

SECTION - 7

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

7.1 Environmental Management

Proper Environmental Management includes allocation of resources for mitigation of any potential environmental impact that may be caused due to the implementation of the project. For effective management of the environmental impacts identified in Section – 6 of this EIA Report, a comprehensive Environmental Management Plan (EMP) is prepared and if required; to be followed during design, construction and operation phases of project.

The objective of the EMP is to provide framework for the implementation of the proposed mitigation measures during all the three phases of the proposed project. The proper implementation of the EMP will ensure that all the adverse environmental impacts identified in the EIA are adequately mitigated, either totally prevented or minimized to an acceptable level and required actions to achieve those objectives are successfully taken by the concerned institutions or regulatory agencies. The implementation of EMP should be carefully coordinated with the design and construction program of the project to ensure that relevant mitigation measures are implemented at the appropriate stage and adequate resources are properly allocated to achieve the desired results.

For effective environmental management, the client should assign the necessary responsibilities to an Environmental Committee (EC) through Project Director PMA, which should be responsible for implementation of the EMP and Environmental Monitoring of the proposed project. The Project Director will be assisted by an Environmental Expert and a Social Expert in implementing the mitigation measures proposed in EMP.

The Contractor will be responsible for the implementation of the proposed project under the supervision of PMA. The Contractor should be bound to follow the provisions of the contract documents especially about environmental protection and apply good construction techniques and methodology without damaging the environment. Obligation of the contractor, to safeguard, mitigate adverse impacts and rehabilitate the environment should be addressed through environmental provisions

in the contract document as already highlighted in Section-6 and through adequate implementation at site.

7.2 Staff and Training

7.2.1 Environmental Committee and its Responsibilities

PMA will form up an Environmental Committee (EC), which will be responsible for the environmental management and supervisory affairs during the construction phase of the proposed project.

The responsibilities of the Environmental Committee (EC) are as follows:

- To ensure implementation of all the proposed mitigation measures proposed in EMP during the construction of the project;
- To organize routine monitoring of motor vehicle/rail emissions, air quality, traffic, noise and vibration; etc. In case, the noise and emission levels exceed the acceptable levels; a penalty or ban must be enforced;
- To develop operational guidelines and implementation schedule;
- Receiving complaints from residents and institutions and assisting the local environmental authority including liaison with EPD Punjab; and
- To ensure that the proposed project is implemented in an environment friendly manner, causing least harm to the existing environment including flora and fauna, sites of religious and cultural significance etc.

7.2.2 Equipment and Instruments

Environmental monitoring during different stages of project will be carried out by a private laboratory hired by PMA during construction and operational stages of the proposed project.

7.3 Environmental Management Plan

The Environmental Management Plan (EMP) provides the framework for the implementation of the mitigating measures and environmental management and monitoring during the construction and operation phases of the proposed project. **Tables 7.1** portray impacts, targets, mitigations and the responsible organizations for the implementation of the mitigation measures during the construction and the operation phases respectively.

Table 7.1: Environmental Management Plan

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------------------|-----------------------------------|---|--|----------------|
| Design Phase | | | | |
| 1 | Social Issues | To minimize inconvenience for the public | <ul style="list-style-type: none"> ▪ Mitigation measures will include provisions in the design such as: provision of pedestrian overhead bridges or crossings on every rail station, public awareness through media, proper traffic diversion plans, appropriate sign boards, and timely completion of the project. | DC and PMA |
| 2 | Land Acquisition and Resettlement | To avoid/minimize land acquisition and resettlement | <ul style="list-style-type: none"> ▪ Mitigation measures will involve careful site selection by the designer to minimize the impact by avoiding acquisition of commercial area. Also adequate budget will be provided in the Project cost for the compensation to the affected people as per Land Acquisition Act, 1894 and framing of a judicious and fair compensation package for provision of compensation on at least the prevailing market rates. | DC and PMA |
| 3 | Flora | To avoid the cutting of trees as far as possible. | <ul style="list-style-type: none"> ▪ Plan for compensatory planting for four trees against each fallen tree of similar floral function; ▪ Transplantation plan of maximum trees/plants to | DC and PHA |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|-----------------------------|--------------------------------------|---|----------------|
| | | | <p>be affected;</p> <ul style="list-style-type: none"> ▪ Provision of compensation in the Project Budget for the loss of fruit trees (if any) to the affected people; and ▪ Disallow introduction of exotic species with known environmental setbacks (Eucalyptus, etc.). | |
| 4 | Air Quality and Noise Level | To minimize air and noise pollution. | <ul style="list-style-type: none"> ▪ Incorporate technical design features that enable continuous traffic flux and avoid congestions e.g. sign boards, speed limits and bays; ▪ Noise barriers shall be installed in sensitive areas/ populated areas through which the proposed LRMTS will pass. | DC and PMA |
| 5 | Public Utilities | To avoid disturbance to the public. | <ul style="list-style-type: none"> ▪ Incorporate technical design features to minimize affect on public utilities; and ▪ All public utilities likely to be affected by the proposed project need to be relocated/rehabilitated well ahead of the commencement of construction work. | DC and PMA |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------------------------|----------------|---|---|----------------|
| 6 | Seismic Hazard | To minimize the structural damage | <ul style="list-style-type: none"> ▪ The proposed stations will be designed and constructed to withstand low to moderate earthquakes. For seismic hazard analysis, updated structural and seismic evaluations will be consulted. | DC and PMA |
| Construction Phase | | | | |
| 1 | Soil | To minimize soil erosion and contamination. | <ul style="list-style-type: none"> ▪ All spoils will be disposed off as desired and the site will be restored back to its original conditions; ▪ Non-bituminous wastes from construction activities will be dumped in approved sites, in line with the legal prescriptions for dumpsites, and covered; ▪ As applicable and needed, plantation of grasses and shrubs will be done at appropriate place where required; ▪ Excavations would be kept confined to the specified foundation spots as per the approved engineering drawings. Unnecessary excavations should be avoided; ▪ Site camps for the resident labour should not be | CC , SC and EC |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|------------|--------|--|----------------|
| | | | <p>setup on the land earmarked for developing green belts and lawns;</p> <ul style="list-style-type: none"> ▪ Oils, lubricants, chemicals, and other listed hazardous materials should be stored safely at their designated spots, enclosures or store rooms, which should be safe from rainfall and away from any potential source of fire; ▪ Septic tanks of adequate capacities should be constructed for receiving and treating wastewater from all temporary worksite toilets and at the temporary container offices, if any. The toilet wastewater should not be discharged untreated onto the adjacent lands; ▪ All machineries and materials should be stored at the designated areas and compounds; ▪ All the unspent and left over materials be completely removed offsite upon completion of construction and the site be restored to original or near to original condition; and ▪ Washout from washing of equipment and gadgets should be drained into either a septic | |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|---|--|--|--------------------|
| | | | tank or a sand-gravel bed for removal of the grit and contaminants. | |
| 2 | Land Acquisition, Resettlement and Compensation | To minimize land acquisition and resettlement | <ul style="list-style-type: none"> ▪ Mitigation measures will involve land management and providing judicious compensation to the affectees by providing sufficient budget in the Project cost. The process of land acquisition and compensation will be followed in a transparent manner to minimize the impacts. | PMA |
| 3 | Camp Site | To minimize loss of assets and vegetation/forests due to labor movement. | <ul style="list-style-type: none"> ▪ All efforts during the design stage should be made to minimize the removal of existing macro-plants at camp sites; ▪ The contractor(s) will provide plan for removal & rehabilitation of site upon completion; ▪ Photographical and botanical inventory of vegetation before clearing the site; and ▪ Compensatory plantation to be scheduled when construction works near end. | CC, SC, PMA and EC |
| 4 | Health and safety of workers and | To minimize health risks | <ul style="list-style-type: none"> ▪ Obligatory insurance against accidents for labourers/workers; | CC, SC, EC |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|------------------------|--------|---|----------------|
| | associated communities | | <ul style="list-style-type: none"> ▪ Providing basic medical training to specified work staff and basic medical service and supplies to workers; ▪ Layout plan for camp site, indicating safety measures taken by the contractor, e.g. fire fighting equipment, safe storage of hazardous material, first aid, security, fencing, and contingency measures in case of accidents; ▪ Work safety measures and good workmanship practices are to be followed by the contractor to ensure no health risks for labourers; ▪ Protection devices (ear muffs) should be provided to the workers doing job in the vicinity of high noise generating machines; ▪ Provision of adequate sanitation, washing, cooking and dormitory facilities including light up to satisfaction; ▪ Proper maintenance of facilities for workers will be monitored; ▪ Provision of protective clothing for labourers handling hazardous materials, e.g. helmet, | |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|------------|--------|---|----------------|
| | | | <p>adequate footwear for bituminous pavement works, protective goggles, gloves etc;</p> <ul style="list-style-type: none"> ▪ Ensure strict use of wearing these protective clothing during work activities; ▪ Elaboration of a contingency planning in case of major accidents; ▪ Instruct foremen to strictly enforce the keeping out of non-working persons, particularly children, off work sites; and ▪ Adequate signage, lightning devices, barriers, yellow tape and persons with flags during construction to manage traffic at construction sites, haulage and access roads. ▪ There should be proper control on construction activities and Oil spillage leakage of vehicles. ▪ The labour works with different transmittable diseases should be restricted within the construction site. ▪ Efforts will be made to create awareness about road safety among the drivers operating construction vehicles; | |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|------------|--------|--|----------------|
| | | | <ul style="list-style-type: none"> ▪ Timely public notification of planned construction works; ▪ Close consultation with local communities to identify optimal solutions for diversions to maintain community integrity & social links; ▪ Seeking cooperation with local educational facilities (school teachers) for road safety campaigns; ▪ Provision of proper safety and diversion signage, particularly at sensitive/accident-prone spots; ▪ Setting up speed limits in close consultation with the local stakeholders; ▪ If identified, consider additional guard rails at accident-prone stretches and sensitive locations (schools & hospitals); ▪ Reducing the impacts of vector borne diseases on long-term health effect of workers should be accomplished through implementation of diverse interventions aimed at eliminating the factors that lead to disease, which includes: Prevention of larval and adult propagation of vectors through | |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|--------------------|------------------------------|--|----------------|
| | | | <p>sanitary improvements and elimination of breeding habitat close to human settlements and by eliminating any unusable impounding of water;</p> <ul style="list-style-type: none"> ▪ During construction work pedestrian and vehicular passages should be provided for crossing near settlement; ▪ Fencing around the camps should be strong enough so that it can not be broken easily by local people for making passages; and ▪ Use of water should not disturb public water availability and source of water should be selected carefully. | |
| 5 | Emergency Response | To be prepared for emergency | <ul style="list-style-type: none"> ▪ An Emergency Response Plan for earthquakes and manmade disasters will be developed by the PMA. Emergency Response Plan will be implemented in close consultation with the Rescue 1122 Service, Fire Fighting Department, bomb disposal squad and paramedics. In addition, training of the staff/employees regarding the emergency procedures/plans will | PMA & CC |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|-------------|---------------------------|--|----------------|
| | | | be regularly conducted. | |
| 6 | Air Quality | To minimize air pollution | <ul style="list-style-type: none"> ▪ All vehicles, machinery, equipment and generators used during construction activities should be kept in good working condition and be properly tuned and maintained in order to minimize the exhaust emissions; ▪ Blowing of dust from potential sources at the worksite should be avoided by shielding them from the exterior, for example using polythene curtains or raising a fence of corrugated sheets around areas of active constructions; ▪ Blowing of dust and particulate matter from stockpiled loose materials (e.g. sand, soil) should be avoided either by sheeting them with tarpaulin or plastic sheets or by sprinkling them with light shower of water; ▪ Open burning of solid waste from the Contractor's camps should be strictly banned; ▪ Preventive measures against dust should be adopted for on-site mixing and unloading operations. Regular water sprinkling of the site | CC, SC and EC |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|------------|-----------------------------|--|----------------|
| | | | <p>should be carried out to suppress excessive dust emission(s);</p> <ul style="list-style-type: none"> ▪ Only good quality oils, petroleum products, additives and spares should be used in the machinery, generators, and the construction vehicles. Usage of used oil should be strictly prohibited; ▪ Emissions from power generators and construction machinery are important point sources at the construction sites. Proper maintenance and repair is needed to minimize the hazardous emissions; and ▪ NEQS applicable to gaseous emissions generated by construction vehicles, equipment and machinery should be enforced during construction works. | |
| 7 | Noise | To minimize noise pollution | <ul style="list-style-type: none"> ▪ Selection of up-to-date and well maintained plant or equipment with reduced noise levels ensured by suitable in-built damping techniques or appropriate muffling devices; ▪ Confining excessively noisy work to normal | CC, SC and EC |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|------------|--------|---|----------------|
| | | | <p>working hours in the day, as far as possible;</p> <ul style="list-style-type: none"> ▪ Providing the construction workers with suitable hearing protection like ear cap, or earmuffs and training them in their use; ▪ Preferably, restricting construction vehicles movement during night time; ▪ Heavy machinery like percussion hammers and pneumatic drills should not be used during the night without prior approval of the client; ▪ Vehicles and equipment used should be fitted, as applicable, with silencers and properly maintained; ▪ Use of low noise machinery, or machinery with noise shielding and absorption; ▪ Contractors should comply with submitted work schedule, keeping noisy operations away from sensitive points; implement regular maintenance and repairs; and employ strict implementation of operation procedures; ▪ Noise barriers in sensitive areas in the form of high boundary walls (concrete or wood), earth | |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|--|-----------------------------|---|----------------|
| | | | <p>berms, etc. in front of schools, hospitals and mosques; and</p> <ul style="list-style-type: none"> ▪ Public hearings to discuss appropriate solutions and materials to control noise (e.g. mud or brick walls, bushes, etc.). | |
| 8 | Solid Waste (Construction Waste and Hazardous Waste) | To minimize the Solid Waste | <ul style="list-style-type: none"> ▪ Wastewater effluent from contractor's workshop and equipment washing yards would be passed through gravel/ sand beds to remove oil/ grease contaminants before discharging it into natural streams; ▪ An efficient and responsive solid waste management system should be devised for the entire duration of the construction phase. Such a system should provide for separate collection of different categories of constructional wastes. The wastes which will be reusable/recyclable (iron bars, aluminum) should be sold to waste vendors and those which cannot be sold out (brick pieces) may be used as a filling material for leveling the depressions, subject to technical feasibility; | CC, EC |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|------------|--------|---|----------------|
| | | | <ul style="list-style-type: none"> ▪ Training of working force in the storage and handling of materials and chemicals that can potentially cause soil contamination; ▪ Solid waste generated during construction and camp sites will be safely disposed in demarcated waste disposal sites and the contractor will provide a proper waste management plan; ▪ Proper labelling of containers, including the identification and quantity of the contents, hazard contact information etc.; ▪ Training of employees involved in the transportation of hazardous material regarding emergency procedures; ▪ Providing the necessary means for emergency response on call 24 hours/day; ▪ The sewage system for camps will be properly designed (pit latrines or, as required, septic tanks) to receive all sanitary wastewaters; ▪ Lined wash areas will be constructed within the camp site or at site, for the receipt of wash | |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|-------------|---------------------------------------|--|----------------|
| | | | <p>waters from construction machinery;</p> <ul style="list-style-type: none"> ▪ Use of pesticides in nurseries will be done deemed necessary and suggested by the experts; ▪ Insecticides that are less toxic to human health should be used; ▪ Construction workers and supervisory staff should be encouraged and educated to practice waste minimization, reuse and recycling to reduce quantity of the waste for disposal; and ▪ Prohibit open burning of solid waste. | |
| 9 | Groundwater | To avoid contamination of groundwater | <ul style="list-style-type: none"> ▪ Protection of groundwater reserves from any source of contamination such as the construction and oily waste that will degrade its potable quality; ▪ The solid waste will be disposed off in designated landfill sites to sustain the water quality for domestic requirements; ▪ Water required for construction is obtained in such a way that the water availability and supply to nearby communities remain unaffected; | CC, SC and EC |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|------------|---------------------------------|--|---------------------|
| | | | <ul style="list-style-type: none"> ▪ Regular water quality monitoring according to determined sampling schedule; ▪ Continuous withdrawal and over pumping of groundwater should be avoided. Instead, intermittent pumping be carried out to conserve the groundwater resources; ▪ Take precautions construct temporary or permanent devices to prevent water pollution due to increased siltation; and ▪ Wastes must be collected, stored and taken to approve disposal site. | |
| 10 | Flora | To minimize the impact on flora | <ul style="list-style-type: none"> ▪ Only trees coming along the rail track, shall be removed and efforts shall be made to save the suitable trees along rail track and to make them, part of the future plantation plan; ▪ Camp sites will be established on waste/barren land rather than social and commercial land. However, if such type of land is not available, it will be ensured that minimum clearing of the vegetation is carried out and minimum damage is caused to trees and undergrowth; | CC, SC, PMA and PHA |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|------------|---|---|----------------|
| | | | <ul style="list-style-type: none"> ▪ Construction vehicles, machinery and equipment will remain confined within their designated areas of movement; ▪ The Contractor's staff and labour will be strictly directed not to damage any vegetation such as trees or bushes; ▪ Contractor will provide gas cylinders at the camps for cooking purposes and cutting of trees/bushes for fuel will not be allowed; and | |
| 11 | Fauna | To minimize the impact on fauna of the project area | <ul style="list-style-type: none"> ▪ Hunting, poaching and harassing of wild animals will be strictly prohibited and Contractor will warn their labour accordingly; ▪ Camps will be located at least 500 m away from the nearest wild life area (if any) and their source of food as well as water; ▪ The camps will be properly fenced and gated to check the entry of animals in search of eatable goods. Similarly, wastes of the camps will be properly disposed off to prevent the chances of eating by wild animals, which may become hazardous to them; | CC, SC and EC |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|-------------------------------------|--|---|----------------|
| | | | <ul style="list-style-type: none"> ▪ Special measures will be adopted to minimize impacts on the wild birds, such as avoiding noise generating activities during the critical periods of breeding; ▪ Staff working on the project should be given clear orders, not to shoot, snare or trap any bird; and ▪ The Contractor will make arrangements to minimize the vibration, noise pollution through good engineering practices. | |
| 12 | Disposal of Mucking Material | To minimize the scars on the land in the project area | <ul style="list-style-type: none"> ▪ Mitigation measure will include proper landscaping, which should be given due consideration along with re-establishment of the local/indigenous vegetation. The excavated materials that are unsuitable for use will need to be stored, transported and disposed of appropriately at designated sites. | CC, SC and EC |
| 13 | Public Utilities and Infrastructure | To minimize the disturbance to public utilities and infrastructure | <ul style="list-style-type: none"> ▪ Mitigation measures will include rehabilitation of existing utilities before construction to avoid any inconvenience to the residents of the project area or provide them with alternate arrangement | CC, SC and EC |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|--------------------|--|--|---------------------------|
| | | | during the construction period. | |
| 14 | Traffic Management | To minimize traffic problems in the project area | <ul style="list-style-type: none"> ▪ Proper traffic management plan will be needed to avoid traffic jams/public inconvenience; ▪ Movement of vehicles carrying construction materials should be restricted during the daytime to reduce traffic load and inconvenience to the local residents; ▪ Coordinated planning of traffic diversions by the traffic police and the Transport Department in accordance with the construction program with advance warnings to the affected residents and road users; ▪ Construction vehicles, machinery and equipment will move or be stationed in the designated ROW to avoid un-necessary compaction of soil. ▪ Availability of continuous services of the police in the diversion and control of traffic; and ▪ The executing agency is required to maintain liaison between the Traffic Police, local residents/ travelers and the contractor to facilitate traffic movement during construction | Traffic Police, CC and EC |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|---|---|---|---|
| | | | stage. | |
| 15 | Lifestyle and Culture | To minimize cultural conflicts | <ul style="list-style-type: none"> ▪ Timely public notification and announcement of mobilizing equipment; ▪ Local labour should be employed for construction works; and ▪ Water supply and sanitation facilities, Contractor's workforces should exacerbate the existing shortages and environmental hazards; contractor should primarily seek their own sources of water in due distance (min. 1 km) from local user's wells. | CC, SC, PMA and EC |
| 16 | Heavy Vehicles on the Existing Road Network & Sensitive Receptors | To minimize negative impacts on existing road and surroundings. | <ul style="list-style-type: none"> ▪ Any vehicle with an open load carrying area used for transport of potentially dust producing materials shall have properly fitted side and tailboards. Materials having potential to produce dust shall not be loaded to a level higher than the side and tail boards and shall be covered with clean tarpaulin in good condition. The tarpaulin shall be properly secured and extended to at least 300 mm over the edges of the sideboard and tailboard; | CC, SC, Traffic Police Department, and EC |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|--------------------------|-------------|------------------------------------|---|----------------|
| | | | <ul style="list-style-type: none"> ▪ The Contractor shall not use any vehicles either on or off road with grossly excessive noise pollution. Noise mufflers shall be installed and maintained in good condition on all motorized equipment under the control of the Contractor; ▪ Timely maintenance of affected roads to avoid any inconvenience to the road commuters. | |
| Operational Phase | | | | |
| 1 | Flora | Raising of compensatory plantation | <ul style="list-style-type: none"> ▪ A large number of plants will be raised along the rail track at available spaces. The presence of adequate flora, along the track, will absorb flue gases, emitted from a large number of cars, vehicles and public transport, which shall in turn improve air quality. ▪ Organic farming will be encouraged to minimize the use of chemical fertilizers and pesticides. | PHA and PMA |
| 2 | Air Quality | To minimize air pollution | <ul style="list-style-type: none"> ▪ Setting up of a system to monitor air quality along project area in accordance with the applicable standards/limits; ▪ Along rail track tree plantations as applicable and feasible under harsh climatic conditions; | PMA |

| Sr. No. | Parameters | Target | Mitigation | Responsibility |
|---------|-------------|---|---|----------------|
| | | | <p>plants should be selected in accordance to their ability to absorb emissions;</p> <ul style="list-style-type: none"> ▪ Regular rail track maintenance to ensure good surface condition; ▪ Regular vehicle/rail check up to control/ensure compliance with NEQS; | |
| 3 | Solid Waste | To minimize generation of solid waste and implement waste management system | <ul style="list-style-type: none"> ▪ Solid Waste generated from stations will be properly disposed off through provision of waste bins and local solid waste collection and management system. ▪ Proper labeling of containers, including the identification and quantity of the contents; ▪ Management of hazardous waste during road maintenance works will be similar as given for construction phase. ▪ Installation of sign boards for solid wastes at all the rail stops of metro rail transit system on the orange line in Lahore. | PMA |

KEY

| | | | | | |
|-----|----------------------------|-----|-----------------------------------|-----|----------------------------------|
| DC | Design Consultant | CC | Construction Contractor | PHA | Parks and Horticulture Authority |
| PMA | Punjab Metro Bus Authority | SC | Supervision Consultant | | |
| EC | Environmental Committee | EPD | Environment Protection Department | | |

7.4 Environmental Monitoring

Environmental Monitoring is undertaken during both the construction and operational phases to ensure the effectiveness of the proposed mitigation measures. Certain environmental parameters are selected and quantitative analysis is carried out. The results of analysis are compared with the guidelines; standards and pre-project condition to investigate whether the EMP and its implementation are effective for the mitigation of impacts or not. Parameters to be analyzed during construction and operation of the project and responsibilities for monitoring and reporting have been discussed below. A cost estimate for this measurement of parameters is given in **Table 7.2.**

7.4.1 Construction Phase

a) Air Quality

Air quality monitoring will be carried out biannually during the construction phase at the representative locations.

The following parameters will be monitored:

- CO
- NO_x
- SO_x
- PM₁₀

b) Ground Water Quality

Ground water quality monitoring will be done once during the construction phase at the representative locations. The following parameters will be monitored:

- Total Coliforms
- Fecal E.Coli
- Total Colonial Count
- Fecal Enterococci
- pH Value
- Total Dissolved Solids (TDS)
- Total Hardness
- Nitrate
- Chloride
- Sodium

c) Surface Water Quality

Surface water quality monitoring will be done once during the construction phase at the representative locations. The following parameters will be monitored:

- pH
- Dissolved Oxygen
- Total Suspended Solids (TSS)
- Total Dissolved Solids (TDS)
- Alkalinity
- BOD₅
- COD
- Turbidity

d) Noise Levels

The noise levels monitoring will be carried out once at representative locations in the project area.

7.4.2 Operational Phase**a) Air Quality**

Air quality monitoring will be done biannually during the operational phase at the representative locations. The following parameters will be monitored:

- CO
- NO_x
- SO₂
- PM₁₀

b) Ground Water Quality

Ground water quality monitoring will be done biannually during the operational phase at the representative locations. The following parameters will be monitored:

- Total Coliforms
- Fecal E.Coli
- Total Colonial Count
- Fecal Enterococci
- pH
- Total Dissolved Solids (TDS)

- Total Hardness
- Nitrate
- Chloride
- Sodium

c) Surface Water Quality

Surface water quality monitoring will be carried out biannually during the operational phase at the representative locations and the following parameters will be monitored:

- pH
- Dissolved Oxygen
- Total Suspended Solids (TSS)
- Total Dissolved Solids (TDS)
- Alkalinity
- BOD₅
- COD
- Turbidity

d) Noise Levels

The noise level monitoring will be carried out biannually at representative locations in the project area.

7.4.3 Responsibilities for Monitoring and Reporting

The EC will be responsible for environmental monitoring and reporting throughout the construction and operation phases. A monitoring report will be prepared on monthly basis and one comprehensive report will be prepared annually. Contents of the report will include results of environmental monitoring in comparison to the standards for the various parameters, location and sampling time along with recommendations. One report will be submitted during the construction phase to each of the following authorities and institutions: (i) PMA and (ii) EPD-Punjab whereas, one report will be submitted to EPD-Punjab during the operational phase.

Table 7.2: Budget Estimate for Environmental Monitoring During the Construction and Operation Phases

| Components | Parameters | No. of Samples (No. of Samples x Frequency x Year) | Frequency | Responsibility | Duration | Cost (Rs.) |
|---------------------------------------|---|---|------------|----------------|----------|------------------|
| Construction Phase (06 Months) | | | | | | |
| Air Quality | CO, NO _x , SO _x , PM ₁₀ | 1x2x2 = 4 | Biannually | Contractor/ EC | 24 hours | 160000/- |
| Ground Water Quality | Total Coliforms, Fecal E. Coli, Total Colonial Count, Fecal Enterococci, pH, TDS, Total Hardness, Nitrate, Chloride, Sodium | 1x2x2 = 4 | Biannually | Contractor/ EC | - | 60000/- |
| Surface Water Quality | pH, Dissolved Oxygen, TSS, TDS, Alkalinity, BOD ₅ , COD, Turbidity | 1x2x2 = 4 | Biannually | Contractor/EC | - | 60000/- |
| Noise Level | - | 1x2x2 = 4 | Biannually | Contractor/EC | 24 hours | 8000/- |
| TOTAL | | | | | | 288,000/- |
| Operation Phase (1 year) | | | | | | |
| Air Quality | CO, NO _x , SO _x , PM ₁₀ | 1x2x2 = 4 | Biannually | EPD Punjab | 24 hours | 160000/- |
| Ground Water Quality | Total Coliforms, Fecal E. Coli, Total Colonial Count, Fecal Enterococci, pH, TDS, Total Hardness, | 1x2x2 =4 | Biannually | EPD Punjab | - | 60000/- |

| | | | | | | |
|------------------------------|--|-----------|------------|------------|----------|------------------|
| | Nitrate, Chloride, Sodium | | | | | |
| Surface Water Quality | pH, Dissolved Oxygen, TSS, Alkalinity, BOD ₅ , COD, Turbidity | 1x2x2 = 4 | Biannually | EPD Punjab | - | 60000/- |
| Noise Level | - | 1x2x2 = 4 | Biannually | EPD Punjab | 24 hours | 8000/- |
| TOTAL | | | | | | 288,000/- |
| GRAND TOTAL | | | | | | 576,000/- |

KEY

EC – Environmental Committee

7.5 Plantation Plan

To minimize the negative impacts arising due to increased vehicular activity on the along the whole track of LRMTS and to enhance the landscape of the project area, plantation at available spaces may be carried out. A Plantation Plan is prepared for LRMTS

The existing plantation in the project area was visited as an essential component of Environmental Impact Assessment (EIA) of the project. The ornamental, flowering and seasonal plants/trees exist in the center median. The plants/trees growing within the project area are being looked after by Parks and Horticulture Authority (PHA) Lahore and if any plant/tree cut down/uprooted, saplings have to be planted against any uprooted plant/tree as replacement.

The execution of Lahore Rapid Mass Transit System (LRMTS) Network will involve the cutting/uprooting of about 3653 including 2907 mature ornamental and flowering plants/trees owned by the Parks and Horticulture Authority (PHA) Lahore. A detail of existing plants/trees is provided in Table 7.3. The Contractor has to establish labour sites, material depots, workshops near road side may result in loss of vegetation.

The following plan is proposed for Parks and Horticulture Authority (PHA) Lahore ornamental and flowering plants.

- i. The plants/tree inventory prepared by the consultants may be shared with the concerned Parks and Horticulture Authority (PHA) Lahore.
- ii. The cut/uprooted plants/trees will remain the property of the Parks and Horticulture Authority (PHA) Lahore.
- iii. The replenish cost will be paid to the Parks and Horticulture Authority (PHA) Lahore as per Government policy.
- iv. The Parks and Horticulture Authority (PHA) will plant 10 saplings for every cut/uprooted plants/tree and take care of the plantation including the replacement of dead plants for four years.

The following plants were identified in the ROW.

Table: 7.3 Plants identified in the Project Area

| Sr. No. | Name of Species | Location/Area (Km) | Total Plants/Trees |
|------------------------------------|---------------------------|---|--------------------|
| ORNAMENTAL PLANTS | | | |
| 1 | <i>Ficus Elastica</i> | Stabling yard (Ali town) to Dera Gujran (27km) | 1701 |
| 2 | <i>Allistonia species</i> | | 1101 |
| 3 | <i>Phoenix palm</i> | | 12 |
| 4 | <i>Rananic palm</i> | | 15 |
| 5 | <i>Cane palm</i> | | 25 |
| 6 | <i>Pongamia glabra</i> | | 29 |
| 7 | <i>Ficus relegiosa</i> | | 24 |
| Sub- Total | | | 2907 |
| FLOWERING PLANTS | | | |
| 1 | <i>Bougainvillia</i> | Stabling yard (Ali town) to Dera Gujran (27km) | 125 |
| 2 | <i>Nerium oleander</i> | | 610 |
| 3 | <i>Yalka green</i> | | 11 |
| Sub- Total | | | 746 |
| Grand Total of Plants/Trees | | | 3653 |

7.5.1 Plantation Cost**Table 7.4 Estimated Cost of Plantation of 29,070 Plants for First Year**

| Sr. No. | Particulars of Work | Quantity | Rate (Rupees) | Amount (Rs) |
|---------|---|------------------------|-------------------|-------------|
| 1 | Clearance and leveling of site | 29,070 plants (230MD) | 400/MD | 92,000 |
| 2 | Layout | 29,070 plants (116 MD) | 400/MD | 46,400 |
| 3 | Digging of Pits 2.5cft. | 29,070 pits (1,160MD) | 400/MD | 464,000 |
| 4 | Average cost plants | 29,070 plants | Rs.20/- | 581,400 |
| 5 | Carrying of plants 50,000 nos. from Nursery to site including | 29,070 plants | Rs. 5/- per plant | 145,350 |

| | | | | |
|----------------------|---|-----------------------------|----------|------------------|
| | loading/unloading | | | |
| 6 | Planting of plants with ball of earth | 29,070 plants (580 MD) | 400/MD | 232,000 |
| 7 | Replacement of earth with silt 1 cft. per pit | 29,070 cft. | Lump sum | 58,000 |
| 8 | Hand watering 200 times x 29,070 = 5,814,000 plants | 5,814,000 plants (11600 MD) | 400/MD | 4,640,000 |
| 9 | Weeding 4 times 29,070 x4 | 116,280 plants (230 MD) | 400/MD | 92,000 |
| 10 | Miscellaneous | | | 29,000 |
| Sub-Total (A) | | | | 6,380,150 |

Table 7.5 Estimated Cost of Plantation of 20% Plants and Maintenance for Second Year

| Sr. No. | Particulars of Work | Quantity | Rate (Rupees) | Amount (Rs) |
|---------|---|-----------------------------|-------------------|-------------|
| 1 | Restocking of 20% plants | 5,800 No. | 20.00 each | 116,000 |
| 2 | Carrying of plants from Nursery to site including loading/unloading | 5,800 No. | Rs. 5/- per plant | 29,000 |
| 3 | Re-Digging of Pits 20% - 580 No. | 580 No. (230 MD) | 400/MD | 92,800 |
| 4 | Planting of plants with ball of earth – 11,600 No. | 11,600 No. (116 MD) | 400/MD | 46,400 |
| 5 | Hand watering 150 times x 29,070 = 4,360,500 plants | 4,350,000 plants (8,700 MD) | 400/MD | 3,480,000 |
| 6 | Reopening of pits twice 1 cft per pit 29,070+25,000 = 54,070 | 54,070 cft. (348 MD) | 400/MD | 139,200 |

| | | | | |
|----------------------|------------------------------------|--------------------------|--------|------------------|
| 7 | Weeding twice 29,070x2 = 58,140 | 58,140 plants (116MD) | 400/MD | 46,400 |
| 8 | Miscellaneous | | | 52,200 |
| Sub-Total (B) | | | | 4,002,000 |

Table 7.6 Estimated Cost of Plantation of 20% Plants and Maintenance for Third Year

| Sr. No. | Particulars of Work | Quantity | Rate (Rupees) | Amount (Rs) |
|----------------------|---|----------------------------|-------------------|------------------|
| 1 | Restocking of 20% plants | 5,800 No. | 20.00 each | 116,000 |
| 2 | Carrying of plants from Nursery to site including loading/unloading | 5,800 No. | Rs. 5/- per plant | 29,000 |
| 3 | Re-Digging of Pits 20% - 5,800 No. | 5,800 No. (230 MD) | 400/MD | 92,800 |
| 4 | Planting of plants with ball of earth – 5,800 No. | 5,800 No. (116 MD) | 400/MD | 46,400 |
| 5 | Hand watering 150 times of 29,070 = 4,360,500 plants | 4,360,500plants (8,700 MD) | 400/MD | 3,480,000 |
| 6 | Reopening of pits twice 1 cft per pit 29,070+25,000 = 54,070 | 54,070cft. (340 MD) | 400/MD | 139,200 |
| 7 | Weeding twice 29,070x2=58,140 | 58,140 plants (116 MD) | 400/MD | 46,400 |
| 8 | Miscellaneous | | | 52,200 |
| Sub-Total (C) | | | | 4,002,000 |

Table 7.7 Estimated Cost of maintaining for Fourth Year

| Sr. No. | Particulars of Work | Quantity | Rate (Rupees) | Amount (Rs) |
|----------------|-------------------------------------|--------------------------|----------------------|--------------------|
| 1 | Hand watering 150 times 50x 29,070 | 29,070 plants (5,800 MD) | 400/MD | 2,320,000 |
| 2 | Weeding twice 29,070 x2 | 58,140 plants (116 MD) | 400/MD | 46,400 |
| 3 | Trimming/pruning of plants | 29,070 No. (348 MD) | 400/MD | 139,200 |
| 4 | Miscellaneous | | | 46,400 |
| | Sub-Total (D) | | | 2,552,000 |
| | Grand Total (A, B, C, and D) | | | 16,936,150 |

Cost for raising 29,070 plants and their Maintenance for four years

Rs. 16,936,150/-

Trees Recommended

Trees recommended for planting are Sheesham, Neem, Sirris, Amaltas, Alstonia and Mulberry.

7.6 Environmental Technical Assistance and Training Plan

In order to raise the level of professional and managerial staff, there is a need to upgrade their knowledge in the related areas. The EC should play a key role in this respect and arrange the trainings.

An environmental and social training and Technical Assistance (TA) program is to be carried out before the implementation of the project. Contractor's environmental awareness and appropriate knowledge of environmental protection is critical to the successful implementation of the EMP because without appropriate environmental awareness, knowledge and skills required for the implementation of the mitigation measures, it would be difficult for the Contractor(s) workforce to implement effective environmental protection measures. A suitable training program is proposed to train the Contractor(s) staff who will be involved in the Construction Phase and the professional staff from the client involved at the operational stage of the project.

The PMA will engage TA consultant to manage the environmental training program. The objective of the TA will be, to help in establishment of appropriate systems, and to train senior PMA staff and EC responsible for managing environment, operations, and planning, who can then impart training at a broader level within and outside the PMA (i.e., the training of trainers). The TA consultant will organize training courses for PMA and contractor staff to train them in specialized areas such as air and noise pollution monitoring; develop environment operation manuals in consultation with the EPD Punjab. The details of this training program are presented in **Table 7.3**

Table 7.3: Personnel Training Program/ TA Services

| Provided by | Contents | Trainees/Events | Duration |
|--|--|---|----------|
| TA consultants/ organizations specializing in environmental management and monitoring | Short seminars and courses on: Environmental laws and regulations, daily monitoring and supervision | Three seminars for PMA and Contractor project staff | 2 day |
| TA consultants/ organizations specializing in social management and monitoring | Short seminars and courses on: Social awareness | Three seminars for project staff dealing in Social/lands matters | 2 day |
| TA consultants/ organizations specializing in Occupational, health and safety issues | Short lectures relating to Occupational Safety and Health | Two seminars for contractor's staff | 2 day |

7.7 Environmental Monitoring, Mitigation and Training Cost

The cost required to effectively implement the mitigation measures is important for the sustainability of the Project both in the construction and operation stages of the Project.

These costs are summarized as below:

| | | |
|-------------------------------|---|--------------|
| Environmental Monitoring Cost | = | 576,000/- |
| Tree Plantation Plan | = | 16,936,150/- |

Environmental Training Cost = 1,000,000/- (lump sum)

Total = 18,512,150/-

Say = 18.512 Million Rupees