Answer / Respond
Mr. L. A. Millavithanaarchchi Residential	How have you plan the route of the LRT train near the fly over bridge in Rajagiriya?	LRT route will go either sides of the fly over bridge. The height of the rail track will be increased at this point compared to other locations
Mr. Nandana Kumara Businessmen	What is the technical difference between Light Rail and Mono Rail? There are many apartments around the Rajagiriya. But, those buildings are constructed environmental sensitive areas. CEA has not taken any actions for this problem. Some of these	It is pleasure to given your ideas or suggestions. We have already taken permission from the minister for this project.

	constructions have been legally charged. Marsh lands are destroyed by development project in Sri Lanka. But, CEA has not taken any actions for this. The traffic problem cannot solve by developing the road network in Sri Lanka; Attitudes of people should also be changed accordingly. There are many issues when compensating people for their loses by development projects. It is useless to discuss these problems without the presence of any responsible politians or responsible officers.	
Mr. S. G. A. Edirisingha Businessmen	Due to these development projects, I have to face many problems. Walls are cracked in a building that I own due to construction work of a development project. There is a land behind my building and all the trees are died due to lack of water in soil. My business has been closed for the last 5 months now. RDA did not provide reasonable compensation for people who were affected by these development projects.	We are not in a position to handle these problems. We are here only to provide awareness about the LRT project. It is better if you could discuss these problems with RDA.

Mr. H. M. J. J. Herath was thanked all the participants for their attendance and valuable feedback.

The meeting was adjourned at 12 noon.

Workshop on Accessible Station for Disabled People

Workshop on Accessible Station for Disabled People

The Study emphasizes the accessibility of the LRT to all beneficiaries such as pregnant women, women with small children, elderly persons, and persons with disabilities. The design accessible to such population is beneficial for all passengers such as passengers with large luggage. By introducing the example of Japan and other countries, the workshop pursues the station design accessible to all users.

JICA promotes the idea of "Mainstreaming disability" which aims to include disabled people in the development process of infrastructure as well as gender mainstreaming. Under the ideas, the Study involves the disabled persons and women in the design stage to directly reflect their opinions.

(1) Current condition on the barrier-free transportation in Sri Lanka

1) Legal and Institutional Arrangement

The government of Sri Lanka prescribes "Protection of the Rights of Persons with Disabilities Act, No. 28 of 1996" to ensure the equal rights of the disabled persons. In addition, Minister of Social Services and Social Welfare prescribed "Disabled Persons (Accessibility) Regulations, No. 1 of 2006" to ensure the accessibilities of disabled people in all public buildings and transportation. The regulation was developed through the consultations with party organization and referred the regulation of the United Nations.

Ministry of Health, Directorate for Youth, Elderly and Persons with Disabilities prescribes "Design Considerations on Accessibility for Persons with Disabilities" in 2013. However, this design consideration has not regally stipulated such as regulation and gazette. The sizes described in the design consideration are partly different from the "Disabled Persons (Accessibility) Regulations", and it is not widely recognized as the accessibility regulation.

According to the interview with a party organization official, the "Disabled Persons (Accessibility) Regulations" is in the process of revision to modify the mistakes of the figures and usability of disabled persons.

2) Government Stakeholder of Disability Sector

As for government sector, Ministry of Social Empowerment, Welfare and Kandyan

Heritage is the leading agencies regarding to securing accessibility of disabled persons by prescribing the law and the regulation and implements social welfare activities. National Secretariat for Persons with Disabilities (NSPD) and Department of Social Services implement programs such as providing monthly allowance for PWDs, operating a vocational training center, facilitation for recreational activities for disabled children and so on. Ministry of Health, Nutrition & Indigenous Medicine also covers mainly health issues of persons with disability and has a department called Department of Youth Elderly Disabled & Displaced.

3) JICA's cooperation of the Disability Sector

JICA has been implementing various kinds of technical assistance and projects in Sri Lanka and has strong working relationship with government stakeholders and party organization. For example, JICA Distance Learning and Multimedia Education Project provided trainings to transfer the technology of DAISY conversion in 2003. Japan Overseas Cooperation Volunteer (JOCV) has been contributing to the disability sector such as occupational therapist, physiotherapist, and social welfare sector in Sri Lanka and as of September 10 volunteers has been dispatched in entire Sri Lanka. In addition, R/D of "The Project for Strengthening Education for Children with Special Needs through Inclusive Education Approach in Sri Lanka" was signed in November 2017 and the Project is expected to start in April 2018.

4) Challenges of the disabled persons using public transportation

In response to the above-mentioned regulation, a certain number of facilities installed the slopes, handrails elevators. However, the contractors often do not understand the meanings of the regulation and install the barrier-free measure improperly, for example, too sleep ramps with slippery material and randomly equipped guiding blocks. Regarding to the railway facilities, most of the train stations were constructed before the regulation and its designs are far from barrier-free. Poorly equipped facilities and the design of the station currently prevent disabled persons from going out and using the public transportation comfortably by themselves. According to the interview with the participants of the accessible LRT system workshop, certain numbers of disabled people manage to commute by themselves, and they sometimes get lost due to insufficient information for disabled people

(2) Current condition on the gender issues regarding to the public transportation in Sri Lanka

According to the UNDP's Human Development Index (HDI) in 2016, Sri Lanka was rated 0.766 and ranked as 73rd of 188 countries while Inequality-adjusted HDI (IHDI) was rated 0.678 and 65th of 188 countries. The difference between HDI and IHDI is lower than other South Asian countries such as India, Bangladesh, Nepal, and Pakistan[1]. That indicates gender inequality is smaller than other neighboring countries, yet economic status and political participation remains to be coped. In Sri Lanka, Ministry of Women and Child Affairs is the leading ministry to promote gender equality such as policy making and awareness raising activities.

Even though there is no detailed statistics available in this specific sector, the major issues regarding to the women in public transportation in Sri Lanka are sexual harassment in the crowed vehicles and minor offenses such as pick pockets since women are more likely to be the target of such offences. Extremely crowded vehicle, unavailability of escalator and elevator, high and wide gap between platform and vehicle can be major deterrence of using public transportation especially for women in later stage of pregnancy.

(3) Overview of the workshop on accessible station for disabled people

The workshop was a consulting process with preferable parameters of design standard for barrier-free facilities such as platform, ticketing gate and steps for disable people, pregnant and elders in the workshop. The workshop (WS) with the model of the station facilities was held with the participants of disable people, women, pregnant women, elderly persons to understand their needs and preferable size for LRT facilities. The contents of the workshop were described as follows:

1) Objective of the workshop

The objective of the workshop is to understand the needs of expected users who needs special cares to be barrier-free station areas in the new LRT system and to raise the awareness of counterpart agencies regarding to the barrier free design.

Throughout the communication with the party organizations, it is designed to mutually understand the difficulties relating to the mobility of persons with disabilities by experiencing the limitation of movement. It was expected to formulate the action plan by the group discussion with various stakeholders.

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[1] While the difference in Sri Lanka is 11.6, that of India is 27.2, Bhutan is 29.4, Nepal is 27.0, and Pakistan is 30.9. (http://hdr.undp.org/en/composite/IHDI : accessed on Dec.4th December, 2017)

Also trial of the actual size of the station facilities can verify the usability of major facilities such as LRT station buildings to be constructed in the future (ticket gates, elevators, ticket vending machines, platform, and handrail) and usability of the dimensions.

2) Participants of the workshop

The participant of the workshop is shown in the table below.

Table 1 Expected participants of the workshop

<table>
<tr><th>Stakeholders</th><th>Government officials</th></tr>
<tr><td rowspan="3">・Development with Disabled Network
・Sri Lanka Federation of the Visually Handicapped
・Mobility Handicapped Technician Association Sri Lanka
・Sri Lanka Council for Blind
・Sri Lanka Foundation for Disabled (SLFD)
・DAISY Lanka Foundation
・Sri Lanka Spiral Cord Network
・Janathakshan
・Disability Organization Joint Front</td><td>・MMWD
・Ministry of Social Empowerment and Welfare
・Ministry of Women and Child Affairs
・UDA
・Sri Lanka Police</td></tr>
<tr><th>Expected passengers</th></tr>
<tr><td>・Pregnant women
・Elderly persons
・Disabled persons and those who are supporting the going out (Visually impaired, physically impaired using wheelchair and staff, hearing impaired)</td></tr>
</table>

Source: Study Team

3) Program of the workshop

The workshop was conducted as a two-day program. The objective of the first day was to understand the barrier-free transportation in Japan and current challenges of the public transportation in Sri Lanka.

Foundation for Promoting Personal Mobility and Ecological Transportation (ECOMO Foundation) made two presentations about explanation of barrier-free concepts, its history of development, and practices of barrier-free transportation in Japan as well as examples of human resource development activities. These presentations enabled participants to have general understanding of disability and barrier-free and more concrete examples of what to be achieved in Sri Lanka. Group discussion followed after these presentations with different topics toward accessible LRT system in Sri Lanka. Each group presented the result of the group discussion.

After having understanding of barrier-free/accessible transportation from the first day's program, the second day, all participants had opportunities to learn the actual challenges for persons with disability to use public transportation. In order to verify the usability of barrier-free facilities (ticket vending machine, ticket gate, handrail, elevator, platform) at LRT station, disabled participants and participants without disability using supporting tools (wheel chair, crutches, eyes mask, elderly experience kits) tried the models of actual size of the station facilities and gave their specific comments and suggestions on each item.

1st day, September 6, 2017 (Wednesday)

Theme: Introduction of the Japanese Barrier-free activities

Time	Item	Lecturers
8:30-9:00	Registration	
9:00-9:20	Opening Remarks Ice Breaking	Mr. H.M.J.J Herath MMWD
9:20-9:30	Introduction of the LRT Project	Mr. H.M.J.J Herath MMWD
9:30-10:00	Understanding disability	Mr. Atsushi Matsubara ECOMO-foundation
10:00-10:30	Effort for barrier-free transportation in Japan	Ms. Keiko Takeshima ECOMO-foundation
10:30-10:40	Coffee Break	
10:40-10:55	Introduction of the concept of station design	Mr. Yoshihisa Asada JICA Study Team
10:55-11:25	Group Discussion (Topic: Issues on barrier-free in Sri Lanka and Action Plan to solve the issues)	All Participants
11:25-11:50	Presentation on the result of the Group Discussion	All Participants
11:50-12:00	Closing Remarks	Mr. H.M.J.J Herath MMWD

2nd day, September 7, 2017 (Thursday)

Theme: Needs for accessible LRT Station

Time	Item	Lecturers
8:30-9:00	Registration	
9:00-9:20	Opening remarks	Mr. Chaminda Ariyasada MMWD

9:20-9:40	Challenges to use public transportation	Mr. Nishantha Kumara Mr. C. Siriwardena
9:40-10:00	Preparation and explanation of the assessment of the accessible route for disabled persons	Facilitators: Ecomo-foundation, JICA Study Team
10:00-11:00	Needs/evaluation on sizes of facilities for LRT station for all (Target: ticket wicket /ticketing machine / handrail/ elevator/ slope/platform)	
11:00-11:10	Coffee Break	
11:10-10:50	Wrap up of the assessment on route (Mutual understanding of barriers)	All Participants
11:50-12:00	Wrap up and closing remarks	Mr. Chaminda Ariyasada MMWD

Source: Study Team

1) Reasonable accommodation for the participants

The participants of the workshop included visually impaired persons, hearing impaired persons and wheelchair users. In order to assure the physical and information accessibility for the participants, following reasonable accommodations were arranged.

- The venue of the workshop was accessible by elevator. Eventually, the venue was the same building as Ministry of Social Welfare, so a lot of participants especially visually impaired persons could arrive at the venue by themselves because they occasionally visit the building.
- The workshop was held with sign language translation. In Sri Lanka, Ministry of Social Welfare employs three sign language translators who can provide translation services.
- The project compiled a DVD of the workshop which includes the proceeding of the workshop, movie of the lecture with sign language translation and DAISY version of the proceeding so that every participant could access the proceeding and lecture of the workshop.

2) Result of the workshop

The result of the workshop was complied as the proceeding of the workshop. For the detailed contents, please refer to Appendix 11 Proceeding of the workshop.

Throughout the implementation of the workshop, the Sri Lankan side understood the importance of actal trial of the facilities and the difficulties of disabled people. Height and width of the facilities will be considered based on the result of the workshop. The Project also consider the station facilities raised by the participants such as proper arrangement of the guiding blocs, audio announcement of the destintion, understandable signature, help desk and botton and so on. Participants commented that a certain number of visually impaired persons cannot read braille especially for those who lost the sight in the middle of their lives. Audio information is essential as well as braille when providing necessary information in the station and vehicle.

Annex K

Noise Modelling

Noise Map for Proposed Light Rail Transit System In Colombo

Report No:CTS-1708659

Prepared for

Consulting Engineers & Architects
Associated (Pvt) Ltd

Prepared by

Electro Technology Laboratory
Industrial Technology Institute
N0:363 ,Bauddhaloka Mawatha
Colomo 07

2017 November 12

Report Documentation Page

Customer by their letter dated 12th of June 2017 requested Industrial Technology Institute (ITI) to develop a noise model for Proposed Light Rail Transit System In Colombo. The objective of this noise modeling is to predict potential rail traffic noise impacts at identified sensitive locations.

Customer	**Date of Report**	**Report Type**
Consulting Engineers & Architects Associated (Pvt) Ltd	2017 November 12	Final Report

Title	**Report No**
Noise Map for Proposed Light Rail Transit System In Colombo	**CTS - 1708659**

Perform Organization Name & Address

Industrial Technology Institute
Electro Technology Laboratory
363, BauddhalokaMawatha,
Colombo 07.

Project Team

Mr. A. S. Pannila	– Additional Director General, Technical Services
Mr.Ruwan Weerasinghe	– Senior Deputy Director, Electro Technology Laboratory
Mr.Asanka Perera	– Research Scientist
Mr.Chathura Pannila	– Research Scientist

Content

1. Introduction

The technological advancement of last decade has allowed an exciting new type of assessment "Noise Mapping". It has proved a useful tool for strategic planning purposes for developers, local councils and industrial customers.

Noise mapping is a very powerful calculation tool which can provide noise control plots cover an area, or noise levels at individual locations. It enables complex calculations for many noise sources to be undertaken over a large geographical area. Changes in situation, for example the addition of new noise sources or the effects of mitigation can be readily assessed and presented visually.

Noise mapping indicates the predicted levels of noise on contours or areas of colour on a noise map, similar to isobars on a weather map. The noise mapping process requires a computer noise model to calculate the noise levels at a given location. The noise model is a 3D virtual environment, which incorporates the various noise sources along with any environmental factors which may affect the spread of sound (buildings, noise barrios, etc).

Through the use of noise mapping acoustic engineers and consultants are able to assay complex environments and design a range of noise solutions for any existing industries or proposed industrial projects. This can include potential alternations to the industrial buildings and or providing noise solution at the sources.

There are several technical and practical reasons why noise maps are normally produced using computer prediction rather than from actual noise measurements. To produce a map based on measurements would require many measurements to be taken over long periods and this would have been prohibitively expensive. In most cases, the noise at a location is produced by a combination of different sources.

The objective of this noise modeling is to evaluate predicted traffic noise impacts to the residential & sensitive areas due to the sky train system going to be constructed.

1.1 Background of the project

Based on current traffic condition in major roads in Colombo city, and to have an efficient public transport mode compared to the private vehicles, introduction of efficient and quality public transportation system is urgently necessary. The Colombo Urban Transport Survey Project (CoMTrans) conducted by Oriental Consultants Global Co., Ltd. (OCG) from 2012 to 2014 found that out of seven major corridors heading towards the center of Colombo, Malabe Corridor is observed to have the most serious traffic condition with the largest number of private cars with lowest movement speed at peak hours. Therefore, the new public transport system namely SKYTRAIN along to Manabe corridor was proposed and studied followed by CoMTrans.

The Ministry of Megapolis and Western who is responsible for urban development in the Colombo metropolitan area has set out the "Western Region Master Plan - 2030". A priority concern of this master plan is to solve the traffic congestion in Colombo Metropolitan Area by introducing a better and quality public transport system. Therefore, the GoSL officially requested to introduce the proposed Light Rail Transit (LRT) system to the government of Japan.The Feasibility study for the LRT system was started in March 2017.

1.2 Assessment Locations

The horizontal grid noise maps were generated at a height of 1.2m from the ground level by considering the assessment locations within the area by calculating predicted noise levels. The selected sensitive locations are shown in Table 01. Further the predicted vertical noise contour maps were generated by considering only the railway track and a buildings to calculate the noise levels for the facade of the building at a distance 8m and 12.5m from the nearest railway track.

Assessment Locations		**UTM Coordinate**	
		East / m	**North / m**
L1	National Hospital – Ward Place	399826.22	490921.21
L2	Windsor Tower apartments – Ward Place	400694.05	490726.47
L3	Rajagiriya Ayurweda Hospital	402378.80	490233.23

Table 01 – Assessment locations and their coordinates

2.0 Acoustic Methodology

Acoustic weighting

All noise levels reported in this analysis are given in "A"weighted decibels dB (A). "A"weighting places the greatest emphasis on the human ear's audible spectrum, particularly the range that most humans commonly hear (1,000Hz to 6,000Hz). The human ear's detectable threshold between two sound pressure levels is approximately 3dB (A). "A" weighting is the most accepted scale for measuring traffic noise because it closely simulates the human ear's hearing response and correlates well with perceived auditory nuisance patterns.

Noise level reporting

Predicted noise noise levels are reported in terms of $L_{A,Eq}$, i.e., the "A"-weighted equivalent noise level during a fixed period of time. $L_{A,eq(h)}$ represents the acoustical energy of noise levels during a time period. It provides a single, convenient value that contains the same acoustical energy over that period as the acoustical energy generated by the variable readings over the same period.

2.1 Noise modeling software - IMMI(WölfelMeßsysteme)

Since 1986, WölfelMeßsysteme IMMI is international recognized software package for environmental pollution mapping that integrates air dispersion modeling (gases, dust, odours), outdoors sound propagation (road traffic, railway, industrial and recreational noise) and interfaces to CAD and GIS packages.

Figure 01 – IMMI logo

IMMI is used by professionals working with public authorities, consulting engineering companies and the industry. IMMI covers a wide range of applications ranging from noise mapping modeling. IMMI integrates noise pollution in a single software package. , IMMI is one of the leading packages worldwide.

IMMI is continuously adapted to meet the requirements of evolving regulations and standards. Depending on the calculation method, IMMI calculates L_{eq}, L_{day}, $L_{evening}$, L_{night}, L_{den}, L_{Amax}, L_{10} and other sound or statistical indicators. Currently IMMI equipped withroad traffic noise, railway traffic noise, air transport noise and industrial/recreational noise. Also it contains more than twenty national and international noise calculation methods.

Noise mapping gained additional importance with the arrival of EU Directive 2002/49/EC relating to the assessment and management of environmental noise. IMMI is equipped with a full set of functions to produce Strategic Noise Maps of major roads, major railways, major airports and major agglomerations.

Special acoustics features

- Calculation in either overall "A" weighted levels or frequency-dependent in octave or third-octave bands.
- Difference maps: compare the noise impact of different planning scenarios.
- Energetic and arithmetic addition and subtraction of noise maps.
- Databases of noise spectra and transmission loss/absorption spectra.
- Façade level calculation.
- Calculation of noise levels and peak levels at single receiver points and grid receivers.
- Calculation of (mainly) outdoors propagation of noise in compliance with national and international (ISO/EU) noise calculation standards/methods.
- Works with fully geo-referenced data.
- Interpolation and drawing of contours, filled coloured or gray-shaded contours, isolines, etc.
- Calculating digital terrain models using original data or applying optimization algorithms.
- Presenting results in electronic form, numeric/text tables and coloured maps.
- 2D and (animated) 3D visualization of pollution maps and clippings.
- Interfacing with horizontal GIS applications, especially the ESRI ArcGIS^{TM} family of products, MapInfo^{TM} and GoogleEarth^{TM}.
- Distributed calculation of pollution maps on networked and multi-core computers.
- Use of meteorological data.

2.2 Data Collection

In order to develop a noise map for area under consideration, it is necessary to provide the rail traffic volume data, geographical information and background information to the noise model. The building details which supposed to construct the physical environment were entered to the modeling software based on the information given by Consulting Engineers & Architects Associated (Pvt) Ltd. Also the building heights were updated by using "LiDar" – (Light detection and ranging) data from the survey department of Sri Lanka.

2.3 Traffic Volume Data

The required traffic data for the noise model was extracted by using the predicted traffic volume data given by the Consulting Engineers & Architects Associated (Pvt) Ltd .Attention was given to traffic data passes through railway lines since it is the main noise source for this modeling. Further for modeling purpose the predicted traffic flow during the day time and night time were considered. The *Table 02* shows the daily traffic volume data for day time and night time.

Track	Day Time (0700h – 2200h)		Night Time(2200h – 0700h)	
	Volume / day	Speed / kmh^{-1}	Volume / day	Speed / kmh^{-1}
Rail Track - 1	176	40	33	40
Rail Track - 2	176	40	33	40

Table 02 – Daily sky train traffic Volume and Speed

2.4 Modeling Assumption

Following assumptions were made during the modeling work.

- Use the noise emission spectrum of a single Train according to " SRM II" element library
  This element library contains the Dutch calculation method for railway noise. IMMI implements the SRM II railway noise. SRM is an acronym for *"Standard Reken-Methode"* .This Dutch calculation method for railway noise is fully compliant with the requirements of both EU directive 2002/49/EC and recommendation 2002/613/EC.

Frequency / Hz	63	125	250	500	1000	2000	4000	8000	Sum
Sound Pressure Level / dB(A)	72.0	79.6	92.2	97.6	94.2	90.5	84.1	76.0	100.6

Table 03 – Noise spectrum of a single train unit at 40kmh^{-1}

- Environmental parameters
  Following values were considered as environmental parameters for noise mapping.

Day Time – Temperature 31°C and Relative humidity 60%
Night Time – Temperature 26°C and Relative humidity 80%

3.0 Noise Modeling

3.1 Presentation of Modeling Results

- Horizontal grid calculation

  To represent the modeling results, Color contour noise maps were generated with 5dB steps for assessment locations as mentioned in Table 01. The horizontal grid calculation is performed at a height of 1.2m from the ground level which is the height of a receiving person.

  [See Annexure 01 to 06]

- Vertical grid calculation

  To find out the predicted noise levels at different heights, vertical grid calculation was performed. Calculation conditions as follows. [See Annexure 07 to 09]

✓ Case 1 - Without Building nearby LRT structure.
✓ Case 2 - When a 20m height building is located at 8m away from the nearest railway track.
✓ Case 3 - When a 40m height building is located at 12.5m away from the nearest railway track.

4.0 Results

4.1 Predicted Horizontal Grid Noise Maps

The noise maps were generated considering the following situations considering daily sky train traffic volume and speed.

Annexure 1	– Noise Map for Location 1 – National Hospital (Day Time)
Annexure 2	– Noise Map for Location 1 – National Hospital (Night Time)
Annexure 3	– Noise Map for Location 2 – Windsor Tower Appartment (Day Time)
Annexure 4	– Noise Map for Location 2 – Windsor Tower Appartment (Night Time)
Annexure 5	– Noise Map for Location 3 – Ayurweda Hospital (Day Time)
Annexure 6	– Noise Map for Location 3 – Ayurweda Hospital (Night Time)

4.2 Predicted Vertical Grid Noise Maps

The LRT noise of the equivalent noise level (LAeq) was predicted for different cases with various receiving points. The result is shown in below table.

Case 1 - Without Building near LRT structure. [See Annexure 07]

Receiver Point	Relative Height	Noise level at 12.5m from nearest rail track - (L_{Aeq}) / dB(A)	
		Day Time	Night Time
P1	1.2m	52.8	47.8
P2	4.2m	55.1	50.1
P3	7.2m	57.4	52.4
P4	10.2m	65.9	60.9
P5	13.2m	67.5	62.5
P6	16.2m	65.8	60.8

Table 04 – Case 1

5.0 Discussion

Horizontal Grid Noise Maps

All horizontal grid noise maps were generated 1.2m height from the ground level. Horizontal grid noise maps illustrate the propagation of noise in vertical plane. The propagation of noise highly depends on the location of obstacles such as buildings. Therefore a location and geometry of a building are directly affected to the propagation of noise.

It is clear, most of buildings located near the sky train lines are affected with the range 50dB(A)-55dB(A) average noise level at day time for assessment location L1.Also at the night time the average noise level range is 45dB(A)-50dB(A).

When consider locations L2 and L3 , buildings located near the sky train lines are affected with the range of 55dB(A)-60dB(A) average noise level at day time and 50dB(A)-55dB(A) average noise level for the night time.

Vertical Grid Noise Maps

According to the vertical grid noise maps, it is clear that at around 13.0m height above from the ground level will give the highest noise level for all three cases for Day time and Night time. This is due to the elevation of the Sky train lines since the rail lines are driven about 11.0m height from the ground level.

The noise from the sky trains is gradually increased up to the 13m height from the ground level and above this level the noise from sky trains is gradually decreased. Therefore the critical height is the 13.0m height from the ground level.

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For

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A.S.Pannila
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R.M. Weerasinghe
Senior Deputy Director
Electro Technology Laboratory

2017/11/12

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Noise Map for Location 1 – National Hospital (Day Time)

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Noise Map for Location 1 – National Hospital (Night Time)

Annexure 03

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Noise Map for Location 2 – Windsor Tower Appartment (Day Time)

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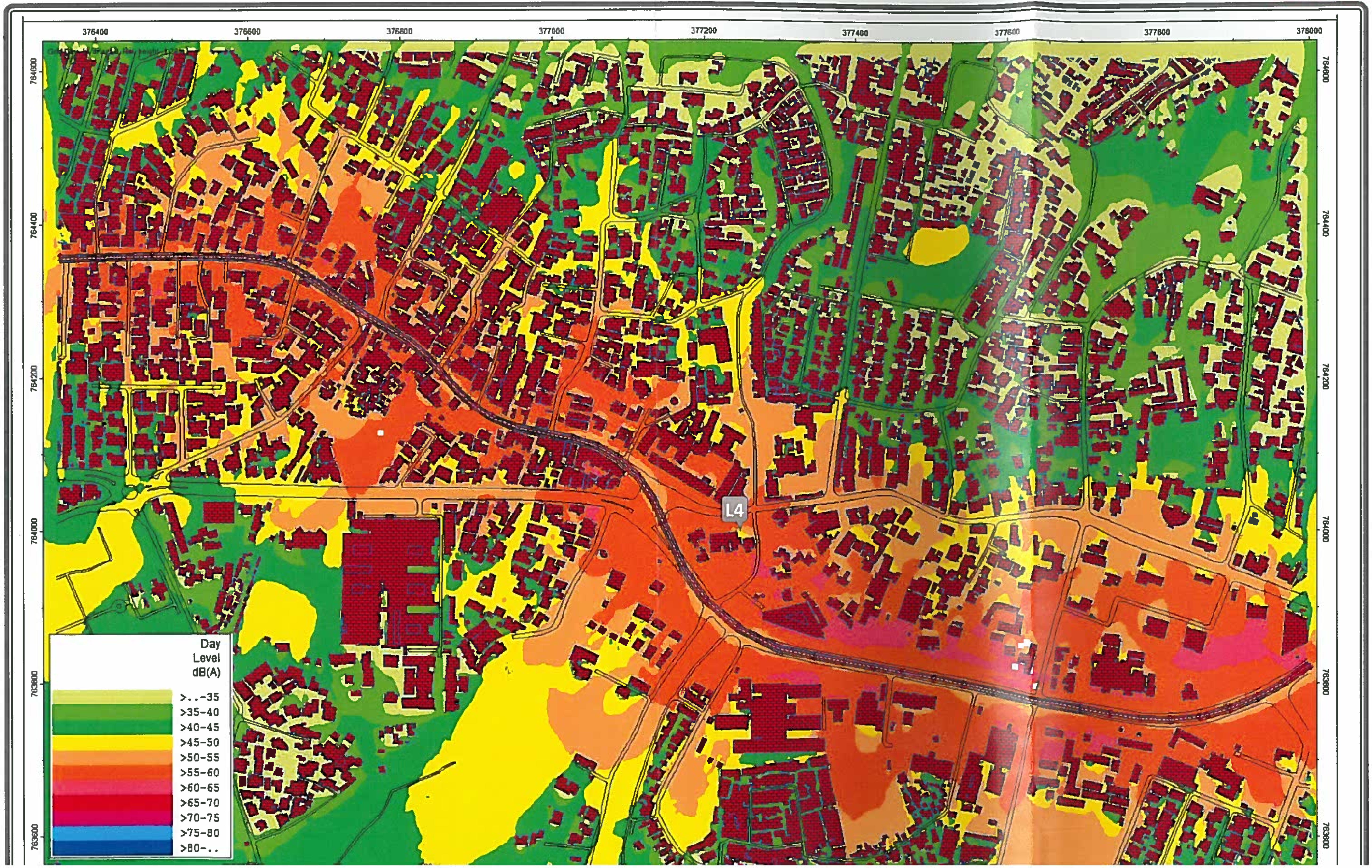
Noise Map for Location 2 – Windsor Tower Appartment (Night Time)

CTS-1708659

Noise Map for Location 3 – Ayurweda Hospital (Day Time)



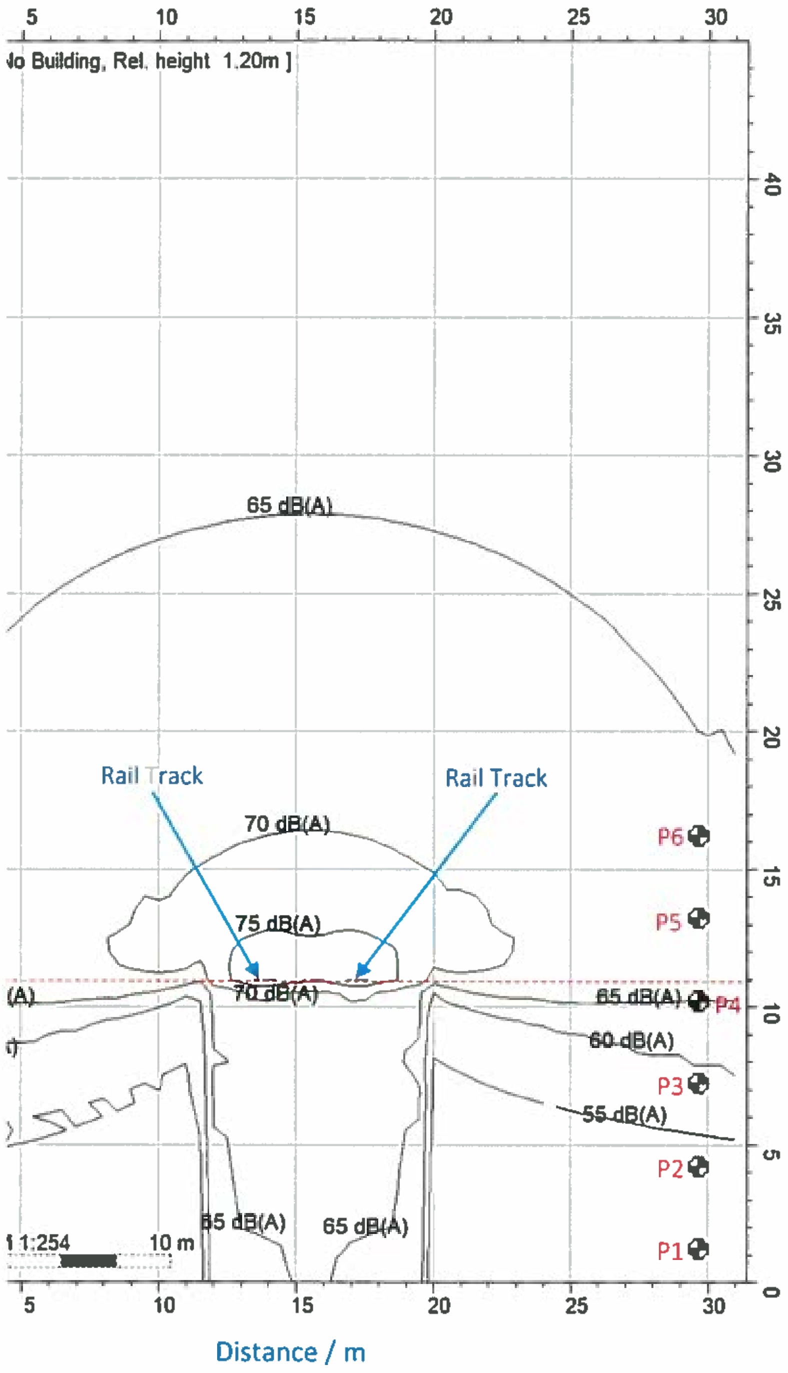
CTS-1708659

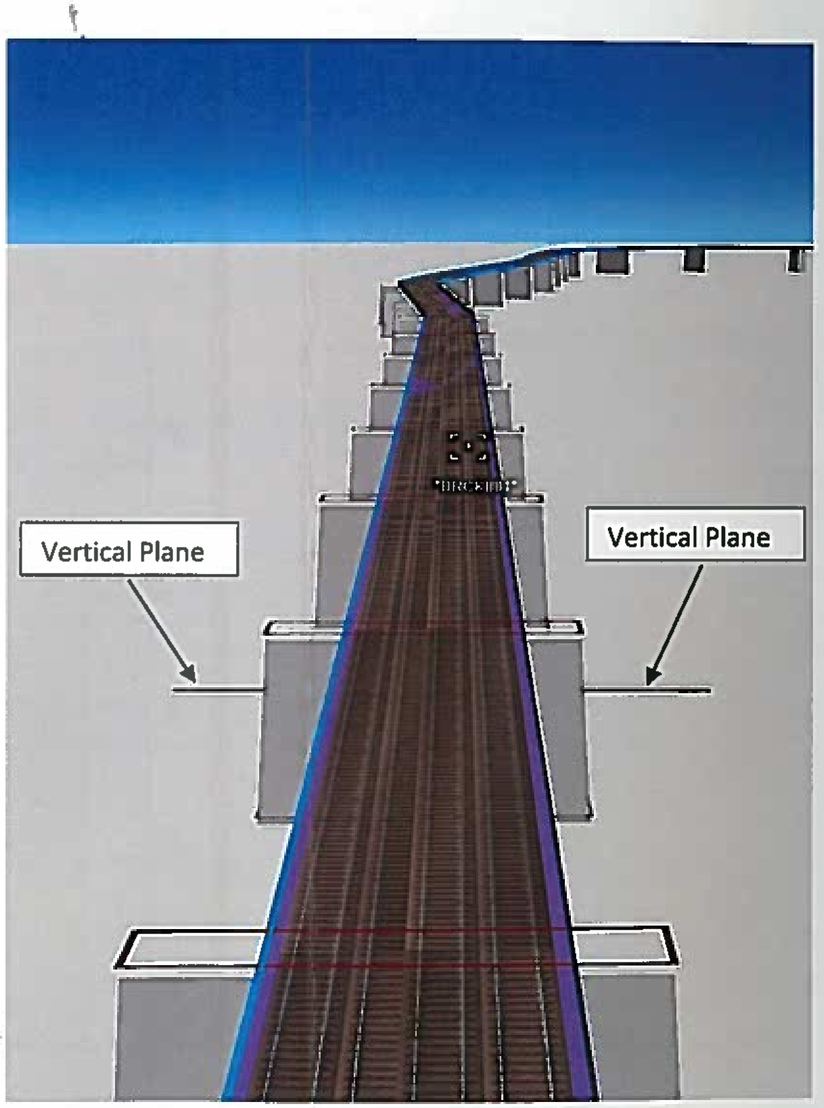
Noise Map for Location 3 – Ayurweda Hospital (Night Time)

CTS-1708659

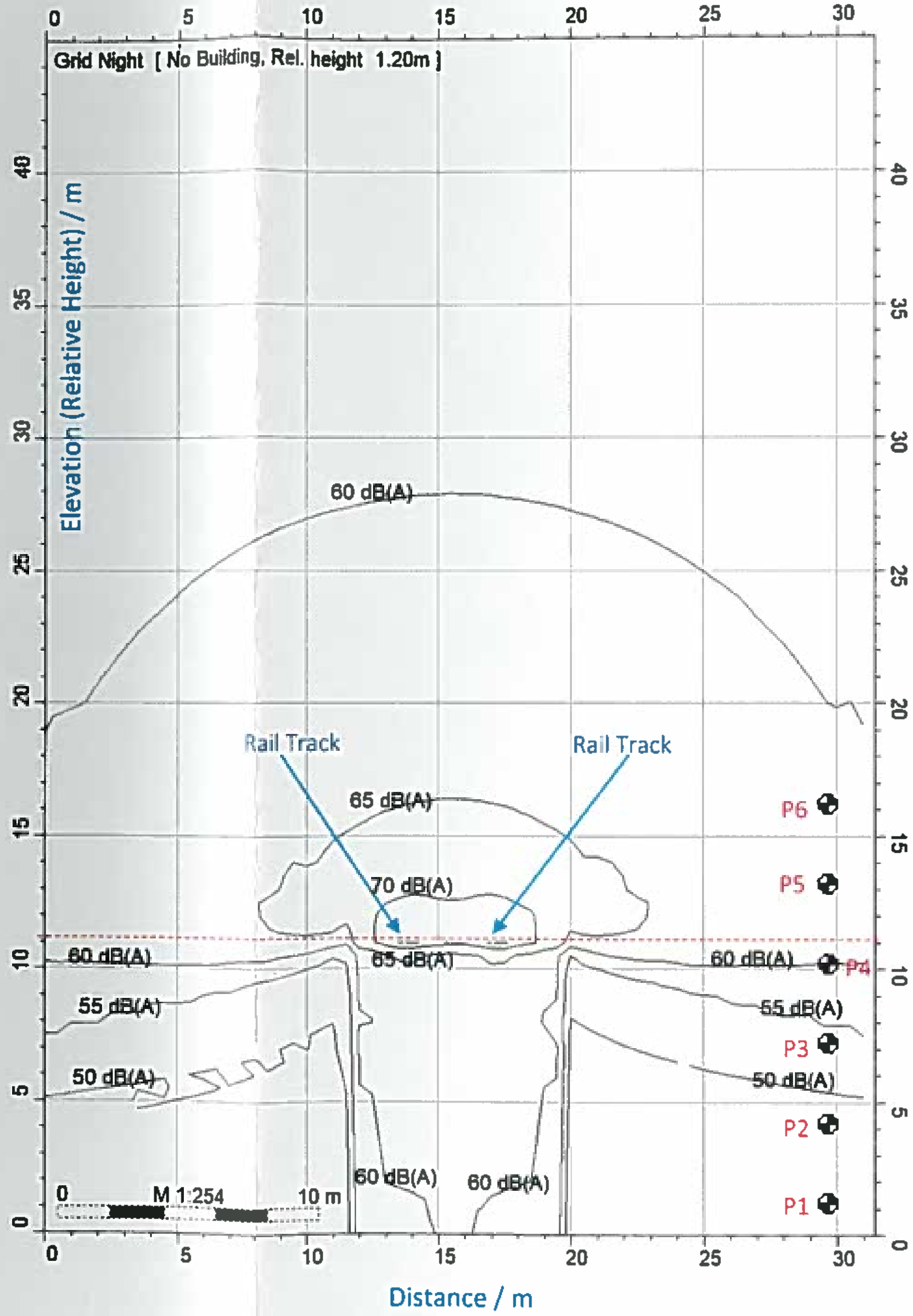
Noise Propagation in Vertical Plane – Case1

Day Time





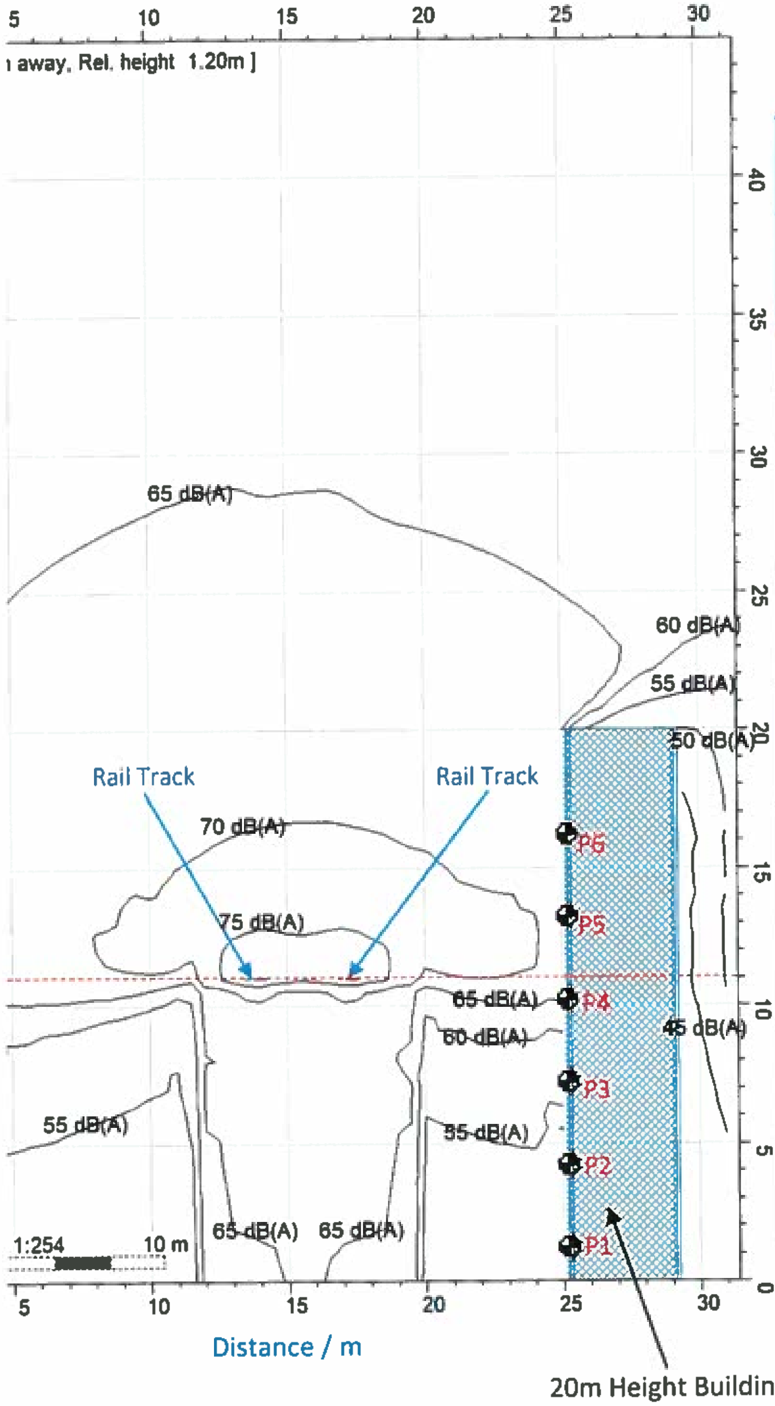
Night Time

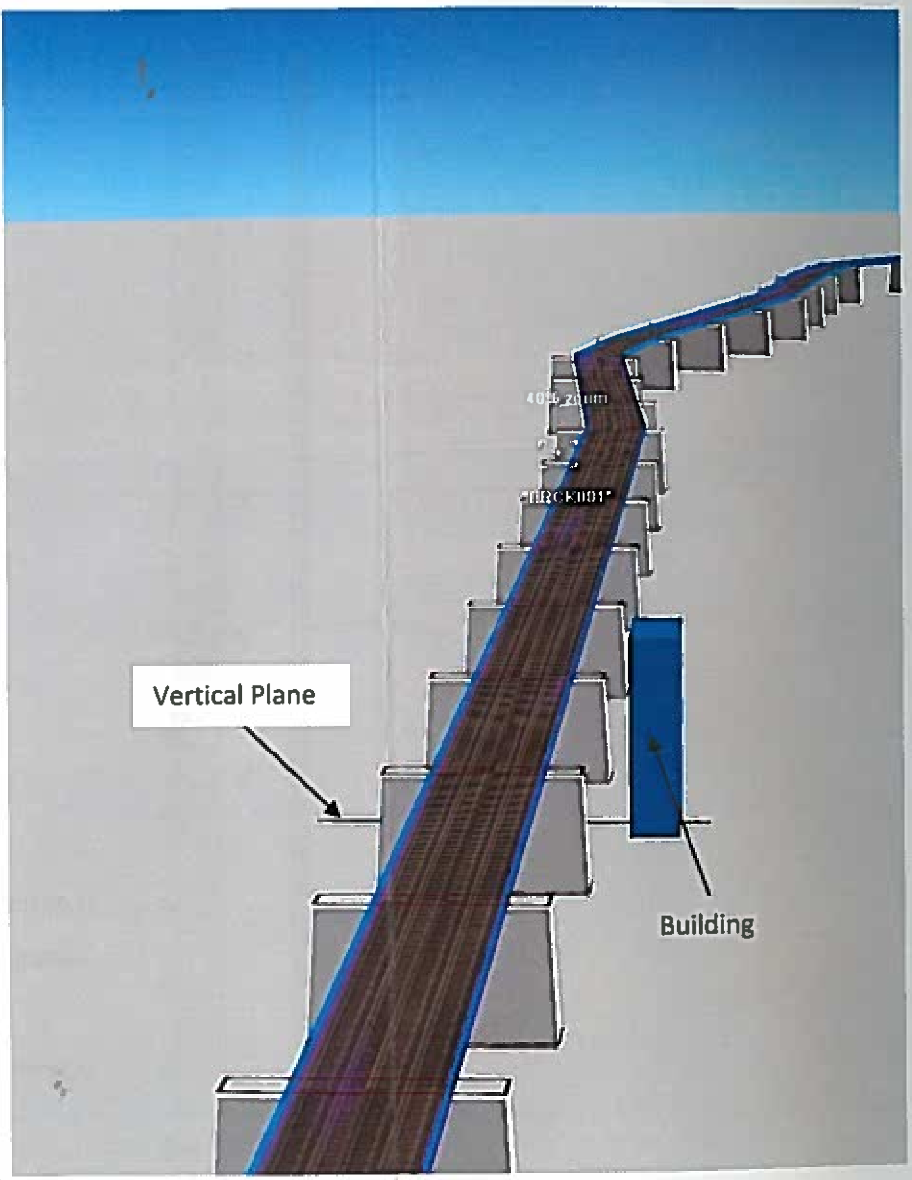


CTS-1708659

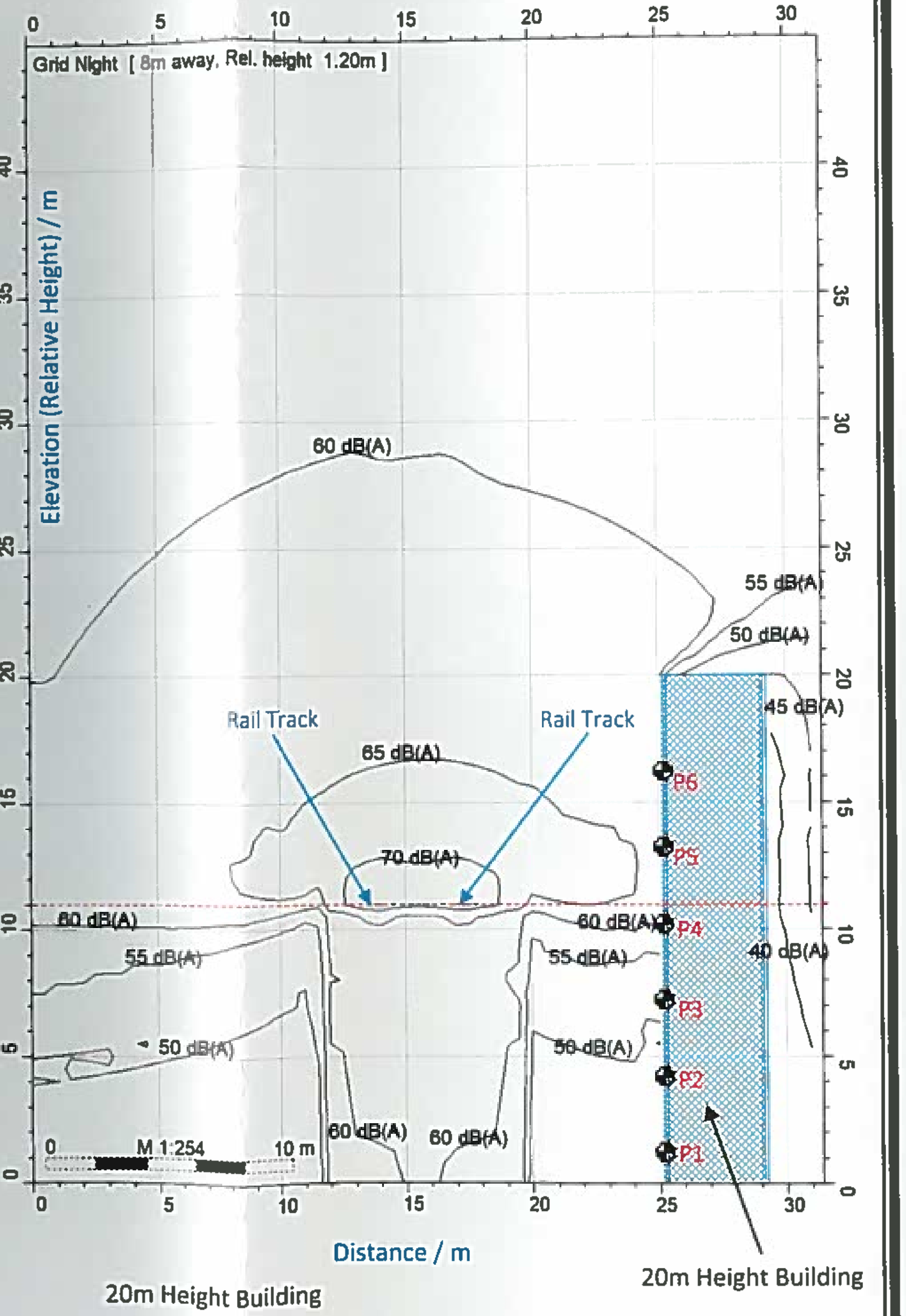
Noise Propagation in Vertical Plane – Case2

Day Time





Night Time



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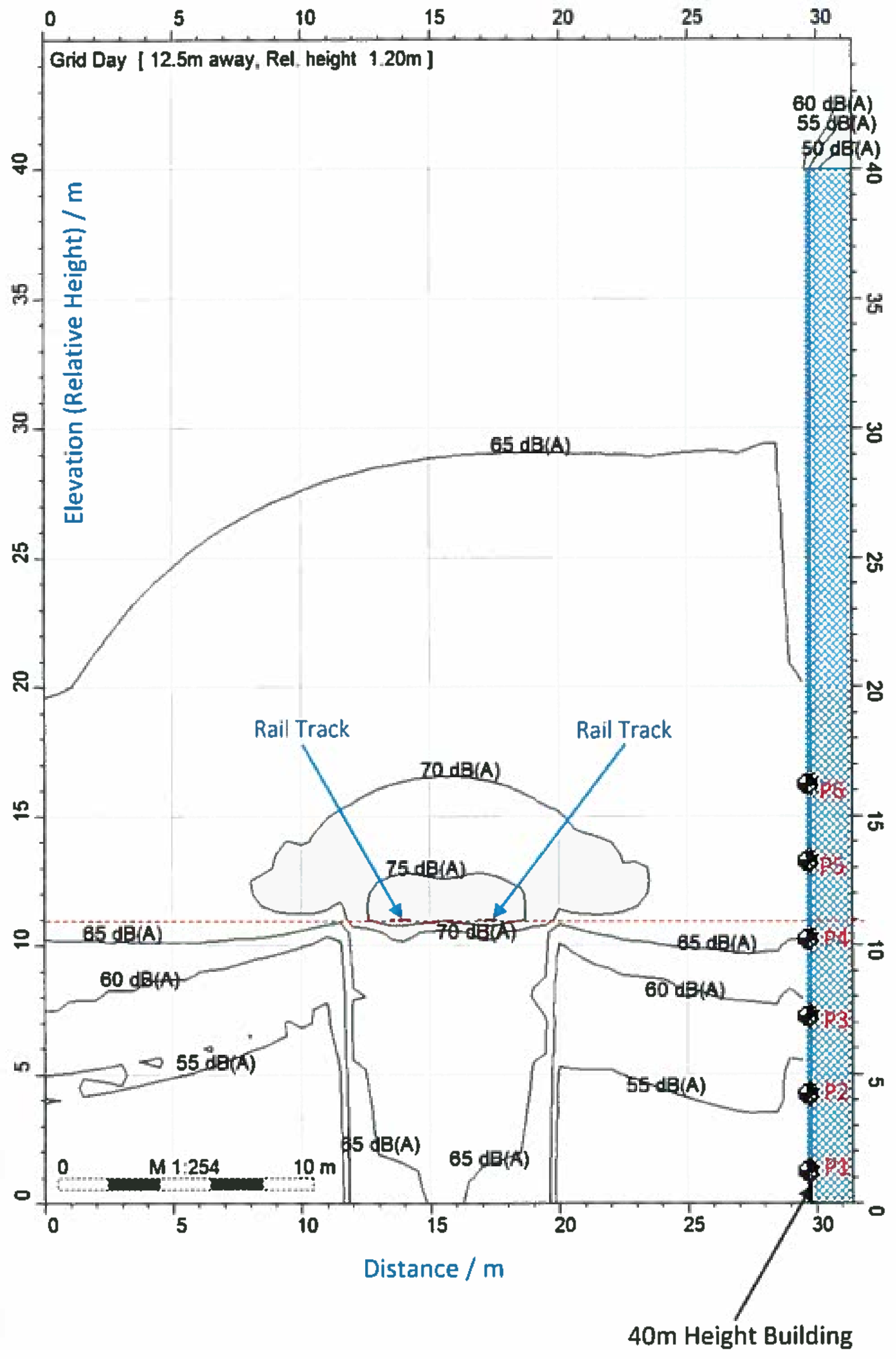
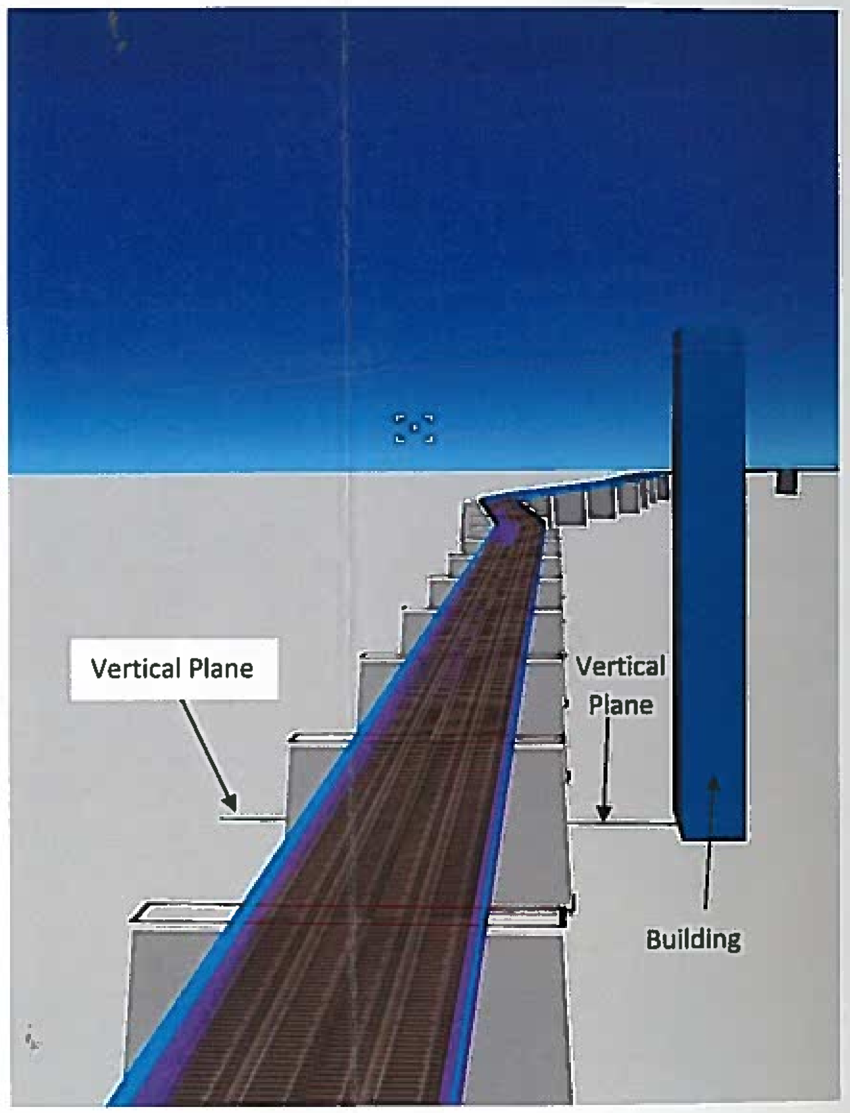
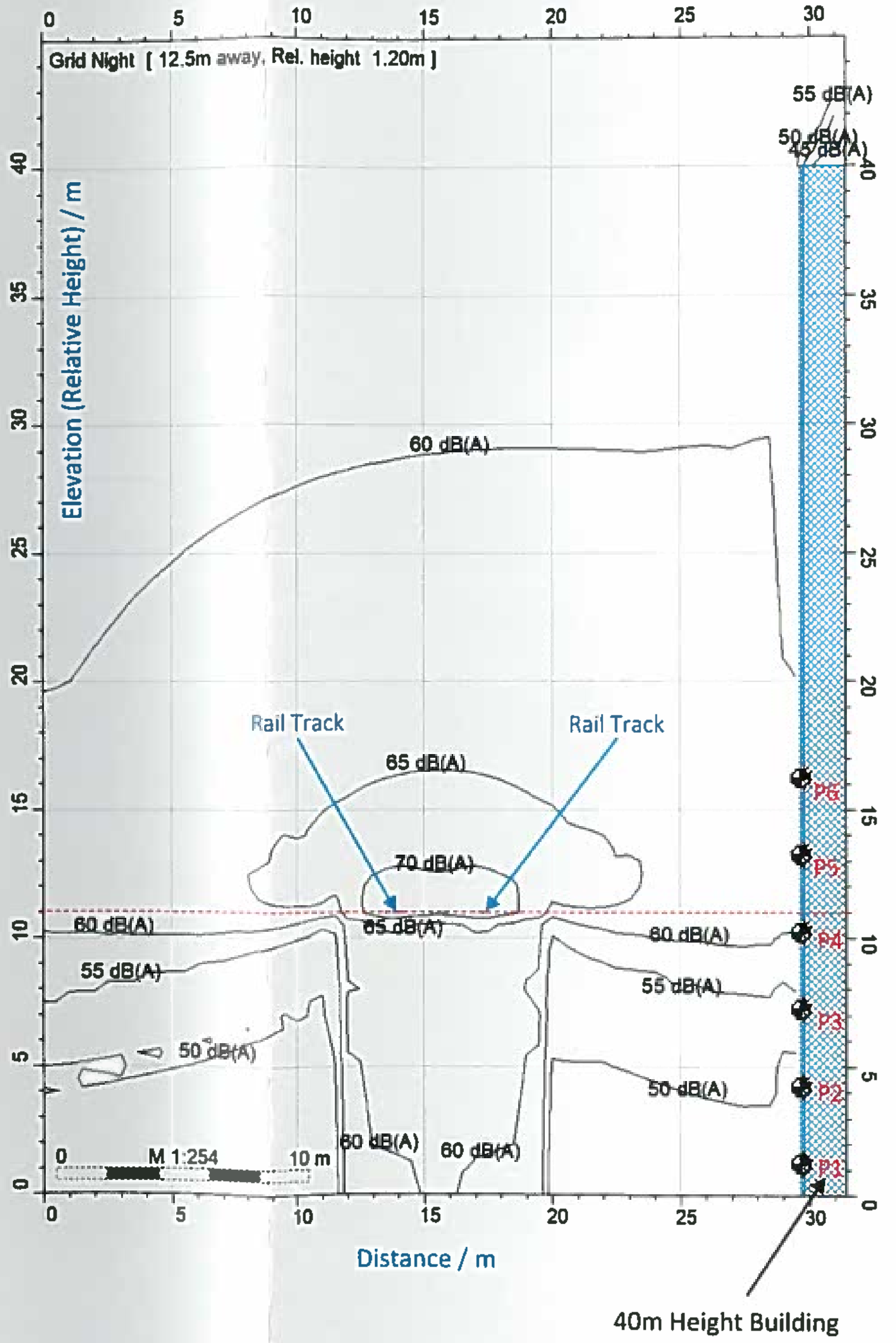
Noise Propagation in Vertical Plane – Case3

Day Time





Night Time



Calculated Condition (Case 3): Consider the noise generated from sky trains on piers and there is a 40m height building at 12.5m away from the nearest railway line.

Annex L

Flood Modelling

Flood Modelling and Other Flood Studies for the Proposed LRT Project

Mitigation Hydrological Impacts

The LRT may aggravate flood lift and delay flood recession during its construction and operation stages. The 2D modelling undertaken by SLLRDC using Sobek Model presents the baseline flood levels and the project induced flood levels for both construction and operation stages. The model also shows the delays in flow recession, if any.

Sub Models for Sensitive Flood Plains

SLLRDC uses one dimensional flood model to model flood scenarios of the Metro Colombo area. MIKE 11 flood model which is a product of Danish Hydraulic Institute is being used for this purpose. This main flood model was used to extract basic parameters for two 2D sub models using Sobek 2D flood model. Two 2D sub models were created for the following areas:

- Sub Model 1-Parliamentary lake and the flood plains of Parliament Lake (Diyawanna Lake)
- Sub Model 2-Depot area and the entry route to the proposed depot are from Malabe Kaduwela Road to the low-lying area on to the left of Chandrika Bandaranayaka Kumaranathunga Mawatha. on the flood plains of Madewela East Diversion Canal. The Depot area is situated.

The selected 2D areas that show sensitive flood plains are depicted in the figures below.

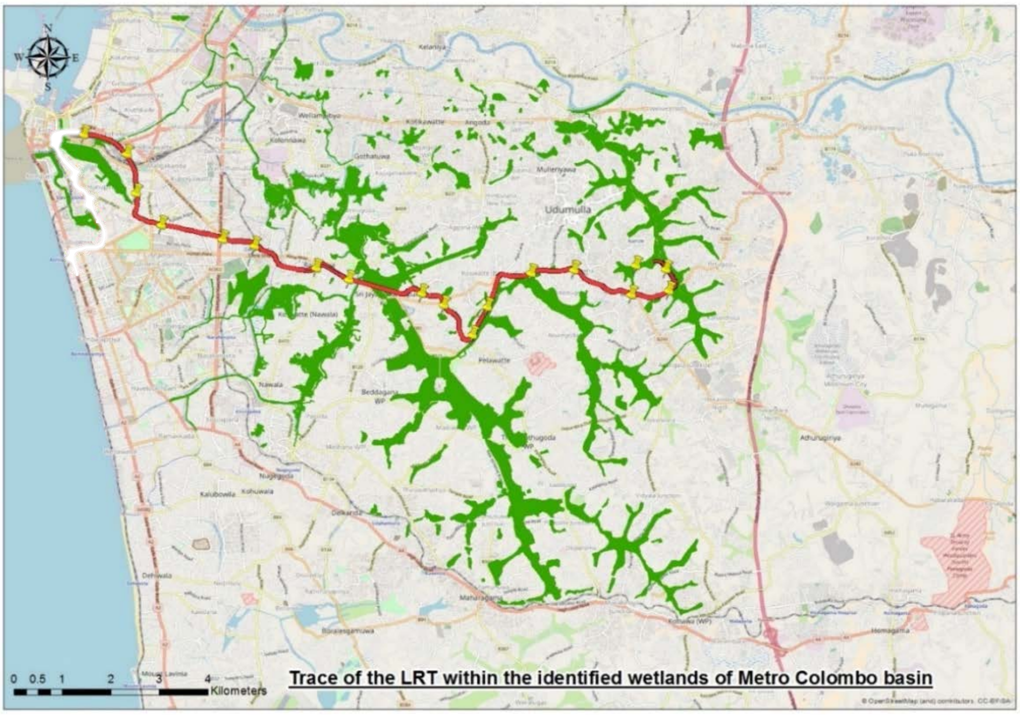


Figure 1- Trace of LRT with Identified Wetlands

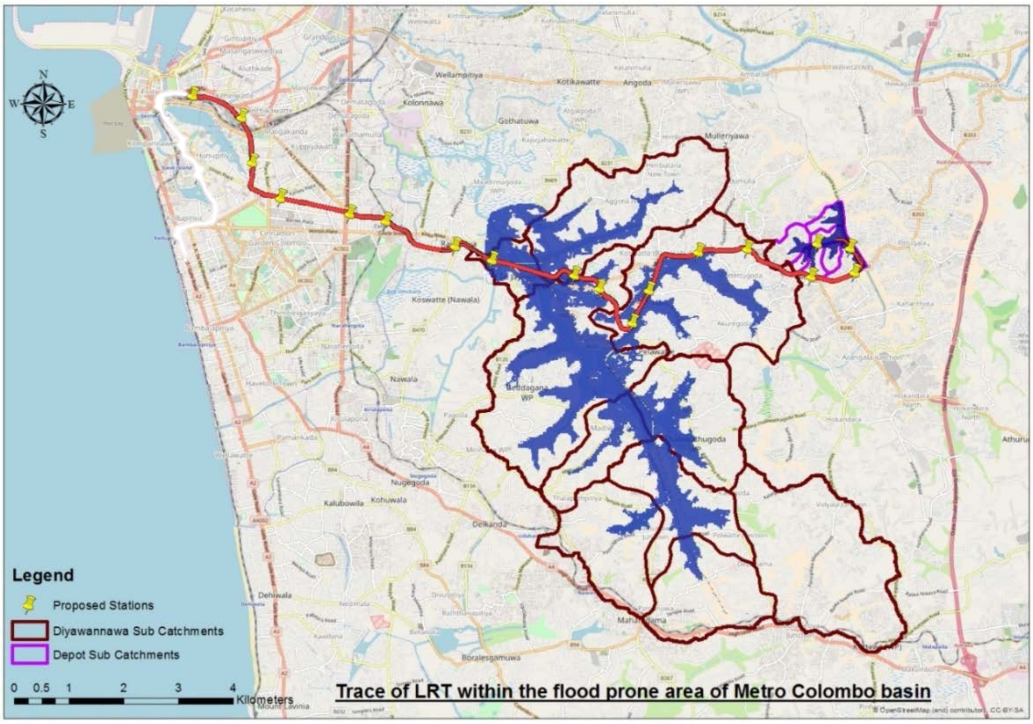


Figure 2- Trace of LRT with Flood Prone Areas

Model Calibration

As the sub models were used only to measure the sensitivity of construction for stochastic events no model calibration was done. However, the sub models were inherited from the SLLRDC master models which have been subjected to some calibration process.

Representation of the LRT in the Model

Representations of the pilot road section was done through raising the elevations of the cross sections beds and the bottom levels of the 2D model area represented by a Digital Elevation Model [DEM]. Similar techniques were used to represent pillars of the LRT on the flood plain for the operational stage. A typical representation of the LART trace at Diyuawanna Lake is depicted in the figure below.

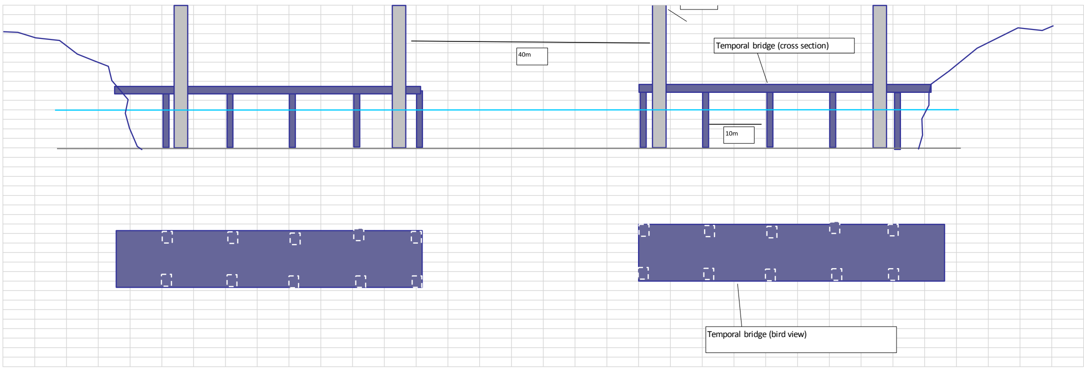


Figure 3- LRT Pillar Representation in Diyawanna Lake

Geometric Parameters Used for The Model

Following main geometric parameters were used to represent the LRT in the flood model for the construction and operational stages

Construction Stage

- Maximum temporary fill height for the depot 0.6m from existing ground level

Operational Stage

- LRT pillar size 1mx1m, LRT pillar spacing 10m,LRT Depot pillar spacing 10mx10m grid

Modelled scenarios

The following scenarios were considered for flood modelling.

1. 10 Year – Without LRT **[Baseline] – for both Diyawanna Lake and Depot**
2. 10 Year – With LRT- **[Construction]- for both Diyawanna Lake and Depot**
3. 50 Year – Without LRT **[Baseline]-Depot**
4. 50 Year – With LRT- **[Operational]-Depot**
5. 100 Year – Without LRT **[Baseline]-Diyawanna Lake**

6. 100 Year – With LRT- **[Operational]-Diyawanna Lake**

As the hydrological impacts on the Pilot Road will be short term (Say 5 years of maximum construction period) 10-year return period was selected for the operational stage standard 100-year return period was selected. Model simulation were carried out for each of these scenarios.

Hydrologic Modelling

For the hydrologic modelling HEC HMS hydrologic model was used. Hydrologic input was through HEC HMS model was provided to the selected sub model area in the hydrodynamic model. A typical inflow hydrograph for one sub catchment is given in the figure below.

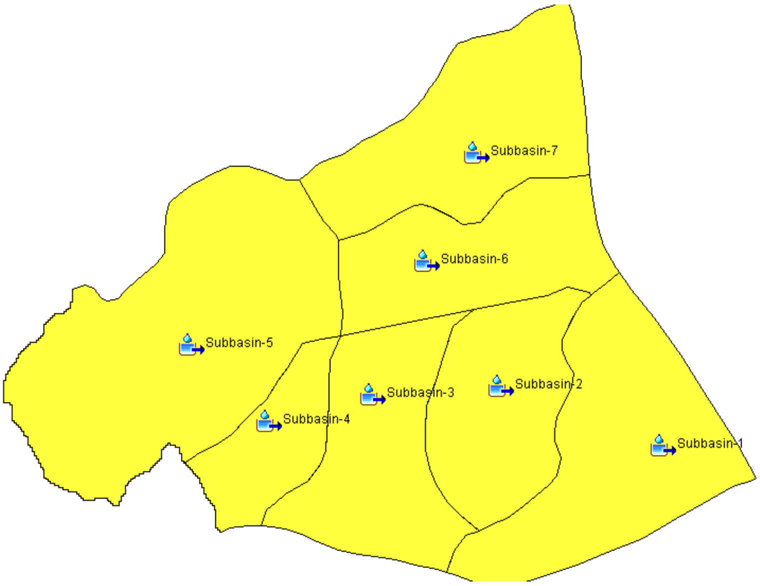


Figure 4-Hydrologic model for the depot area

Hyetograph Formulation

Hyetographs used for 10 Year and 100 Year return periods (using the updated IDF curve for Colombo)

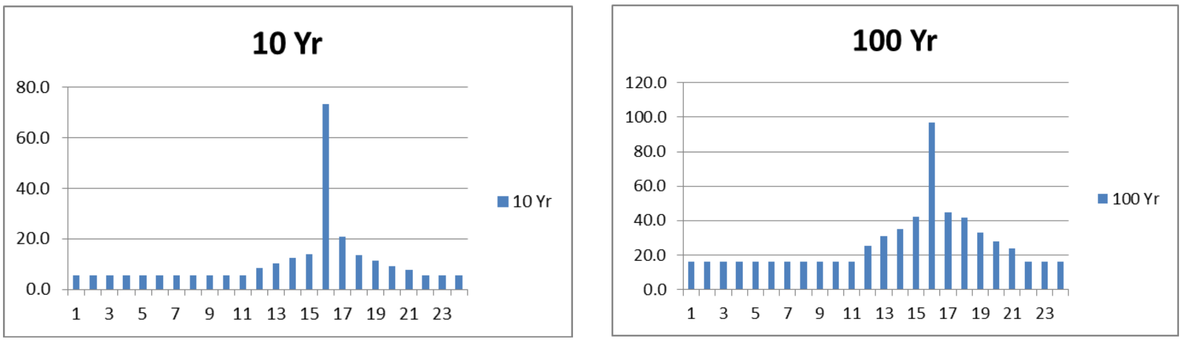


Figure 5-Hyetographs (Rain Histograms) for 10-year and 100-year return periods

Table 1- Hyetographs for Different Return Periods -Alternating Block Method

Time (hr)	Return Period					
	T2	T5	T10	T25	T50	T100
	2	5	10	25	50	100
1	2.5	3.8	5.4	8.2	11.5	16.0
2	2.5	3.8	5.4	8.2	11.5	16.0
3	2.5	3.8	5.4	8.2	11.5	16.0
4	2.5	3.8	5.4	8.2	11.5	16.0
5	2.5	3.8	5.4	8.2	11.5	16.0
6	2.5	3.8	5.4	8.2	11.5	16.0
7	2.5	3.8	5.4	8.2	11.5	16.0
8	2.5	3.8	5.4	8.2	11.5	16.0
9	2.5	3.8	5.4	8.2	11.5	16.0
10	2.5	3.8	5.4	8.2	11.5	16.0
11	2.5	3.8	5.4	8.2	11.5	16.0
12	3.8	5.9	8.5	13.0	18.2	25.5
13	4.5	7.0	10.1	15.7	22.0	31.0
14	5.7	8.2	12.3	20.8	28.1	35.3
15	5.8	9.9	14.0	24.1	31.7	42.5
16	57.0	66.1	73.2	84.5	90.8	96.7
17	14.2	18.0	20.7	25.1	33.4	45.0
18	5.8	9.2	13.4	21.5	29.4	41.6
19	5.0	7.9	11.5	17.7	25.0	32.9
20	4.1	6.4	9.2	14.1	19.9	27.9
21	3.6	5.5	7.9	12.1	17.0	23.7
22	2.5	3.8	5.4	8.2	11.5	16.0
23	2.5	3.8	5.4	8.2	11.5	16.0
24	2.5	3.8	5.4	8.2	11.5	16.0
sum	144.0	196.6	256.1	363.8	476.5	626.5

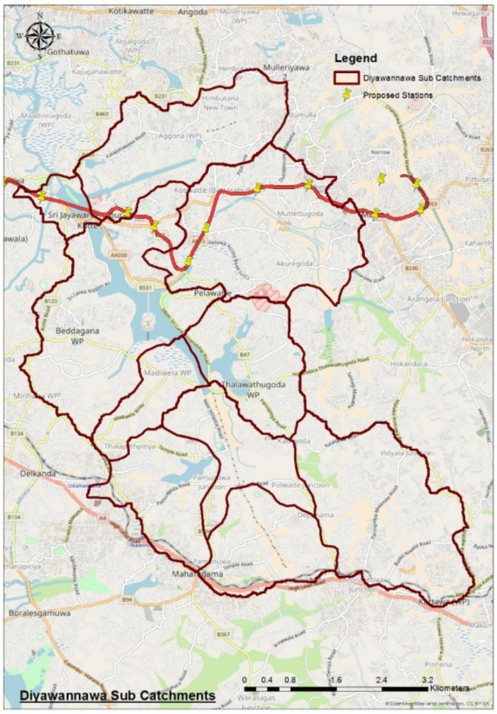


Figure 6-Sub Catchment Areas for Diyawanna Lake

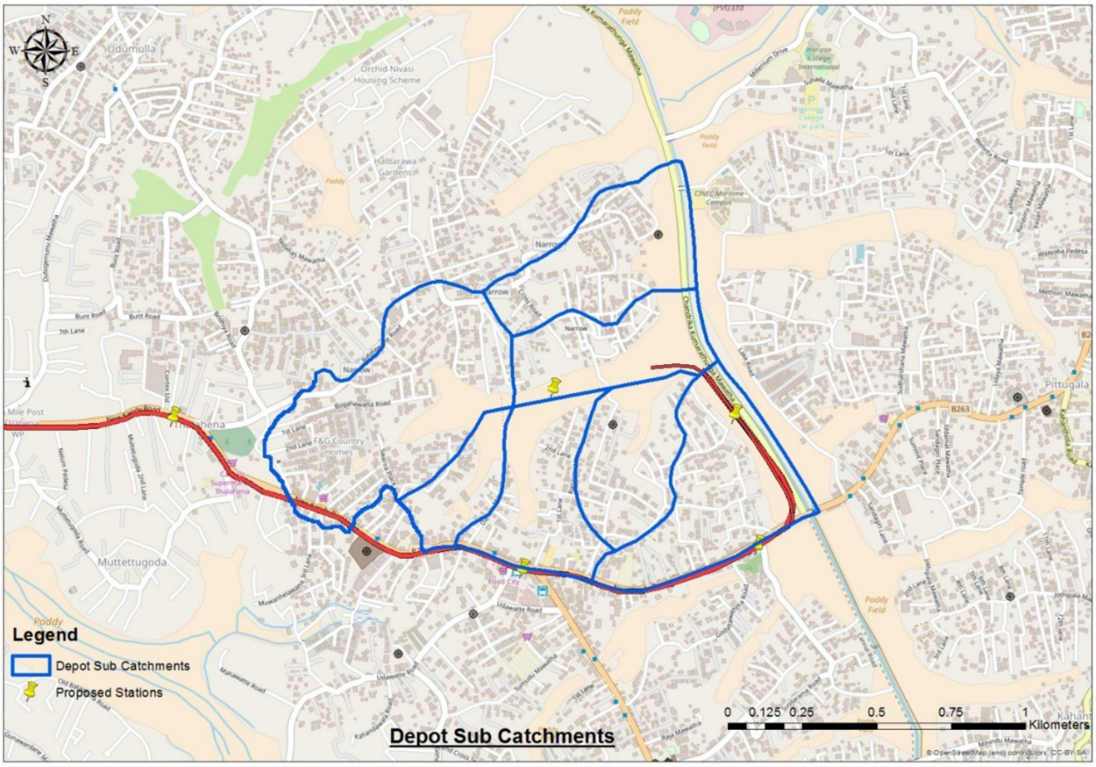


Figure 7-Sub Catchment Areas for Proposed Depot Area

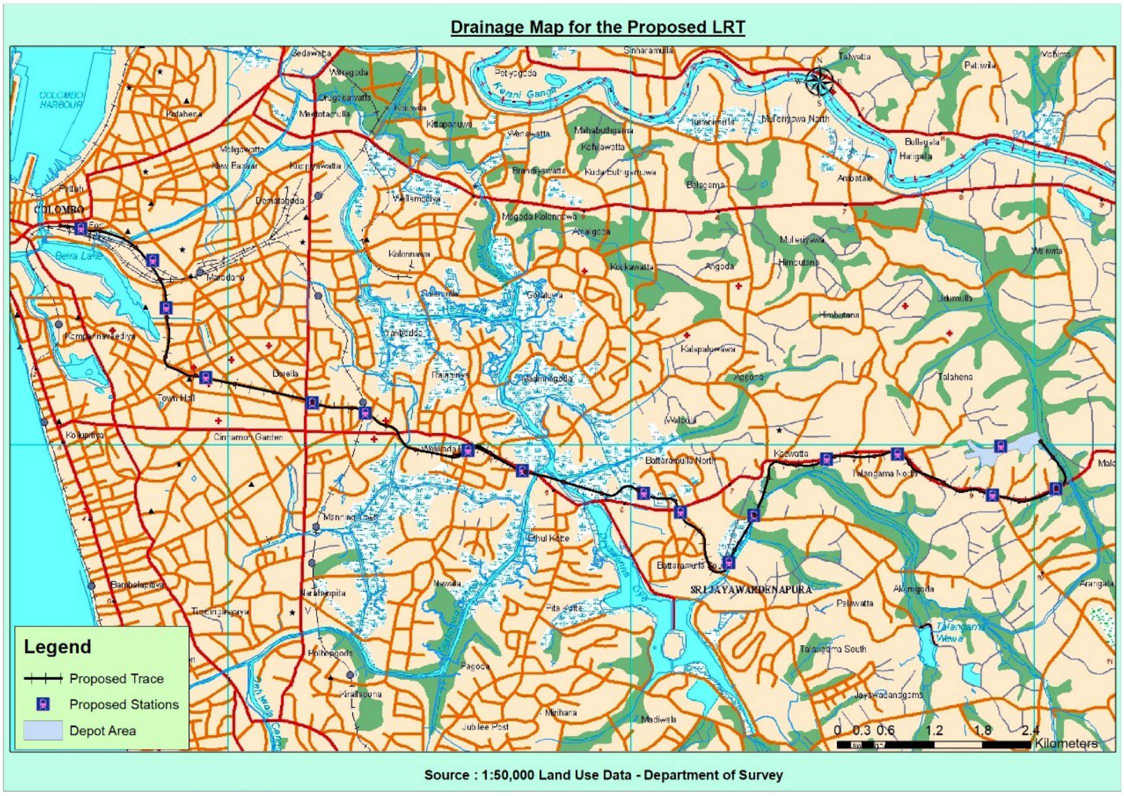


Figure 8-River Network for the Main Model of Colombo Metro Area with LRT Trace

Modelling Results for Different Scenarios

The following model results are presented inter alia.

(1) Water levels with and without LRT for different scenarios for Diyawanna Lake, Depot Area and Parliament

(2) Flood recession times with and without LRT for different scenarios for Diyawanna Lake, Depot Area

(3) Flood extent maps for Depot Area for different scenarios

(4) Flood hydrographs for Depot Area and Diyawanna Lake for different scenarios

Modelling Results

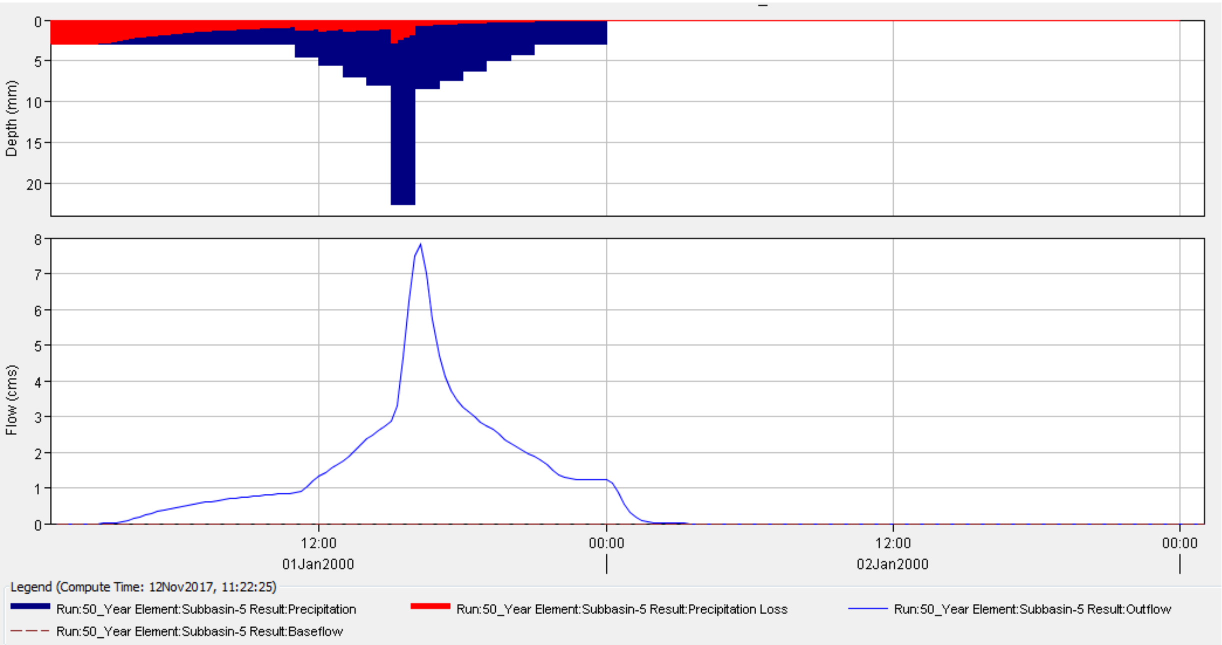


Figure 9-Typical Inflow Hydrograph(Discharge Vs Time Graph) of a sub catchment

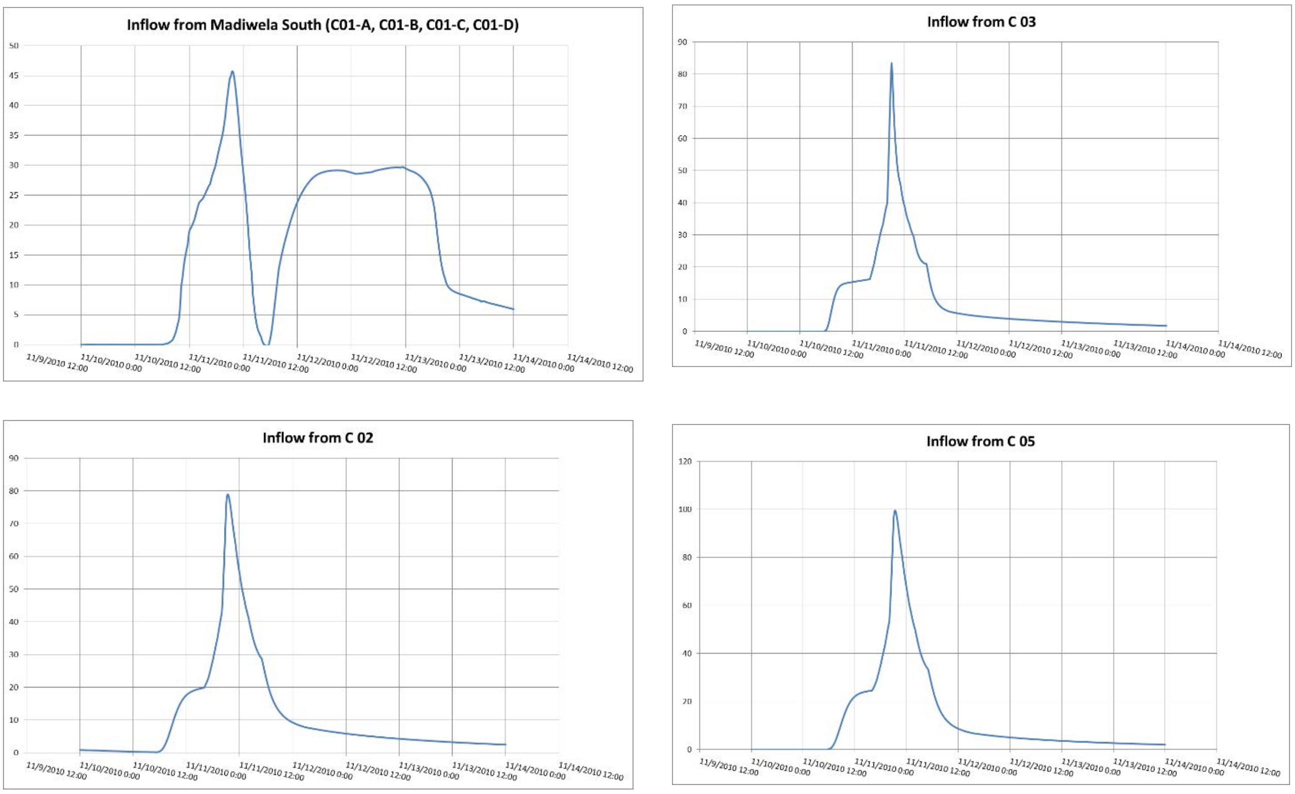


Figure 10-Inflows (Discharge Vs Time) from sub catchments

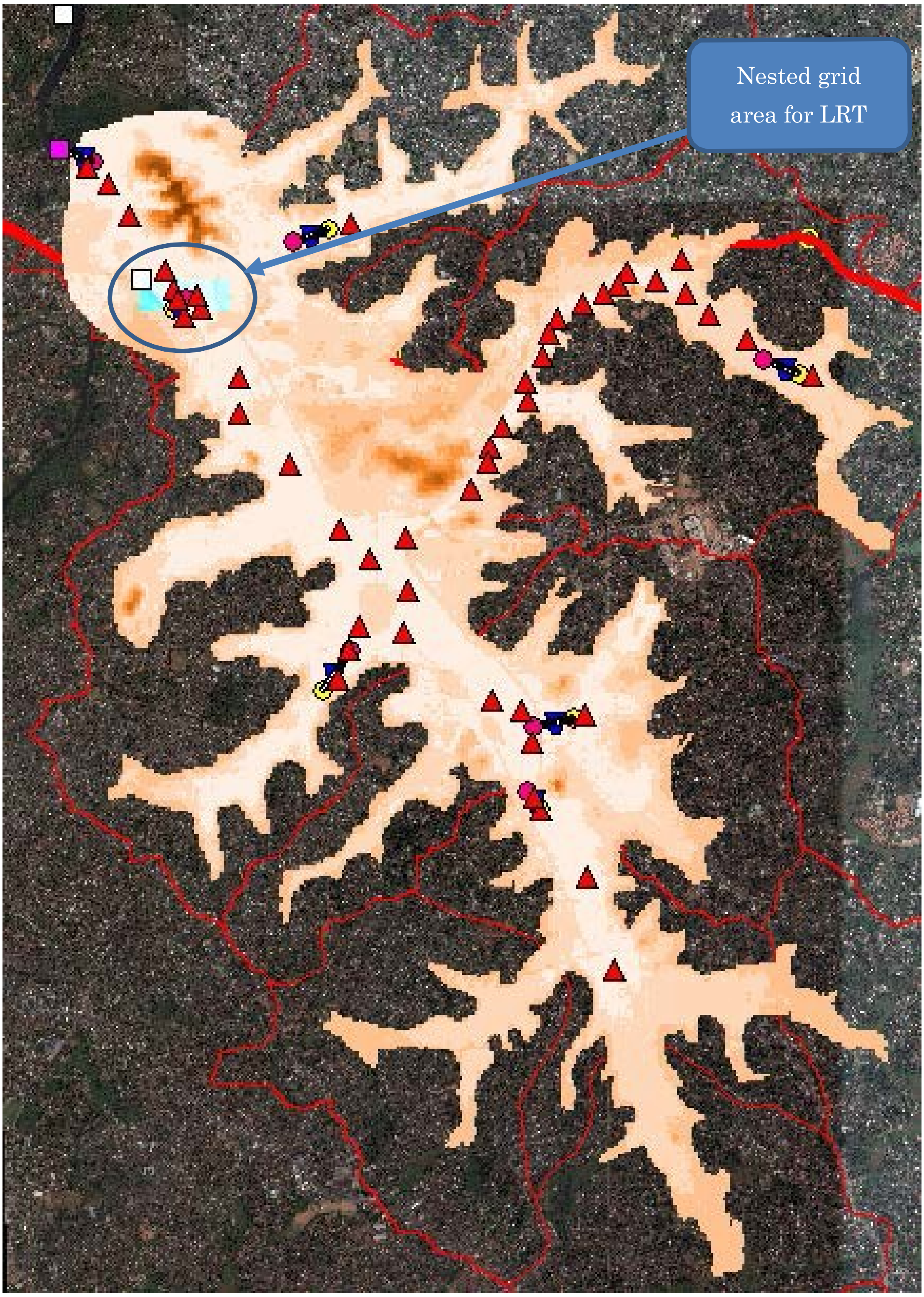
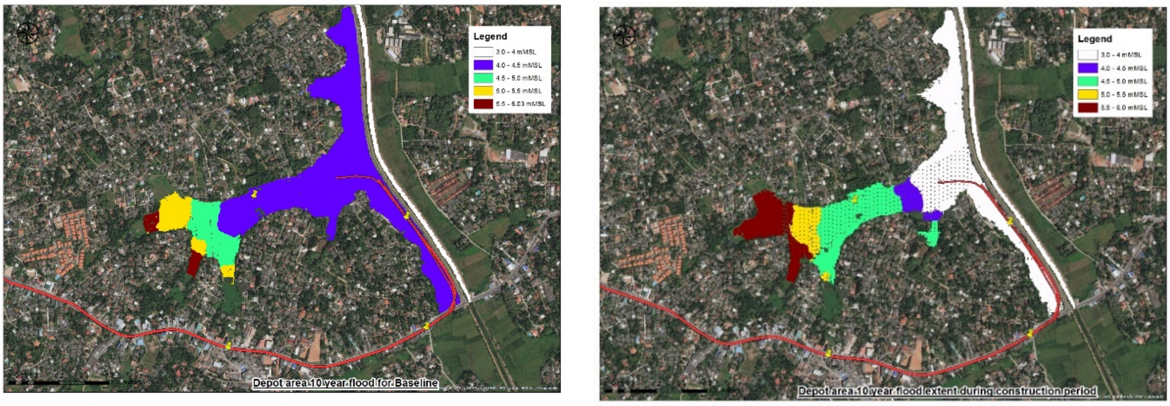


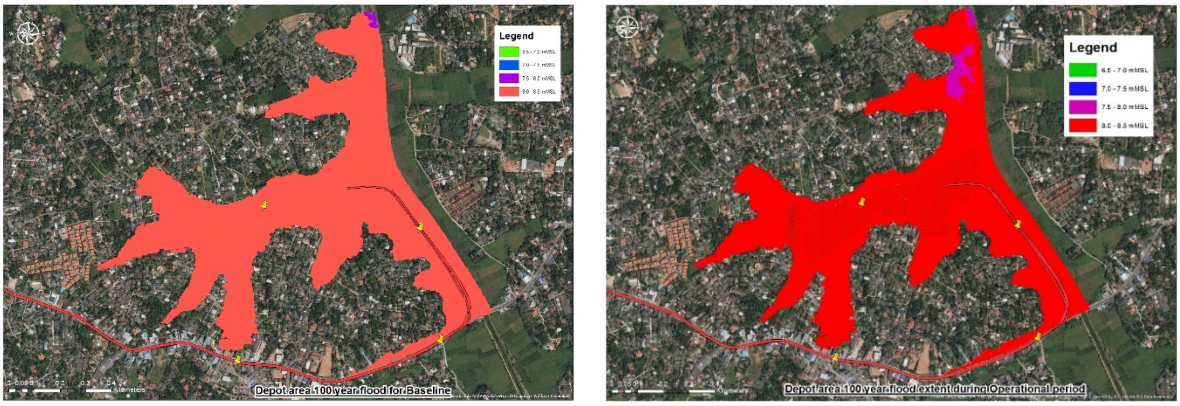
Figure 11-Diyawannawa Sobek 2D Model (Flood Spread with Levels) with nested grid (Finer Grid for LRT Crossing) option

Flood extent maps for depot area for different scenarios are shown in the figures below.



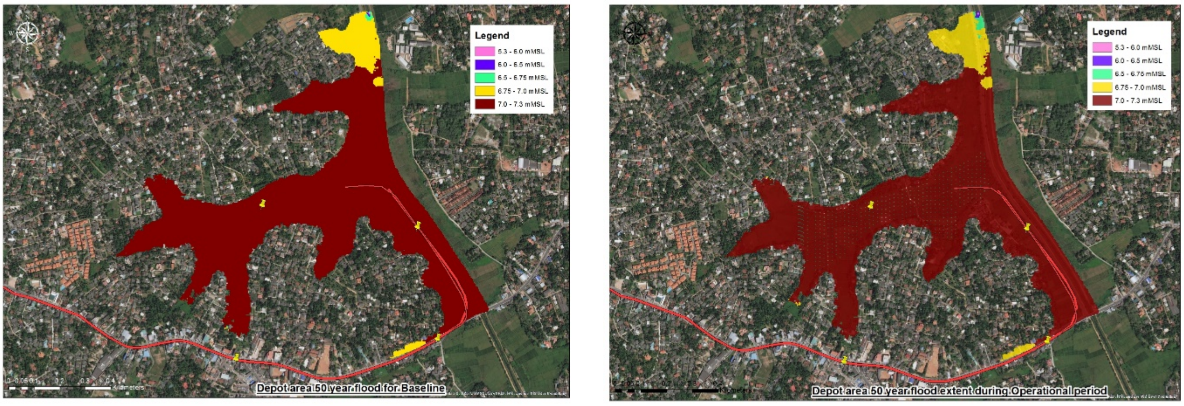
10 Year Flood Extent (Baseline)

10yr flood extent construction period)



50yr flood extent (Baseline)

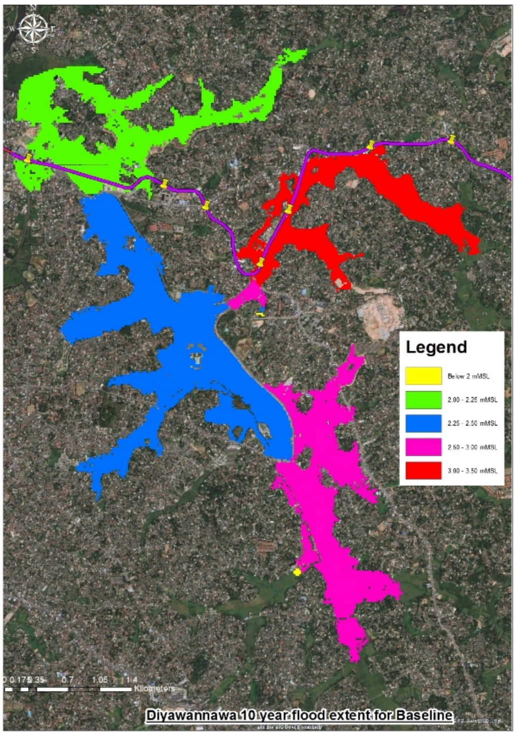
50yr flood extent (operational period)



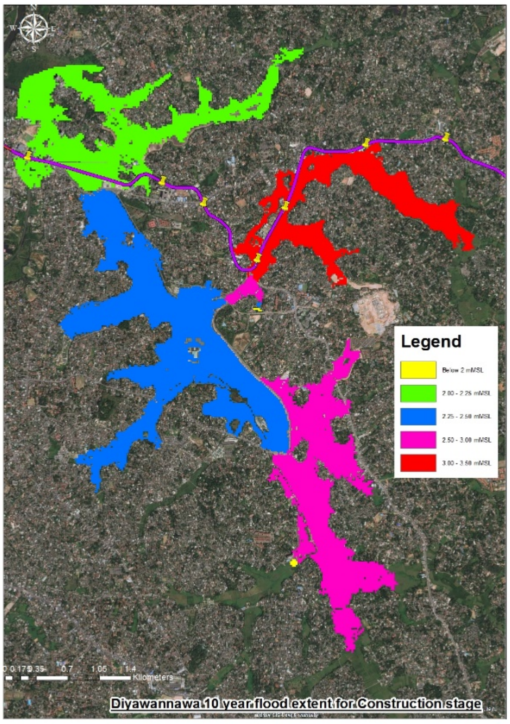
100yr Flood Extent (Baseline)

100yr flood extent (operational period)

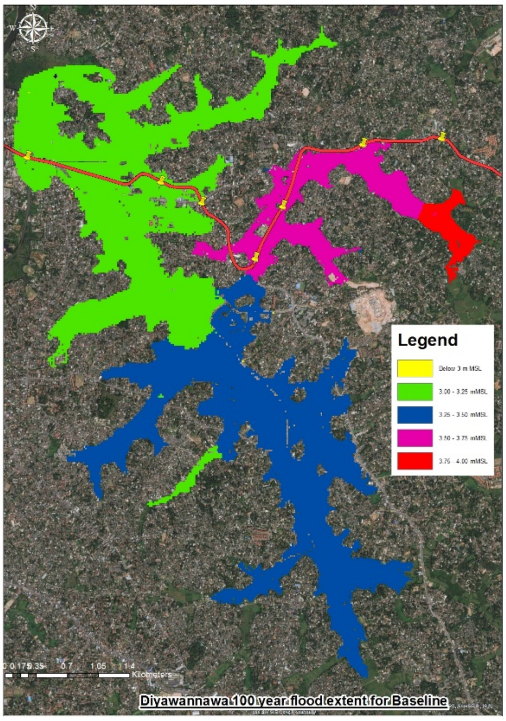
Figure 12-Depot Area flood spread (with levels) under baseline operational conditions



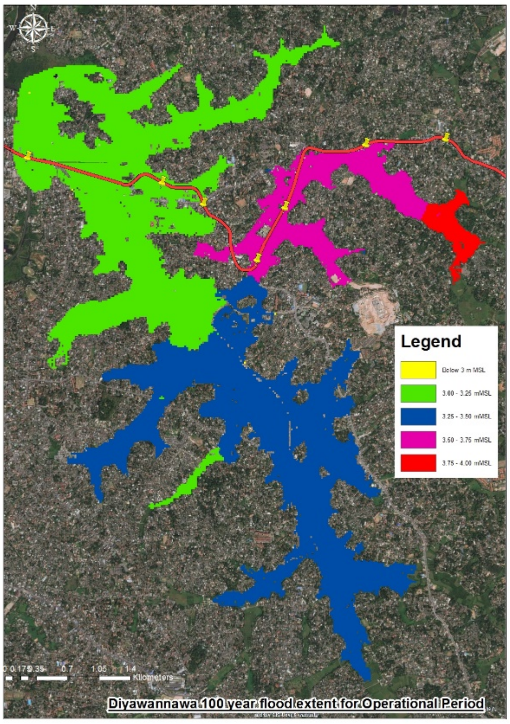
10 Year (Baseline)



10 Year (Construction)



100 Year (Baseline)



100 Year (Operational)

Figure 13-Diyawanna Oya flood spread (with Flood Levels) for the operational condition

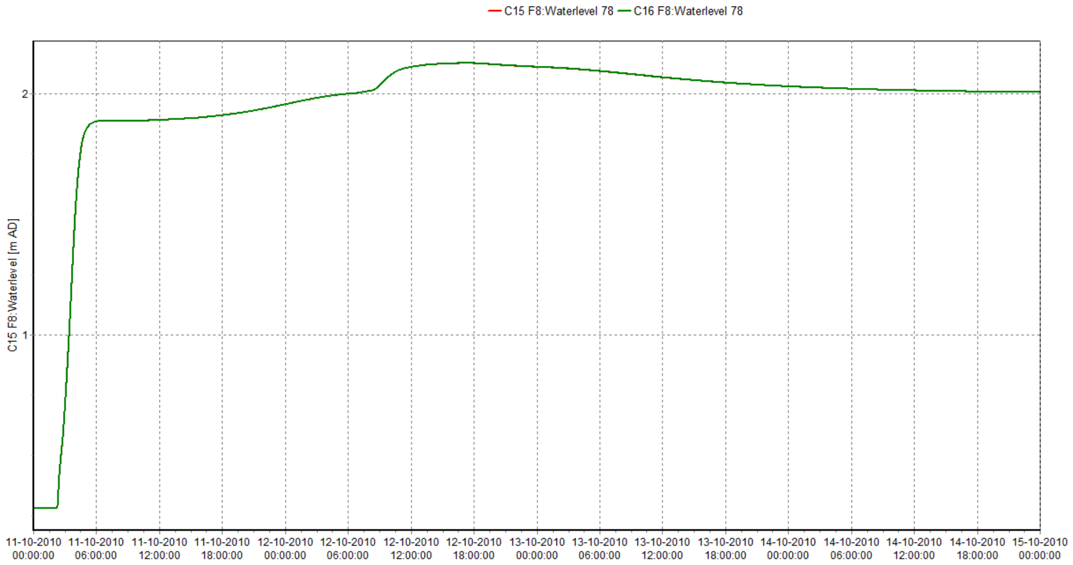


Figure 14-Stage Hydrographs (Water Level vs Time) for Diyawanna Lake for Construction and Operational Conditions

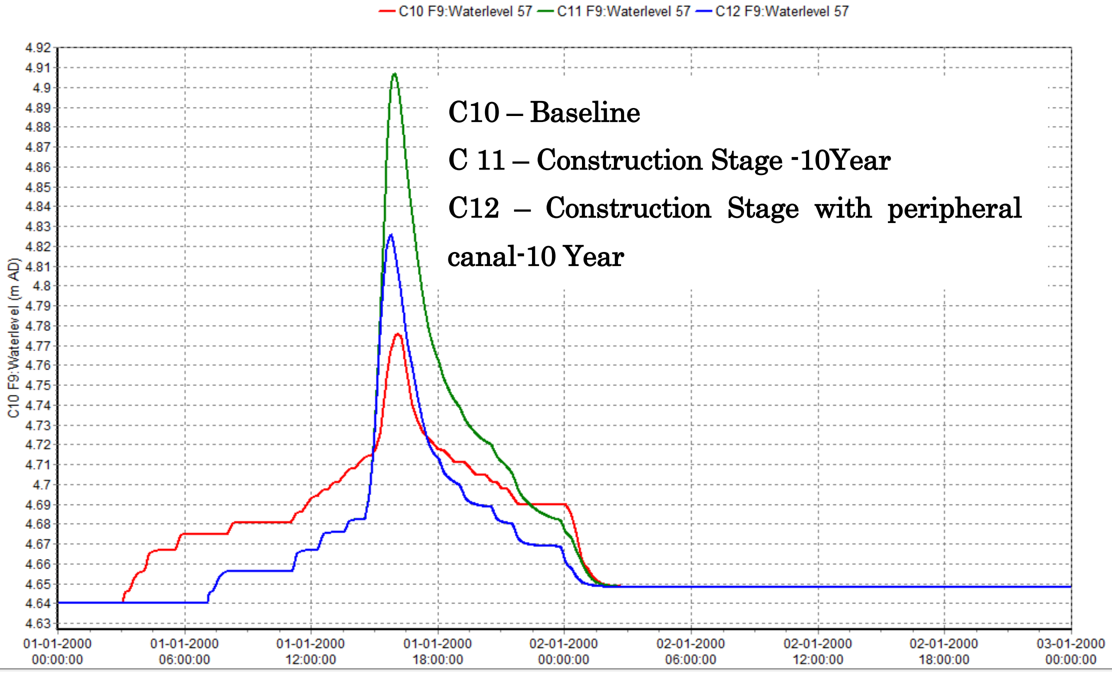


Figure 15-Stage Hydrographs (Water Level vs Time) for Depot for Construction and Operational Conditions including the peripheral canal

Table 2 - Water levels and extra flood lift (backwater) for selected scenarios

No	Scenario	Place	Flood Level-Without LRT MSL (m)	Flood Level-With LRT MSL (m)	Backwater (Extra Flood Lift) (m)	Remarks
1	Baseline-10 Year	Diyawanna Lake	2.1	2.1	Nil	No significant backwater
2	Construction-10 Year					
3	Baseline-10 Year	Depot Area	4.62	**	**	**
4	Construction-10 Year		**	4.91	0.29	Backwater is considerable
5	Construction-10 Year with 3m wide peripheral canal		**	4.8	0.18	Backwater reduces with the proposed canal
6	Baseline-50 Year/100 Year		7.16/8.38	**	0.09/0.04	No significant backwater during the
7	Operational-50 Year/100 year		**	7.25/8.42		
10	Baseline-100Year	Parliament	3.16	3.16	**	There is no difference in WL due to introduction of LRT pillars
11	Construction-100 Year		**	3.16	0.00	

Flood recession times with and without LRT for different scenarios for Diyawanna Lake, Depot Area is shown in the table below.

Table 3-Delay in flood recession for selected scenarios

No	Scenario	Place	Flood Recession Time without LRT (hrs)	Flood Recession Time with LRT (Hrs)	Flood Recession Delay (hrs)	Remarks
1	Baseline-10 Year	Diyawanna Lake	As there is no backwater no change in recession time.			Flood recession delay is significant with temporary filling.
2	Construction-10 Year					
3	Baseline-10 Year	Depot Area	16	**	14	
4	Construction-10 Year		**	More than 30		
5	Construction-10 Year with 3m wide peripheral canal		**	15	-1.0	
6	Baseline-50 year/100 Year		19.5/20	**	0/ 0	
7	Operational-50 year/100 Year		**	19.5 /20		Proposed canal reduces recession time.
8	Baseline-10 Year	Parliament	Since there is no backwater for both construction and operational stages for Diyawanna Oya Lake there is no backwater near Parliament which is upstream.			
9	Construction-10 Year					
10	Baseline-100Year					
11	Construction-100 Year					

Note: The durations are based on animation and propagation of flood of 2D simulation.

Determination of 100 Year Flood Level for the Depot

One hundred flood level for the depot site was independently obtained using the flood frequency analysis of Kelani River water levels at Ambatale which is the closest river gauging station for the Depot. The flood frequency curve and the flood frequency analysis table are given below. Depot elevation will be kept above 100-year flood level.

Table 4– Flood Frequency Details for Kerlani River at Ambatale

Return Period	Frequency Factor	WL in m
2	-0.151	4.29
5	0.888	5.30
10	1.575	5.96
20	2.235	6.60
50	3.089	7.43
100	3.728	8.05

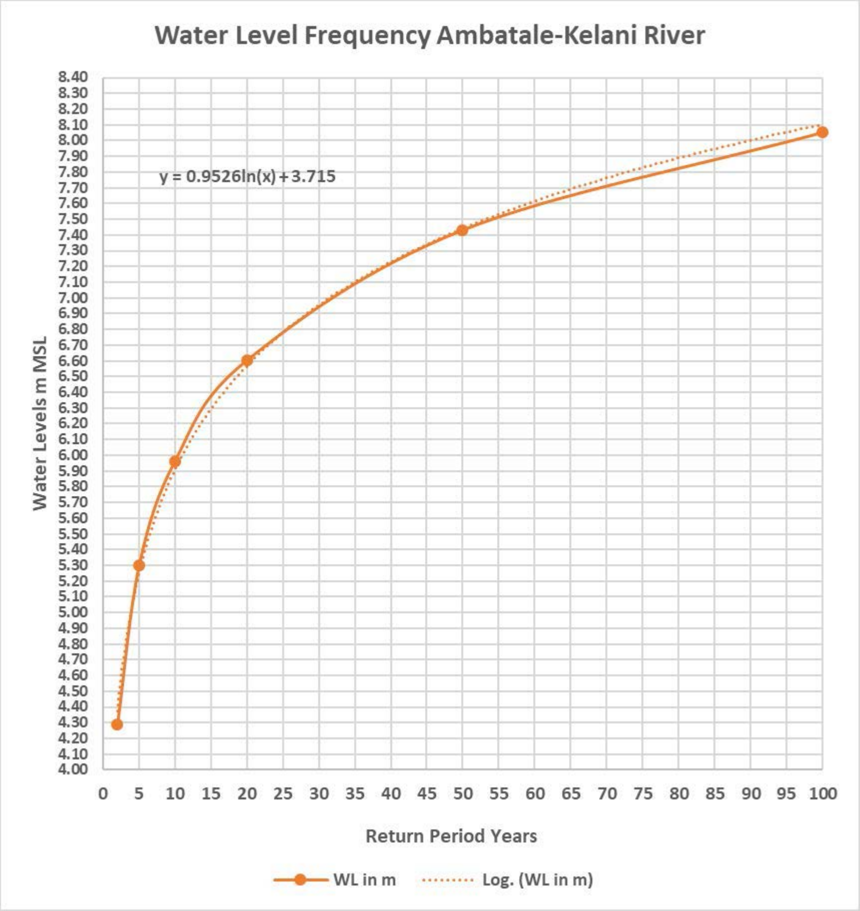


Figure 21 - Flood Frequency Curve Kelani River at Ambatale

Conclusions

It could be concluded that proposed LRT can cause backwater impacts near the depot site because of temporary filling if a 3m wide temporary peripheral canal is not provided. Hence the temporary canal provision is a vital need.

Also, the LRT will not cause any considerable hydrological impact in terms of flood lift (backwater) or flood recession (Delay in flood receding) during its operational stage because of the pillars in Diyawanna Lake and in the Depot site near Chandrika Bandaranayaka Kumasranathunga Mawatha.

Annex M

Scoping and Impact Assessment based on JICA TOR

Impact assessment based on JICA TOR

1 Environmental Scoping Results

Potential environmental and social impacts that may be caused by the project were identified and rated by the Study Team according to JICA TOR. The results are summarized in the table below.

Table 1 Scoping Results

Items	Assessment		Explanation and Points to Remember	
	Construction	Operation	Construction	Operation
Pollution Control				
Air Pollution	A-	B+	Air pollution can increase because of construction works, operation of machineries and movement of workers and materials.	Emissions will be limited to operation of machineries for the maintenance of the rolling stocks at the depot area. The project can reduce volume of traffic, which can lead to improved air quality.
Water Pollution	B-	B-	Wastewater will be produced during construction activities. Also, contaminated water may be generated from the construction of pillars' foundation on the surface.	Wastewater will be produced during maintenance works at the depot and stations. Sewage will also be produced.
Noise & Vibration	A-	A-	Noise will be generated from construction equipment and construction works.	LRT will use steel wheels. Noise will be generated from the movement of the LRT. During maintenance works, the depot area can generate noise and vibration.
Waste/ Soil Contamination	B-	B-	Excavated soil, sludge and general waste will be generated.	Solid and liquid wastes will be generated from the stations and depot area.
Foul Odour	D	D	It is assumed that foul odour will not be generated during construction and	

Items	Assessment		Explanation and Points to Remember	
	Construction	Operation	Construction	Operation
			operation.	
Natural Environment				
Hydrology	C	C	The proposed LRT route will pass through Diyawanna Lake and the depot area is planned to be built on agricultural land/ watershed area. Thus, there is a possibility of altering the hydrology of the area.	
Topography & Geology	D	D	The project area is comparatively flat. There will be no major soil cutting and embankment is planned.	
Benthic environment (bottom sediment)	B-	D	There is a possibility that the project will affect benthic environment. There is a need to thoroughly investigate how to minimize impacts, when bridges are built.	No impact is assumed.
Protected Areas	B-	C	There is a possibility that the planned LRT route will pass through DWC (Department of Wildlife Conservation) designated Sri Jayawardana Bird Sanctuary and CEA (Central Environmental Agency) designated Thalangama Environmental Protected Area.	
Ecosystem	B-	C	Trees and plants along the planned LRT route may be removed or cut. These may include culturally important and old trees (e.g. Bo trees).	There is a possibility of impacts due to the management of plants in order to recover trees felled during construction period.
Social Environment				
Land acquisition and involuntary resettlement	A-	C	The project will need to acquire public and private land, particularly for the stations. Also, around 6-7 ha of agricultural land and wetland will be acquired for the depot area. It is projected that more than 50 households will be resettled due to	There is a possibility that impacts due to land acquisition, resettlement and loss of livelihood will remain.

Items	Assessment		Explanation and Points to Remember	
	Construction	Operation	Construction	Operation
			the project.	
Local economy (employment & livelihood)	B+	B+	It is projected that the local economy will be revitalized with the increase in employment opportunities for technical and general workers.	The project will contribute in developing the local economy through the reduction of commuting time and increased access to traffic.
Land use and local resource use	B-	B+	In this project, existing roads and current land use will be utilized as much as possible. Approximately 7ha of agricultural land in Malabe area will be used as depot area.	Effective land utilization along the planned LRT route and development of regional economy are expected. Increased urbanization may lead to environmental concerns such as increase in waste generation.
Social capital and social institutions (e.g. local decision-making bodies)	D	D	No particular impact is assumed.	
Existing social infrastructures and services	A-	B+	There is a possibility that exiting social infrastructures (e.g. road, relocation of electricity wires, water pipelines) will be affected during construction.	The project will contribute in the development of the local economy and improvement of surrounding social infrastructure and services
Poverty	C	D	There are no slums along the planned LRT route. However, affected households in land acquisition may include poor families.	
Minority Groups. Indigenous People	D	D	There are no minority groups or indigenous people residing within the project site.	

Items	Assessment		Explanation and Points to Remember	
	Construction	Operation	Construction	Operation
Unequal distribution of benefits and damages	C	C	No significant impact on unequal distribution of benefits and damages is expected from this project. However, there is a need to carefully address compensation payment to affected people, who will be resettled or lose livelihood.	
Conflicting interests in the region	C	C	There may be some impact on local conflict of interests	
Gender	C	C	There may be some impact on gender	
Child's rights	C	C	there may be some impact on impact on child's rights t.	
Cultural heritage	A-	C	The project may affect culturally important festivals and Bo trees. There are Bo trees and festival activities held along the planned LRT route. Among these, the Perahera Festival held around the Gangaramaya Temple and the Bo tree in Borella junction, are considered to have high religious value.	The number of temple visitors may increase due to the introduction of the LRT.
Landscape	A-	A+/-	During construction, landscape is temporarily affected due to dust and presence of construction machineries.	The introduction of the elevated structures in Colombo will create a new landscape. It is important to carefully consider the impacts of this new landscape.
Infectious diseases such as HIV and AIDS	C	D	The influx of construction workers may increase the risk of spreading infectious diseases.	No particular negative impact related to infectious diseases is assumed
Work environment (including occupational	B-	B+	Traffic flow will be restricted in areas surrounding construction works. This restriction may increase traffic	The project will introduce a safer transportation system.

Items	Assessment		Explanation and Points to Remember	
	Construction	Operation	Construction	Operation
safety)			accidents.	
Others				
Cross-border impacts & climate change	D	B+		The project will contribute in the reduction of greenhouse gases such as CO_2 from the transport sector.
Light and Ventilation	D	B-		Structures may block sunlight by casting shadows on surrounding areas, particularly those along the LRT route and depot area. Also, the elevated structure may block the flow of air in some areas.

Source: Study Team

2 Impact Assessment

The assessment of potential impacts due to the project during construction and operation phases is summarised inTable2 below. Ratings are given to provide an idea of the scale and type of the impacts.

Based on the assessment results, most of the negative environmental and social impacts will be generated during construction phase. Particular attention will be given to land acquisition, impact on existing facilities/utilities, land use and landscape changes, air pollution, waste management and disposal, and impact on trees (particularly Bo trees) along the proposed route. During operation phase, significant impacts that need to be mitigated and managed include noise, vibration and wastes (solid and liquid).

Table 2 Impact Assessment Summary

IMPACT	RATING	CONSTRUCTION PHASE	RATING	OPERATION PHASE
POLLUTION CONTROL				

IMPACT	RATING	CONSTRUCTION PHASE	RATING	OPERATION PHASE
AIR QUALITY	A-	• Dust will be generated from material transport and handling and excavation activities • Construction machineries and vehicles will also generate air emissions	B+	• Air emissions will be limited to operation of machineries for the maintenance of the rolling stocks at the depot area. • The project can contribute to the reduction of traffic volume, which can lead to improved air quality.
WATER AND SOIL QUALITY	B-	• Excavated materials, spoil and other wastes from construction activities may be prone to erosion • Wastes will be generated by construction workers • There is risk of spillage, leakage and accidental discharge of oil from construction vehicles	B-	• Approximately 100m^3/day of wastewater (containing oil and grease, detergent, dust) will be generated from maintenance activities at the depot during operation. • There may be risk of spillage, leakage, and accidental discharge. • Wastewater from toilets and washing facilities at train stations will also be generated
NOISE	A-	• Increased noise levels due to operation of heavy equipment and machineries, in the vicinity of the construction site • Baseline survey results already show exceedances of noise limits at some noise sensitive receptors	B-	• Noise modelling results meet noise level standards for peak noise (LAmax) and equivalent noise (LAeq) levels set in Japan and Australia. • There may be disturbance, especially to noise sensitive areas (6 hospitals, 5 schools and 4 educational institutions)
VIBRATION	A-	• In general, vibration from construction activities is considered to have low likelihood to cause structural damage to surrounding buildings • For areas with narrow roads (distance of roadside to the vibration source is around 8m or less), vibration levels may exceed maximum permissible limits for structures built with light materials and archaeologically important structures	B-	• Vibration level from the LRT operation may potentially exceed the perceptible threshold for humans, but significant adverse impact on surrounding structures is not expected.
SOLID WASTE	B-	• Construction wastes (e.g. building rubble, excavated soil, construction wastes) will be generated which may cause nuisance to pedestrians and other road users. • Temporary impact on the aesthetics of the city	B-	• Wastes generated from the depot area consist of lubricant oil, sludge, brake shoe, metal scraps and rubber tubes. • Wastes will be generated by LRT users at the train stations.
FOUL ODOR	D	Foul odour will not be generated during construction	D	No impact assumed
NATURAL ENVIRONMENT				

IMPACT	RATING	CONSTRUCTION PHASE	RATING	OPERATION PHASE
HYDROLOGY	B-	• The LRT route will cross Diyawanna Lake and the depot will be built on a flood plain • Based on flood modelling (10-yr return period) results, significant backwater (flood lift) may occur at the depot area during construction stage • Construction activities may hamper and block existing drainage flows.	D	• Based on flood modelling (50-yr return period) results, backwater (flood lift) is not expected to occur at the depot area during operation stage
TOPOGRAPHY & GEOLOGY	D	• The project area is comparatively flat. There will be no major soil cutting and embankment is planned.	D	No impact assumed
BENTHIC ENVIRONMENT	B-	• The proposed LRT route will cross Diyawanna Lake. • Construction of piers may affect the benthic environment (bottom sediments) of the lake. • The ecosystem in the lake has already been altered significantly due to reclamation activities	D	No impact assumed
PROTECTED AREAS	D	• The LRT will not have any direct impact on Sri Jawardenapura-Bird Sanctuary and Thalangama EPA. • The LRT route has been designed to avoid these protected areas	D	No impact assumed
ECOSYSTEM (FLORA & FAUNA)	B-	• 89 trees planted along Denzil Kobbekaduwua Mawattha, may need to be removed. • Several other trees need to be trimmed • Loss of green area (e.g. agricultural land) in the proposed depot area	D	No impact assumed
SOCIAL ENVIRONMENT				
LAND ACQUISITION & INVOLUNTARY RESETTLEMENT	A-	• Land acquisition and resettlement of 2 households and 101 totally and partially affected businesses • About 250,000m^2 of land needs to be acquired. Around 82% of this is private land and a bulk of which is paddy land for the proposed depot area	C	• There is a possibility that impacts due to land acquisition, resettlement and loss of livelihood will remain.
LOCAL ECONOMY (EMPLOYMENT & LIVELIHOOD)	A-	• Impact on livelihood and economic activities of project affected persons (business premises that need to be acquired): » 58 property owners, 101 business owners and 456 employees » 35 paddy land owners and 5 tenant farmers • Temporary loss or impedance of access to business premises	A+	• Generation of new jobs to operate and maintain the LRT • Improve local economy through increased mobility and reduced travel time

IMPACT	RATING	CONSTRUCTION PHASE	RATING	OPERATION PHASE
	B+	• It is projected that the local economy will be revitalized with the increase in employment opportunities for technical and general workers.		
LAND USE & LOCAL RESOURCE USE	B-	• Approximately 15ha of paddy land in Malabe area will be used as depot area.	B+	• Increased urbanization may lead to improvement of local economy
			B-	• Increased urbanization may lead to conversion of paddy lands/green areas to give way to infrastructures
SOCIAL CAPITAL & SOCIAL INSTITUTIONS	D	No particular impact is assumed	D	No impact assumed
EXISTING SOCIAL INFRASTRUCTURES & SERVICES	A-	• Reduction of traffic capacity by 30-50% due to construction activities • Impact on a wider road network due to congestion, especially at 7 critical intersections	B+	• Improvement of social infrastructure and services through increased mobility and connectivity of densely populated suburban areas
		• Impact on underground (e.g. electricity cables, telecommunication lines, sewerage pipes, storm water conduits and water supply lines) and overhead utilities (e.g. electricity and telecommunication lines) • There are two high voltage lines crossing the LRT route, which need to be shifted or lifted up		
POVERTY	D	• There are no slums along the planned LRT route.	D	No impact assumed
MINORITY GROUPS/ INDIGENOUS PEOPLE	D	• There are no minority groups or indigenous people residing within the project site.	D	No impact assumed
UNEQUAL DISTRIBUTION OF BENEFITS	D	• No significant impact on unequal distribution of benefits and damages is expected from this project.	D	No impact assumed
CONFLICTING INTERESTS	B-	• Impact on existing modes of transportation (e.g. 3-wheerlers, bus operators) due to closed roads and/or worsened traffic condition.	B-	• Potential reduction in number of passengers/ users for existing transport operators (e.g. 3-wheerlers, bus operators) due to another mode of transportation
			B+	• The project can ease traffic congestion in Colombo that can lead to smoother operation for buses and 3-wheelers • It can increase the connectivity of existing bus routes through multi-modal transport centers/hubs
GENDER	D	• No particular impact is assumed	D	No impact assumed

IMPACT	RATING	CONSTRUCTION PHASE	RATING	OPERATION PHASE
CHILDREN'S RIGHTS	D	• No particular impact is assumed	D	No impact assumed
CULTURAL HERITAGE	B-	• Branches of around 14 Bo trees along the route may need to be trimmed to give way to the LRT structure. No uprooting of Bo trees is necessary.	D	No impact assumed
	D	• No impact designated archaeologically important structures		
LANDSCAPE	B-	• There could be adverse impacts on aesthetics due to construction activities.	B-	• Impact on special values associated with aesthetics (e.g. nature, views of heritage structures) such as Ward Place, Ceremonial Drive, and Densil Kobbakaduwa Mawatha
			B+	• The LRT may be viewed as increasing the urban feel of the Colombo
INFECTIOUS DISEASES	B-	• The influx of construction workers may increase the risk of spreading infectious diseases.	D	No impact assumed
WORK ENVIRONMENT (OCCUPATIONAL HEALTH)	B-	• Risks related to occupational health and safety (e.g. operating heavy machineries, handling materials, working at heights)	B-	• Risks to occupational health and safety due to improper work practice
OTHERS				
CROSS-BORDER IMPACTS & CLIMATE CHANGE	B-	• Carbon loss from disturbance of paddy land to give way to the depot construction	B+	• Emission of CO_2 from the transport sector can be reduced by approximately 77,200 t-CO_2eq in 2035 due to potential decrease in volume of traffic.
LIGHT & VENTILATION	D	No significant impact assumed	D	• Limited impact on light and ventilation during construction » Adequate space for roadside buildings to get legal light and ventilation is provided with the current structure design » Majority of the LRT route runs from West to East direction with minimal shadowing impact on surroundings
UNUSUAL EVENTS	B-	• Impacts of unexpected events such as accidents and natural hazards	B-	• Impacts of unexpected events such as accidents and natural hazards • Depot structure is designed to be above high flood level

Annex N

Monitoring Form

Monitoring Form

Construction Phase

1) Traffic

Monitoring Item	Monitoring Results during Report Period
Flow of vehicles *Check traffic condition using online traffic density applications*	

2) Community and Occupational Health and Safety

Monitoring Item	Monitoring Results during Report Period
No. of incidents/accidents No. of complaints *Check compliance to occupational H&S management plan*	

3) Water Quality- spill and leakage

Monitoring Item	Monitoring Results during Report Period
Oil and Grease Visual inspection	

4) Water Quality (Surface Water Quality)

Measurement Period		Excess of national standard (Yes/No) If yes, please describe the outline of planned mitigation measures.
Measurement Method		
Measurement Points	Please attach map if necessary	

Measurement Point	Parameter	Unit	Measured Value		National Standards[*1]
			Mean	Max	
	pH				
	temperature,				
	DO				
	turbidity				
	BOD_3				
	Oil&grease				
	total suspended solid				

[*1]: Proposed ambient Water Quality Standards for Inland Waters in Sri Lanka

5) Noise

Measurement Period		Excess of national standards (Yes/No) If yes, please describe the outline of planned mitigation measures.
Measurement Method		
Measurement Points	Please attach map if necessary	

Measurement	Unit	Measured Value	National Standards	Referred International

Point		Mean	Max		
	dB			75 (6am-18pm), 50(18pm-6am) *1	70 (7AM-10PM), 70 (10PM-7AM) *2 55 (7AM-10PM), 45 (10PM-7AM) *3

*1: the National Environmental (Noise Control) Regulations No. 1 of 1996, Schedule III (construction activity)
*2: IFC EHS Guidelines, General EHS Guidelines (April 30, 2007), Industrial area, p.53 (the latest version shall be referred to http://www.ifc.org/)
*3: IFC EHS Guidelines, General EHS Guidelines (April 30, 2007), Residential area, p.53 (the latest version shall be referred to http://www.ifc.org/)

6) Vibration

Measurement Period		Excess of national standards (Yes/No) If yes, please describe the outline of planned mitigation measures.
Measurement Method		
Measurement Points	Please attach map if necessary	

Measurement Point	Unit	Measured Value		National Standards *1
		Frequency Range (Hz)	Vibration in ppv (mm/sec)	
				0-10 Hz: 2.0 mm/sec 10-50 Hz: 4.0 mm/sec over 50Hz: 8.0 mm/sec

Measurement Point	Unit	Measured Value		National Standards[*1]
		Frequency Range (Hz)	Vibration in ppv (mm/sec)	

[*1]: Interim Standard for Vibration Levels by the CEA (Type 3 structures, made of lightweight materials)

7) Removal and trimming of trees

Monitoring Item	Monitoring Results during Report Period
Number and type of species to be cut Visual observation and record	

Operational Phase

1) Water Quality from Depot

Measurement Period		Excess of national standard (Yes/No) If yes, please describe the outline of planned mitigation measures.
Measurement Method		
Measurement Points	Please attach map if necessary	

Measurement Point	Parameter	Unit	Measured Value	Project Standards[*1]	National Standards[*1]
			Mean		
	pH			-	6.0-8.5
	temperature,			-	-
	BOD_5			15	30
	COD			75	250
	TSS			15	50
	TKN (Total Kjeldahl nitrogen)			2.5	150
	Ammoniacal N			2.5	50
	NO3-N			10	10*
	T-P			3	-
	Soluble P			2	5

[*1]: the level which CEA agreed for the discharge to Diyawannawa from proposed wastewater treatment plant at Kalapaluwawa

[*2]: General standards and criteria for the discharge of industrial effluent into inland surface waters (Schedule 1, list 1), CEA

2) Water Quality (Surface Water Quality)

Measurement Period		Excess of national standard (Yes/No) If yes, please describe the outline of planned mitigation measures.
Measurement Method		
Measurement Points	Please attach map if necessary	

Measurement Point	Parameter	Unit	Measured Value		National Standards*1
			Mean	Max	
	pH				
	temperature,				
	DO				
	turbidity				
	BOD_3				
	Oil&grease				
	total suspended solid				

[*1]: Proposed ambient Water Quality Standards for Inland Waters in Sri Lanka

3) Noise

Measurement Period		Excess of national standards (Yes/No) If yes, please describe the outline of planned mitigation measures.
Measurement Method		
Measurement Points	Please attach map if necessary	

Measurement Point	Unit	Measured Value				National Standards	Referred International Standards
		Laeq		Lmax			
		Day (7am-10pm)	Night (10pm-7am)	Day (7am-10pm)	Night (10pm-7am)		
	dB					There is no applicable national standard	Laeq[*1] 60 dB(7AM-10PM) 55dB (10PM-7AM) Lmax[*2] 80dB

[*1]: Manual for noise measurement of general rail, Ministry of Environment, Japan (2010) and Rail Infrastructure Noise Guideline, Environmental Protection Agency in New South Wales (2013)

[*2]: Rail Infrastructure Noise Guideline, Environmental Protection Agency in New South Wales (2013)

4) Vibration

Measurement Period		Excess of national standards (Yes/No) If yes, please describe the outline of planned mitigation measures.
Measurement Method		
Measurement Points	Please attach map if necessary	

Measurement Point	Unit	Measured Value		National Standards[*1]
		Frequency Range (Hz)	Vibration in ppv (mm/sec)	
				0-10 Hz: 2.0 mm/sec 10-50 Hz: 4.0 mm/sec

Measurement Point	Unit	Measured Value		National Standards[*1]
		Frequency Range (Hz)	Vibration in ppv (mm/sec)	
				over 50Hz: 8.0 mm/sec

[*1]: Interim Standard for Vibration Levels by the CEA (Type 3 structures, made of lightweight materials)

5) Restoration program at Depot

Monitoring Item	Monitoring Results during Report Period
Status of restoration *Visual observation*	

Annex O

Leopold Matrix

LEOPOLD MATRIX FOR LIGHT RAIL TRANSIT PROJECT

SCORING CRITERIA	Construction Stage																	
	Structure demolition to clear trace bends	Excavation for foundations for LRT pillars	Utility diversion(Power lines, water supply, telecom cables)	Construction of light rail pillars	Traffic diversions(Human and vehicular)	Pilot Road construction with excavated material in low lying areas	Tree removal and tree branch pruning	Instalation of construction rigs in Diyawanna Oya	Underwater concreting for pillars in streams ands lakes	Construction of elevated stations	Girder /Superstructure construction	Construction of the elevated depot on the low lying area	Installation of rolling stocks	Installation of the wastewater treatment plant for the depot site	Removal of the pilot road and construction waste disposal	Landscaping	Power supply installations	Total Score
Noise	-8 8 -64	-6 6 -36	-3 3 -9	-7 7 -49	-6 6 -36	-6 6 -36	-4 4 -16	-7 7 -49	-6 6 -36	-7 6 -42	-7 8 -56	-9 9 -81	-3 3 -9	0	-4 4 -16	0	-2 4 -8	-543
Road link capacity reduction	-7 7 -49	-8 8 -64	-8 8 -64	-8 8 -64	-8 9 -72	-2 5 -10	-3 3 -9	0	0	-6 6 -36	-7 9 -63	-3 5 -15	-9 6 -54	0	-4 5 -20	-1 2 -2	-2 2 -4	-526
Landscape/Aesthetic Degradation	-6 4 -24	-8 6 -48	-6 6 -36	-5 8 -40	-4 4 -16	-7 6 -42	-8 5 -40	-6 6 -36	-4 6 -24	-8 6 -48	-5 8 -40	-4 8 -32	-4 8 -32	-3 6 -18	-5 4 -20	0	-4 4 -16	-512
Community Health and Safety Degradation	-6 6 -36	-6 6 -36	-8 6 -48	-6 6 -36	-7 8 -56	-5 5 -25	-2 2 -4	-4 4 -16	-4 4 -16	-8 6 -48	-5 5 -25	-8 8 -64	-5 5 -25	0	-6 6 -36	-4 4 -16	-5 5 -25	-512
Occupational Health and Safety Degradation	-5 5 -25	-5 5 -25	-6 6 -36	-6 6 -36	-4 5 -20	-5 5 -25	-4 4 -16	-6 6 -36	-6 6 -36	-6 6 -36	-6 6 -36	-6 8 -48	-6 6 -36	-5 5 -25	-5 5 -25	-2 4 -8	-6 6 -36	-505
Vibration	-3 3 -9	-4 4 -16	-3 3 -9	-7 7 -49	-2 2 -4	-3 3 -9	-3 1 -3	-5 5 -25	-7 7 -49	-6 6 -36	-7 7 -49	-9 9 -81	-5 5 -25	0	0	0	0	-364
Distruption of livelihood and economic activities	-6 6 -36	-8 8 -64	-8 8 -64	0	-6 6 -36	0	0	0	0	-8 9 -72	0	-8 8 -64	0	-3 3 -9	0	0	0	-345
Fauna Flora Distrubance	0	-4 4 -16	0	0	-2 2 -4	-6 6 -36	-4 6 -24	-4 4 -16	-4 4 -16	-4 4 -16	0	-6 6 -36	0	-6 6 -36	-4 4 -16	0	-2 2 -4	-220
Wetland degradation	0	-2 2 -4	0	-2 2 -4	0	-8 8 -64	0	-6 6 -36	-4 6 -24	0	0	-8 8 -64	0	-4 3 -12	-3 3 -9	0	0	-217
Distruption to underground utiliies	-6 6 -36	-9 9 -81	-8 8 -64	0	0	-4 4 -16	0	0	0	0	0	-2 2 -4	0	0	0	0	0	-201
Land acquisition/Resettlement of People /Structures	-3 3 -9	0	-8 6 -48	0	0	-3 7 -21	0	0	0	-4 5 -20	0	-9 9 -81	0	-4 3 -12	0	0	0	-191
Neighbouring land users-Severence of light	0	0	0	-2 4 -8	0	0	0	0	0	-5 5 -25	-6 6 -36	-6 8 -48	-6 6 -36	0	0	-4 4 -16	0	-169
Erosion of excavated material	-2 2 -4	-7 7 -49	-4 5 -20	0	0	-6 5 -30	-4 3 -12	-2 2 -4	0	0	0	-2 2 -4	0	0	-4 4 -16	-4 4 -16	0	-155
Surface water quality degradation	0	0	0	0	0	0	0	-6 6 -36	-6 8 -48	0	0	-6 6 -36	0	0	0	0	0	-120
Distruptions to Bo trees and Shrines	0	0	0	-4 4 -16	0	0	-6 6 -36	0	0	-4 4 -16	-4 4 -16	0	-3 2 -6	0	0	0	0	-90
Construction Distruption at pocket floding locations	0	-4 4 -16	-4 4 -16	-4 4 -16	0	-4 6 -24	0	0	0	0	0	0	0	0		0	0	-72
Spillage and accidential leakage	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	-68
Distruption to overhead utilities	0	0	0	-6 6 -36	0	0	-4 4 -16	0	0	0	0	0	-4 4 -16	0	0	0	0	-68
Backwater at lake/stream crossings	0	0	0	-4 4 -16	0	0	0	-4 4 -16	-4 4 -16	0	0	0	0	0	0	0	0	-48
Wastewater from worker camps	-2 2 -4	-2 2 -4	-2 2 -4	0	0	0	0	-2 2 -4	0	-2 2 -4	-2 2 -4	-2 2 -4	-2 2 -4	0	-3 2 -6	0	-2 2 -4	-42
Backwater at flood plains	0	0	0	-4 2 -8	0	-4 4 -16	0	0	0	0	0	-6 8 -48	0	0	6 6 36	0	0	-36
Distruption to Archeological buildings	0	-3 3 -9	0	-4 4 -16	0	0	0	0	0	0	0	0	0	0	0	0	0	-25
Ground water quality degradation	0	0	0	-2 2 -4	0	0	-2 2 -4	-2 2 -4	0	0	0	0	0	0	0	0	0	-12
Air Quality degradation	-2 2 -4	0	0	-3 2 -6	0	0	0	0	0	0	0	0	0	0	0	0	0	-10
Air quality improvement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boost of Reigional Economic activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Disturbance to Protected areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Increased urbanisation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Socio-Economic benefits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solid waste generated from Depot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solid waste generation from Stations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unexpected Events-Structure Failure, equipment failure and flooding	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wastewater generated from Depot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wastewater generated from stations	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Employment generation		9 9 81	9 9 81	9 9 81	0	6 6 36	6 3 18	4 4 16	4 4 16	6 6 36	5 5 25	9 9 81	6 6 36	4 4 16	4 4 16	6 6 36	5 5 25	600
Travel time saving	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Score	-304	-391	-341	-327	-248	-322	-166	-266	-253	-367	-304	-633	-211	-100	-116	-26	-76	**-4451**

Impact Themes	Operational Stage							
	Driving Train(including test runs)	Passenger services in stations	Emergency action	Regular Maintenance	Brerakdown maintenance	waste disposal from depot and stations	Sludge disposal from depot	Wastewater disposal from depot from wash and clean process	
Occupational Health and Safety Degradation	-6 6 -36	-4 6 -24	-9 9 -81	-6 6 -36	-7 7 -49	-4 6 -24	-5 5 -25	-6 6 -36	-311
Noise	-8 8 -64	-4 6 -24	0	-5 5 -25	-4 4 -16	0	0	0	-129
Unexpected Events-Structure Failure, equipment failure and flooding	-4 4 -16	-4 4 -16	-6 6 -36	-4 4 -16	-4 4 -16	-2 4 -8	-2 4 -8	-2 4 -8	-124
Spillage and accidential leakage	0	0	0	-4 4 -16	-6 5 -30	-4 4 -16	-5 5 -25	-6 5 -30	-117
Wetland degradation	0	0	0	0	0	-6 6 -36	0	-9 9 -81	-117
Solid waste generated from Depot	0	0	0	0	0	-8 8 -64	-6 6 -36	0	-100
Wastewater generated from Depot	0	0	0	0	0	0	0	-9 9 -81	-81
Surface water quality degradation	-2 2 -4	0	0	0	0	-2 2 -4	-6 6 -36	-6 6 -36	-80
Vibration	-6 6 -36	0	-4 4 -16	-2 4 -8	-4 4 -16	0	0	0	-76
Wastewater generated from Stations	0	0	0	0	0	-8 8 -64	0		-64
Road link capacity reduction	-6 8 -48	0	0	0	0	0	0		-48
solid waste generation from station	0	-6 6 -36	0	0					-36
Ground water quality degradation	0	0	0	0	0	0	-4 4 -16	-3 3 -9	-25
Distruption of livelihood and economic activities	0	0	-4 4 -16	0	0	0	0	0	-16
Neighbouring land uses-Severance of Light	-4 4 -16	0	0	0	0	0	0	0	-16
Fauna flora disturbance	-2 2 -4	0	-2 2 -4	0	0	0	0	0	-8
Distruption to Bo trees ans shirnes	-2 2 -4	0	0	0	0	0	0	0	-4
Air Quality degradation	0	0	0	0	0	0	0	0	0
Backwater at lake crossings	0	0	0	0	0	0	0	0	0
Backwater at flood plains	0	0	0	0	0	0	0	0	0
Community health and safety degradation	0	0	0	0	0	0	0	0	0
Constrution distruption at pocket flooding locations	0	0	0	0	0	0	0	0	0
Distruption to overhead utilities	0	0	0	0	0	0	0	0	0
Distruption to underground utilities	0	0	0	0	0	0	0	0	0
Distruption to Archeological buildings	0	0	0	0	0	0	0	0	0
Disturbance to Protected areas	0	0	0	0	0	0	0	0	0
Erosion of excavated material	0	0	0	0	0	0	0	0	0
Land acquisition/Resettlement of People/Structures	0	0	0	0	0	0	0	0	0
Wastewater from worker camps	0	0	0	0	0	0	0	0	0
Landscpae/Aesthetic degradation	0	0	0	9 9 81	0	-2 4 -8	-2 4 -8	-2 4 -8	57
Air Quality Improvement	9 9 81	0	0	0	0	-2 2 -4	0	0	77
Increased urbanisation	9 9 81	0	0	0	0	0	0	0	81
Boost of regional economic activities	9 9 81	6 6 36	0	4 4 16	0	0	0	0	133
Socio-Economic Benefits	9 9 81	9 9 81	0	0	0	0	0	0	162
Employment generation	4 5 20	9 9 81	4 4 16	9 9 81	8 8 64	6 6 36	4 4 16	4 4 16	330
Travel time saving	9 9 81	9 9 81	9 9 81	9 9 81	9 9 81	9 9 81	9 9 81	9 9 81	648
Total Score	197	179	-56	158	18	-111	-57	-192	**136**

Legend

Magnitude[M] X Significance[S]

-	(-1) to (-27)	+	1 to 27
-	(-28) to (-55)	+	28 to 55
-	(-56) to (-81)	+	56 to 81
Negative		**Positive**	

SCORING METHOD	
+ Positive	- Negative
Magnitude[M]/Significance[S]	
"Blank"	Not relevant
1-3	Insignificant
4-6	Significant
7-9	Very significant

Overall Cumulative Score -4315

Annex P

Extended Cost and Benefit Analysis

Economic Costs and Benefits of the Project

Year LRT	Years of operation	Economic Cost				Economic Benefits					Net Benefit
		Investment		O & M Cost	Total Cost (LKR)	VOC	TTC	CO_2	Accident	Total Benefit	
		LRT Construction	Replacement								
2018		3.73	0.00	0.00	3.73	0.00	0.00	0.00	0.00	0.00	-3.73
2019		6.03	0.00	0.00	6.03	0.00	0.00	0.00	0.00	0.00	-6.03
2020		32.08	0.00	0.00	32.08	0.00	0.00	0.00	0.00	0.00	-32.08
2021		59.88	0.00	0.00	59.88	0.00	0.00	0.00	0.00	0.00	-59.88
2022		50.56	0.00	0.00	50.56	0.00	0.00	0.00	0.00	0.00	-50.56
2023		49.60	0.00	0.00	49.60	0.00	0.00	0.00	0.00	0.00	-49.60
2024		41.09	0.00	3.31	44.40	9.23	21.65	0.001	0.10	30.98	-13.42
2025	1	11.60	0.00	3.27	14.87	10.80	24.97	0.001	0.12	35.89	21.02
2026	2	1.21	0.00	3.34	4.55	12.64	28.80	0.001	0.14	41.58	37.03
2027	3	1.09	0.00	3.41	4.50	14.79	33.21	0.001	0.16	48.16	43.66
2028	4	0.00	0.00	3.48	3.48	17.30	38.31	0.001	0.18	55.79	52.31
2029	5	0.00	0.13	3.55	3.68	20.25	44.18	0.002	0.21	64.64	60.96
2030	6	0.00	0.00	3.62	3.62	23.69	50.96	0.002	0.25	74.90	71.28
2031	7	0.00	0.00	3.70	3.70	27.72	58.77	0.002	0.29	86.78	83.08
2032	8	0.00	0.00	3.77	3.77	32.43	67.79	0.003	0.33	100.55	96.78
2033	9	0.00	0.00	3.85	3.85	37.95	78.18	0.003	0.38	116.51	112.66
2034	10	0.00	6.15	3.93	10.08	44.41	90.18	0.003	0.45	135.04	124.96
2035	11	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2036	12	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2037	13	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2038	14	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2039	15	0.00	4.47	4.01	8.48	51.96	104.01	0.004	0.52	156.49	148.01
2040	16	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2041	17	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2042	18	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2043	19	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2044	20	0.00	12.43	4.01	16.44	51.96	104.01	0.004	0.52	156.49	140.05
2045	21	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2046	22	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2047	23	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2048	24	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2049	25	0.00	0.13	4.01	4.14	51.96	104.01	0.004	0.52	156.49	152.35
2050	26	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2051	27	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2052	28	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2053	29	0.00	0.00	4.01	4.01	51.96	104.01	0.004	0.52	156.49	152.48
2054	30	0.00	60.43	4.01	64.44	51.96	104.01	0.004	0.52	156.49	92.05
Total		256.87	83.74	119.43	460.0	1290.4	2617.2	0.113	13.01	3920.73	3460.69
ENVP		131.20	2.50	13.30	146.9	102.00	212.90	0.0097	1.00	315.90	169.00
EIRR											20.20%

Source: Feasibility Study Report

Carbon Dioxide Emission Factor by Vehicle Type

Vehicle Type	Emission Factor (tCO_2/passenger-km)
Car	0.0001026
Motorcycle	0.0001004
Three wheeler	0.0001067
Bus	0.0000257

Source: Feasibility Study Report

Socio-economic Impacts of the Project

Impact	Type	Quantity
Land Area (perch)	Agricultural	7913.8
	Residential	57
	Commercial	259.3
Structures (Sq. metres)	Type 1	8658.52
	Type 2	1111.67
	Type 3	2886.17
Structures (number)	Residential	1
	commercial	65
Self-relocation (Households)	Municipality area	28
	Urban council area	73
Loss of Income (No. of persons)	Business	100
	Loss of wage/ salary	455
Affected persons (No. of Persons)	Business owners	100
	Renters	73
	Workers	455

Source: RAP

Analysis Parameters of Emission Reductions (Construction Phase)

Parameter	Description		Value	Unit	Source
A	**land area of organic soils**		**14.8**	**ha**	**JICA team**
B_{AG}	**Aboveground biomass**	**Tropical moist & wet**	**6.2**	**t-dm/ha**	**Table 3.4.2, IPCC GPG-LULUCF**
R	**Root-to-shoot ratio**	**Tropical moist & wet**	**1.6**		**Table 3.4.3, IPCC GPG-LULUCF**
CF	**Carbon fraction of dry matter**	**Default value**	**0.5**	**t-C/t-dm**	**IPCC GPG-LULUCF**

Source: JICA Study Team

Analysis Parameters of Emission Reductions (Operation Phase – Year 2035)

Parameter	Description		Value	Unit	Source
P_y	Number of passenger of the project activity in year y		246,818,475	passenger/year	= 676,215 passenger/day * 365 JICA team
$BPKM_y$	Passenger transportation volume/activity by the project in year y		1,332,819,765	passenger-km/y	JICA team
		Car	773,035,464	passenger-km/y	JICA team
		Motorcycle	199,922,965	passenger-km/y	
		3 Wheeler	133,281,977	passenger-km/y	
		Bus	226,579,360	passenger-km/y	
$EF_{PKM,i}$	CO2 emission factor per passenger kilometer for transport mode i	Car	0.0001026	tCO2/passenger-km	JICA team
		Motorcycle	0.0001004	tCO2/passenger-km	
		3 Wheeler	0.0001067	tCO2/passenger-km	
		Bus	0.0000257	tCO2/passenger-km	
$BTDP_y$	Average trip distance of the passenger of the project activity in year y		5.4	km	JICA team
$MS_{i,y}$	Share of passengers by transport mode in the baseline scenario in year y	Car	58	%	JICA team
		Motorcycle	15	%	
		3 Wheeler	10	%	
		Bus	17	%	
$EC_{PJ,y}$	Annual electricity consumption associated with the operation of the project activity in year y		45,512	MWh/year	JICA team
EF_{elec}	CO2 emission factor of the grid electricity		0.9274	tCO2/MWh	In year 2015, Build Margin, from SLSEA website

Source: JICA Study Team

Unit Vehicle Operating Cost (VOC)

Velocity (km/h)	Motorcycle	3 Wheeler	Car & Van	Medium & Large Bus	Medium & Large 2 Axle Lorry	Large 3 Axle Lorry
10	17.20	45.03	64.70	144.88	120.46	174.60
15	15.01	37.05	54.44	110.39	93.10	140.60
20	13.97	33.16	49.50	93.01	79.33	123.50
25	13.40	30.78	46.65	82.65	71.06	113.24
30	13.02	29.17	44.75	75.81	65.65	106.50
35	12.83	28.12	43.42	70.97	61.94	101.75
40	12.64	27.27	42.56	67.45	59.19	98.33
45	12.45	26.60	41.90	64.89	57.19	95.86
50	12.54	26.32	41.71	62.99	55.77	94.05
55	12.64	26.13	41.52	61.47	54.63	92.82
60	12.64	25.94	41.52	60.52	53.96	91.87
65	12.73	25.84	41.52	59.76	53.39	91.39
70	12.83	25.75	41.52	59.28	53.20	91.20
75	12.92	25.65	41.61	59.09	53.11	91.30
80	12.92	25.65	41.71	59.19	53.30	91.68
85	13.02	25.65	41.80	59.38	53.68	92.34
90	13.11	25.65	41.99	59.85	54.25	93.29
95	13.21	25.65	42.18	60.52	55.01	0.00
100	13.30	25.65	42.37	61.37	55.86	0.00

Source: JICA Study Team

Accident Loss Savings

Item	Value	Unit
Accident Cost (1)	0.396	LKR/vehicle-km in 1999 values
Accident Cost	1.46015	LKR/vehicle-km in 2017 values
Annual decline in accident rate (1)	4%	
Accident rate deduction in ‘35	48%	‘35/’17
Accident Cost in 2035	0.7003	LKR/vehicle-km in 2017 values

Source: JICA Study Team

Annex Q

Environmental Management and Monitoring Plan

Table 1 Environmental Management Plan (Pre and Construction Phase)

IMPACT THEME	POTENTIAL IMPACT	PROPOSED MANAGEMENT MEASURE	RESPONSIBLE ENTITY	COST(Rs)
NOISE	Increased noise levels in the vicinity of the construction site	<u>Mitigation measures for general construction site (LRT route)</u> • Fitting of exhaust baffles, maintaining vehicles and machinery in a high operable condition, • Use the, low-noise type machine and/or vehicles, • Construction site is separated with corrugated sheets or other suitable material especially at locations near noise sensitive receptors, particularly at National Hospital and school zone. • Scheduling of construction work that cause high noise and vibration to ensure least inconvenience to the public, • Avoid construction work on Poya days and days of other religious and/ or cultural importance, • Avoid high noise construction activities during the night time. • Establishing a complaint mechanism • Advance notification to the surrounding community <u>Mitigation Measures at Depot</u> • Conduct a test piling activity and check the noise level generated from the piling activity at Depot area. • Consider changing the height of hammer drop or weight of hammer to be used, depending on the result of test piling • Install a noise reduction equipment with piling hammer	Contractor/ MMWD (PMU	Tentative cost: Lump sum Rs. 5,000,000 Included in Contractor's service fee
VIBRATION	Increased vibration levels in the vicinity of the construction site	• Identification of type of building structure (Type 3 and Type 4). For Type 4 structure, the consultation with Department of Archaeology is required. • Carry out a property condition survey (crack survey) of nearby structures and record the present condition of the structure, to accurately assess any damage to these structures during the construction stage.	Contractor/ MMWD (PMU)	Tentative cost: Lump sum Rs. 5,000,000 Included in Contractor's service fee

		• Vibration monitoring at selected area around the construction activities. • Regularly communicate with surrounding communities to inform the construction schedule. • Use of lower vibration generating device/machinery. • Scheduling of construction work that cause high vibration must be within authorized construction embodiment times, • Minimisation of piling energy (e.g. reduced hammer drop distance) as necessary depending on receptor distance. • Establishing a complaint mechanism and implementing a procedure to effectively deal with any issue raised by the community.		
TRAFFIC IMPACT	Road link capacity reduction	• Preparation of traffic management plan for each construction stage such as diversion, lane control, safety measures. The traffic management plan will also take into consideration mobility and safety of vulnerable groups (e.g. school children, elderly). • Carry out traffic simulation for above traffic management plan • Road Intersection wise traffic analysis for the key road intersections affected by the study (See Section 1.4 of the Traffic Impact Assessment Report in Annex C for the affected intersections) • A stakeholder committee with the participation of project consultants, Colombo Municipal Council and the other relevant local government bodies, Road Development Authority and Traffic Police, will be appointed to give guidance on the developed traffic management plan • Monitoring of traffic flow during construction stage • Ensuring the safety during the construction period using standard safety measures. • Adherence to the workzone management guidelines formulated by RDA. • Provide minimum 3m lane width for bus routes • Maintain walkable paths for pedestrian movement especially where high density pedestrian traffic flows	Contractor/ MMWD (PMU)	Tentative cost: Lump sum Rs. 5,000,000 Included in Contractor's service fee

		exist (e.g. Malabe, Rajagiriya Road, Olcott Mawatha, Justice Akbar Mawatha and Malay Street, access roads in depot area) • Retain access roads in depot area (slightly diverted) and ensure that design and construction of depot civil structures will not hamper movement of people and vehicles in the area.		
LANDSCAPE	Impact on special values associated with aesthetics (e.g. nature, views of heritage structures)	• The major sensitive areas will be thoroughly studied in terms of landscape impact during detailed design stage through the consultation with concerned agencies. After detailed assessment of landscape impact, if it is found that alternative route is suitable, it will be a subject for supplementary EIA. • Micro level detailing, structures, colours, lighting, planting, trains designs and colours, stations, interactions will be part of the overall design depending on each section. • In order to realise the overall objectives, in the design team in addition to the design and structural engineers it will include; Tow Planners, Urban Designers, Architects, Landscape Architects, and Lighting Experts.	Contractor/ MMWD (PMU)	Tentative cost: Lump sum Rs. 2,000,000 Included in the Project Cost
HEALTH AND SAFETY	Impact on occupational health and safety	• Submission of an Occupational Health and Safety Management Plan (Construction Stage) prior to commencement of work. • Adoption of standard worker safety methods • Provision of personal protective equipment (PPE) • Provision of trainings and awareness programs to employees	Contractor/ MMWD (PMU)	Included in the Project Cost
	Impact on community health and safety • Increase of stress levels for affected residents and commuters • Risk to respiratory diseases due to dust Hazards of communicable and infectious diseases	• The project site will be fenced and access points will not be available for the public. • Appropriate sanitary facilities will be provided at all construction sites. • Environmental pollution control measures, including watering proper maintenance of machinery shall be implemented. • Arrange construction activity and schedule to minimize the impact on surrounding community (e.g. prohibit high noise generating activity on night time)		Tentative cost: Lump sum Rs. 5,000,000 Included in the Contractor's service fee

SOCIO-ECONOMIC IMPACTS	Impact on livelihood and economic activities	• Provision of compensation to the Project Affected Parties (PAPs) using the compensation package decided for LRT Project based on LARC stipulations on assessing the financial and other losses of PAPs. • Provision of alternative access to their premises as far as possible outside the construction sites to carry out their usual business activities and other domestic or related employment activities. • Develop a Livelihood Restoration Plan • Continual liaising with the Project Affected Parties (PAPs) will be undertaken to decide on the site-specific mitigation measures. • Consultation with people whose livelihood depend on modes of transportation that may be affected by the Project (e.g. 3-wheelers and bus operators). They will be included in the development of the traffic management plan.	MMWD (PMU)	Included in Project Cost (GoSL fund)
BIOLOGICAL ENVIRONMENT	Disturbance to Protected areas	• Monitoring of bird species will be conducted.	MMWD (PMU)	Included in monitoring cost
	Fauna and Flora (removal and trimming of some trees)	• Offset trees of 10 times of that is cut down by the project • Enhancement of biodiversity through creation of various type of habitat such as wetland, forest zone and open area. • Use the native species which will enhance the value of ecosystem in the area • Creation of green buffer zone around the Depot by selection of tree species which grows high to mitigate the landscape impact	MMWD (PMU)	20million Rs (approximately 1 ha)
	Wetland Degradation	• Minimize removal or pruning of trees • Introduce a wastewater treatment plant and • Collect scheduled waste for the “Ecocycle” process.	MMWD (PMU)	Management cost
IMPACT ON UTILITIES	Underground Utilities: electricity cables, telecommunication lines, sewerage pipes, storm water conduits, water supply lines	• Close coordination with and provision of support to utility agencies, including CEB and NWSDB. • Adopt schedules for the shifting and temporary termination of infrastructure service supply • Make the public aware of schedules in advance to	Contractor/ MMWD (PMU)	To be finalized during the detailed design stage.

	Overhead utilities: electricity lines, telecommunication lines.	prevent ad hoc activities • Make timely payments as agreed • Assist in shifting of facilities • Obtain information from other on-going projects		
LAND ACQUISITION & RESETTLEMENT	Impact on private properties (land and built structures)	• Develop and implement a Resettlement Action Plan (RAP) and Livelihood Restoration Plan • Carry out consultations with project affected persons (PAPs)	MMWD (PMU)	Included in Project Cost (GoSL fund)
	Impact on government institutions and properties: • RDA • UDA • SLR	• Consult relevant agencies (e.g. RDA, UDA, SLR) • Provide necessary assistance, such as relocation of affected properties.	MMWD (PMU)	Management cost
SOLID WASTE	Erosion of excavated materials, spoil and other waste construction materials etc.	• Prevent stocking of loose earth by the road side • Cover temporary stockpile with polythene sheet and place weights • Manage sand stockpiles by compaction/haunching. • Provide temporary drainage around the sand stockpiles.	Contractor/ MMWD (PMU)	Tentative cost: Lump sum Rs. 2,000,000 Included in Contractor's service fee
	Nuisance to pedestrians and other road users caused by construction wastes Impact on the aesthetics of the city (temporary)	• Careful planning of temporary storage and disposal • Segregate wastes properly. Recyclable materials will be handed to registered recyclers. • Scheduled wastes (e.g. oil) will be collected and carefully stored. Treatment and disposal of these wastes will be contracted out to a registered industrial waste company.	Contractor/ MMWD (PMU)	Tentative cost: Lump sum Rs. 5,000,000 Included in Contractor's service fee
SURFACE WATER & GROUNDWATER	Impact on water quality of Diyawanna Lake	• Monitor water quality in the lake during construction period	MMWD (PMU)	Management cost
	Impact on groundwater quality due to construction of foundation structures	• Monitor groundwater quality	MMWD (PMU)	Management cost
CULTURAL HERITAGE	Impact on Bo trees	• Consult relevant stakeholders • Carry out religious rituals and communicate with relevant stakeholders (Monks and devotee) before the commencement of construction activities.	MMWD (PMU)	Management cost
	Hindrance access to religious and culturally important sites	• A traffic management plan will be developed considering alternative access roads to religious and culturally important sites.	MMWD (PMU)	Management cost
WASTEWATER	Activities of workers	• Provide cylindrical septic tank or portable toilets at the construction areas; • Adequate facility such as sanitary latrines will be provided for temporal accommodation at Depot site.	Contractor/ MMWD (PMU)	Tentative cost: Lump sum Rs. 5,000,000

				Included in Contractor's service fee
	Spillage, leak and accidental discharge of oil from construction vehicles	• Proper use and maintenance of construction machines and heavy vehicles • Install Oil and grease traps in the drainage system • Establish and implement emergency and contingency plan in case of spills	Contractor/ MMWD (PMU)	Tentative cost: Lump sum Rs. 2,000,000 Included in Contractor's service fee
WATER COURSE	Lake crossing	• Use a two-dimensional flood model with a possible tentative blocking arrangement for construction rigs within the Diyawanna. • Conduct lake blocking part by part. • Limit construction of the foundation of LRT structure within the lake during dry season; avoid critical monsoon periods such as April- June and September to November. • Carry out temporary blocking of the lake section according to the instructions of SLLRDC; Re-run the model depending on the site-specific construction arrangements. • Prepare a suitable pumping arrangement in case of flood • If in the opinion of the Engineer that flooding is aggravated because of temporary construction blocks such blocks will be temporarily removed until the flood subsides.	Contractor/ MMWD (PMU)	Included in Contractor's service fee
	Pocket flooding	• Opening of drainage paths over the road • Creation of temporary drainage path from the construction sites to the nearest drain, as necessary. • Removal of construction equipment from site if inundation occurs.	Contractor/ MMWD (PMU)	Included in Contractor's service fee
	Backwater on flood plain	Depot Area • Provide a 3m wide canal right round the fill area • Conduct of construction works in parts. • Control of height of fill; Allow water overtopping over the fill • Propose to improve the existing drainage canals in the low-lying paddy by desilting them. • Establish direct drainage connection between these canals and main canal. • Open culvert gates, in case of flood • Avoid blocking of existing drainages • Refining of the flood modeling; Lower part of the sub catchment will be made as a hydro dynamic model to	Contractor/ MMWD (PMU)	Included in Contractor's service fee

		represent the existing drainages and internal road culverts. • Breach fillings at strategic locations in case of flood <u>Pilot Road in the Low-Lying Areas Adjacent to Chandrika Bandaranayaka Kumaranathunga Mawatha</u> • Minimize height and width of the pilot road to a height of 0.6m. • Provide temporary culverts to all drainage paths and at places of the flood plain crossing the pilot road. • Breach filling at strategic locations in case of flood • Test pilot road using the flood model of SLLRDC		
AIR QUALITY	• Generation of dust • Emissions from construction machineries and vehicles	• Wetting and water spraying • Covering of transport vehicles • Careful stockpiling of construction materials • Monitoring of dust levels • Proper maintenance of construction machineries and vehicles • Careful selection of location of construction yard • Limiting of vehicle speed • Proper planning and siting of construction activities • Set up dust barriers	Contractor/ MMWD (PMU)	Tentative cost: Lump sum Rs. 5,000,000 Included in Contractor's service fee
UNUSUAL EVENTS	Impacts of unexpected events such as accidents and natural hazards	• Develop an Emergency Response Plan • Compliance with applicable performance specification, design standards and codes, health and safety regulations • Provision of firefighting system	Contractor/ MMWD (PMU)	Included in Contractor's service fee

Table 2 Environmental Management Plan (Operation Phase)

IMPACT	POTENTIAL IMPACT	PROPOSED MANAGEMENT MEASURE	RESPONSIBLE ENTITY	COST(Rs)
NOISE	Noise impact from the operation of LRT	• Consider noise mitigation measures (e.g. noise barrier), especially for sensitive areas. • Carry out noise monitoring along LRT route • Standard maintenance of trains, structure and tracks • Establish a grievance mechanism	O&M Company	To be included in the project cost and finalized during the detailed design stage
VIBRATION	Vibration impact from the operation of LRT	• Conduct monitoring of vibration at selected points along the route • Standard maintenance of trains, structure and tracks • Establish a grievance mechanism • Proper maintenance of train structure, tracks and rolling stocks	O&M Company	To be included in the project and budget of the proponent.
HEALTH AND SAFETY	Impact on occupational health and safety	• Develop Health and Safety Management Plan for operational stage • Provide of PPE • Deploy security guards • Develop an Emergency Response Plan • Adoption of standard worker safety methods, • Develop and implement an Occupational Health and Safety Management Plan (Operation Stage) • Putting up of warning signs, • Training of employees,	O&M Company	Tentative cost: Rs. 200,000 per month To be included in the project and budget of the proponent.
SOCIO-ECONOMIC IMPACTS	Impact on livelihood and economic activities	• Monitoring of the Livelihood Restoration Plan for the affected PAPs • Consultation with relevant stakeholders to seek optimum solutions for transport operators (e.g. buses, 3-wheelers) • Provisions to make new bus routes and shuttle services to connect stations to main towns • Propose developing terminals for 3-wheelers close to the train stations.	MMWD (PMU)	Included in Project Cost (GoSL fund)
SOLID WASTE	Waste from depot	• Segregate wastes. • Recyclable materials will be handed to registered recyclers. • Non-hazardous wastes will be disposed in accordance with relevant local regulations. • Regular collection and disposal of wastes • Scheduled wastes (e.g. oil) will be collected and carefully stored. Treatment and disposal of these wastes will be contracted out to a registered industrial waste company	O&M Company	Tentative cost: Rs. 300,000 per month To be included in the project and budget of the proponent.

IMPACT	POTENTIAL IMPACT	PROPOSED MANAGEMENT MEASURE	RESPONSIBLE ENTITY	COST(Rs)
	Waste from stations	• Waste generated from stations will be collected according to the type of waste by registered waste contractor and treated through a registered waste disposal facility	O&M Company	Tentative cost: Rs. 300,000 per month To be included in the project and budget of the proponent.
WASTEWATER	Spillage, leakage, and accidental discharge	• Secondary containers will be placed in storage areas for hazardous substances(e.g. oil) • Spill kits will be provided • Provide drainage from chemical storage areas to oil separator (depot area)	O&M Company	To be included in the project and budget of the proponent.
	Wastewater from depot	• Wastewater treatment system with sufficient treatment capacity will be installed in the depot area. Wastewater will be discharged to the public sewage system. • Periodical maintenance of Wastewater treatment system will be conducted.	O&M Company	Construction cost of installation of WTS (about Rs70,000,000) will be included in the project cost and finalized during detailed design stage.
	Wastewater from stations	• Sewage will be sent to public sewage system • Periodical maintenance of sewage system at station will be conducted.	O&M Company	To be included in the project and budget of the proponent.
BIOLOGICAL ENVIRONMENT (FLORA & FAUNA)	Disturbance to Protected areas	• Monitoring of bird species will be conducted.	MMWD (PMU)	Included in monitoring cost
	Loss of greenery area (agricultural land)	• Maintenance of restored zone under restoration program	O&M Company	Tentative cost: Rs. 100,000 per month To be confirmed at later stage
URBANISATION	Conversion of green areas and paddy fields for the development/ expansion of train stations	• Coordinate with relevant agencies regarding possible alternatives	MMWD (PMU)	Management cost
UNUSUAL EVENTS	• Impacts of unexpected events such as accidents and natural hazards	• Develop an Emergency Response Plan	O&M Company	Included in O&M Company's management cost

Note: An O&M Company will be established for the operation and maintenance of the LRT.

Table3 Environmental Monitoring Plan (Pre and Construction Phase)

Key Aspect	Parameter	Method	Frequency	Location	Responsible Agency/Person	Independent Monitoring Agency	Cost(Rs)
Noise	Noise level (dB) • L_{Aeq}	Noise monitoring using noise level meter	Quarterly • Immediately after complaints	7 locations mentioned in the table 3.3 in EIA Report	Contractor/ MMWD (PMU) in consultation with third party reputed Agency	CEA (during routine inspection)	10,000/sample 120,000/year
Vibration	Vibration level Frequency Range (Hz) Vibration in ppv (mm/sec)	Vibration monitoring using vibration level meter	Quarterly • Immediately after complaints	6 locations mentioned in the Table 3-5 and Figure 3.4 in EIA Report Additional location will be added based on complaint	Contractor/ MMWD (PMU) in consultation with third party reputed Agency	CEA (during routine inspection)	To be decided by Environmental office of PMU
Traffic Impact	Flow of vehicles	Check traffic condition using online traffic density applications	• Depending on the progress of the Project	Critical roads and/or junctions	Contractor/ MMWD (PMU)	RDA	Tentative cost: Rs. 100,000 per month Included in Contractor's service fee
Community and Occupational Health and Safety	No. of incidents/accidents No. of complaints	Check compliance to occupational H&S management plan	• Weekly; • Immediately after receipt of complaint	NA	Contractor/ MMWD (PMU)	-	Included in Contractor's service fee
Livelihood Restoration	Livelihood restoration program	Consultation meeting and survey with PAPs	• Semi-annually until the end of livelihood restoration program	Displacement of residents and commercial establishments affected by the project	MMWD (PMU)	External monitoring committee appointed for the implementation of RAP	Included in project cost from a separate fund
Land Acquisition and Involuntary	Compensation for affected PAPs	Consultation meeting and survey with PAPs	• Monthly until ROW is fully acquired	Displacement of residents and commercial	MMWD (PMU)	External monitoring committee appointed for	Included in project cost

Key Aspect	Parameter	Method	Frequency	Location	Responsible Agency/Person	Independent Monitoring Agency	Cost(Rs)
Resettlement of PAPs				establishments affected by the project		the implementation of RAP	
Impacts on terrestrial and aquatic habitats	Number and type of species observed	Sampling survey	• quarterly	Depot area, Thalangama EPA, Bird Sanctuary	Contractor/ MMWD (PMU)	-	Included in project cost
Removal and trimming of trees	Number and type of species to be cut/to be trimmed	Visual observation and record	• Before and after the tree cutting/trimming	Earmarked Bo Trees along the trace and other tree species identified to remove (Annexure F and H in the EIA Report)	Contractor/MMWD (PMU)	CEA (during routine inspection in consultation with RDA, and relevant Local Authorities	Management cost
Waste Management	Amounts and items of waste		• Monthly	Construction Site, workers camps	Contractor/ MMWD (PMU) in consultation with relevant Local Authority	CEA (during routine inspection)	Management cost
Water Quality- spill and leakage	Oil and Grease	Visual inspection	• Daily	Detection of spills/ leakages at all construction site	Contractor/ MMWD (PMU)	-	Management cost
Surface Water quality	pH, temperature, DO, turbidity, BOD_3, Oil&grease, total suspended solid	Water sampling and analysis as per applicable standard	• Quarterly • Immediately after receipt of complaint	Locations mentioned in the table 3.6 in EIA Report	Contractor/ MMWD (PMU) in consultation with third party reputed Agency)	CEA (during routine inspection)	10,000/sample 120,000/year
Ground Water quality	pH,temperature,BOD,Electrical Conductivuty, Total Coloform	Water sampling and analysis as per applicable standard	• Quarterly • Immediately after receipt of complaint	Locations mentioned in the table 3.9 in EIA Report	Contractor/ MMWD (PMU) in consultation with third party reputed Agency	CEA (during routine inspection)	10,000/sample 120,000/year
Ground Water level	From ground level in meters	Using a tape	• Quarterly • Immediately after receipt of complaint	Locations mentioned in the table 3.9 in EIA Report	Contractor/ MMWD (PMU)	CEA (during routine inspection in line with Water	Management cost

Key Aspect	Parameter	Method	Frequency	Location	Responsible Agency/Person	Independent Monitoring Agency	Cost(Rs)
						Resource Board	
Flood	Flood level Kelani River	Communication with Irrigation Department and meteorological department	• In the event of heavy rain	Kelani River	O&M Company	-	Management cost

Table 4 Environmental Monitoring Plan (Operation Phase)

Key Aspect	Parameter	Method	Frequency	Location	Responsible Agency/Person	Independent Mon Agency	Cost(Rs)
Noise	Laeq 24hr Noise level (Day and Night) Peak noise level (Lmax)	Noise monitoring using noise level meter as per applicable standard	Quarterly for first 2 years immediately on receipt of complains	7 locations mentioned in the table 3.3 in EIA Report. Additional location will be added based on complain 12.5m from center of LRT system and 1.2m from ground level	O&M Company through an accredited laboratory	CEA (during routine inspection)	10,000/sample 280,000/year
Vibration	Frequency Range (Hz) Vibration in ppv (mm/sec)	Vibration monitoring using noise level meter as per applicable standard	Quarterly for first 2 years immediately on receipt of complains	6 locations mentioned in the table 3-5 and figure 3.4 in EIA Report. Additional location will be added based on complain	O&M Company through an accredited laboratory	CEA (during routine inspection)	10,000/sample 240,000/year
Livelihood Restoration	Livelihood restoration program	Consultation meeting and survey with PAPs	To be decided during finalization of RAP	Displacement of residents and commercial establishments affected by the project	MMWD (PMU)	External monitoring committee appointed for the implementation of RAP	To be determined through the implementation of RAP
Land Acquisition and Involuntary Resettlement of PAPs	Compensation for affected PAPs	Consultation meeting and survey with PAPs	To be decided during finalization of RAP	Displacement of residents and commercial establishments affected by the project	MMWD (PMU)	External monitoring committee appointed for the implementation of RAP	To be determined through the implementation of RAP
Impacts on ecosystem	Number and type of bird species observed	Visual observation and recording	Annually	Observation points at boundary of Talangama EPA and Sri Jayawardanapura bird sanctuary close to the LRT route	O&M Company	CEA (during routine inspection)	200,000/year

Key Aspect	Parameter	Method	Frequency	Location	Responsible Agency/Person	Independent Mon Agency	Cost(Rs)
Development at Depot	Status of restoration	Visual observation	Quarterly	Restoration area	O&M Company	UDA	200,000/year
Waste Management	Amount and items of waste	Record the type and amount of waste generated.	Monthly	Construction site	O&M Company, Relevant Local Authorities, Ecocycle INSEE	CEA (during routine inspection)	Management cost
Wastewater from Depot	Quality of effluent Parameters stipulated in CEA standard (Tolerance limits for the discharge of industrial waste into inland surface waters – Schedule I of the National Environmental Protection and Quality Regulations No. 1 of 2008)	Effluent sampling and analysis as per applicable standard	Monthly	Outlet of the WWTP at Depot	O&M Company through an accredited laboratory	CEA (during routine inspection)	10,000/sample 120,000/year
Flood	Flood level Kelani River	Communication with Irrigation Department and meteorological department	In the event of heavy rain	Kelani River	O&M Company	-	Management cost

List of Prepares

Name	Position	Signature
Mr. D A J Ranwala	Team Leader / Hydrologist	
Dr. Dewaka Weerakon	Ecologist	
Dr. H R Pasindu	Traffic Expert	
Mr. Hemantha Jayasundara	Landscape Expert	
Mr.M A W R Fernando	Construction Engineer	
Mr. Yohei Suzuki	JICA Study Team	
Dr. Athula Senarathna	Economist	
Ms. Hasara Kalubowila	Sociologist	

Work Allocation/Contribution

Name	Position	Work Allocation/Contribution
Mr. D A J Ranwala	Team Leader / Hydrologist	• Studying environmental impacts including hydrological impacts during construction and operation phases of LRT Project (Flood Modelling was done by SLLRDC) • Formulating mitigation measures and alternative analysis • Preparing Environmental Monitoring Plan(EMOP) and Environmental Management Plan (EMP)
Dr. Dewaka Weerakon	Ecologist	• Studying ecological impacts (Flora and Fauna) during construction and operation phases of LRT Project • Formulating necessary mitigation measures
Dr. H R Pasindu	Traffic Expert	• Studying traffic impacts during construction and operation phases of LRT Project • Formulating necessary mitigation measures and Traffic Management Plan
Mr. Hemantha Jayasundara	Landscape Expert	• Studying landscape impacts during construction and operation phases of LRT Project • Formulating mitigation measures and alternative analysis
Mr. M A W R Fernando	Construction Engineer	• Studying Construction/ Structural impacts during construction and operation phases of LRT Project • Formulating necessary mitigation measures
Mr. Yohei Suzuki	JICA Study Team	• Review of Previous Studies • Carrying out field investigations and surveys related to existing environment • Alternative analysis • Studying environmental impacts (Noise, Vibration, Health and Safety impacts and impacts due to solid waste and waste water) during construction and operational stages of LRT Project (Noise modelling was done by ITI) • Formulating mitigation measures and alternative analysis
Dr. Athula Senarathna	Economist	• Carrying out Extended Cost Benefit analysis for LRT Project
Ms. Hasara Kalubowila	Sociologist	• Conduct baseline socio-economic surveys • Studying socio-economic impacts during construction and operational stages of LRT Project • Formulating mitigation measures