

SECTION - 6

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.0 General

This section identifies the overall impacts of pre-construction (design), construction and operational phase of the proposed project on the physical, biological and socio-economic environment of the project. In addition, it also narrates the measures that will mitigate or at least minimize the project's adverse environmental impacts.

6.1 Environmental Impact Matrices

The environmental impacts matrices have been developed to evaluate magnitude of the impacts of different project activities on different environmental settings for both construction and operational phases. These matrices are given in **Tables 6.1** and **6.2**. The following scale has been used for the evaluation of impacts:

LA = Low Adverse (low/short-term damage to the environment)

MA = Medium Adverse (moderate damage to the environment)

HA = High Adverse (severe damage to the environment)

LB = Low Beneficial (less beneficial to the environment)

MB = Medium Beneficial (moderate beneficial to the environment)

HB = High Beneficial (highly beneficial to the environment)

N/A = Not Applicable

O = Insignificant / No Impact

6.2 Anticipated Impacts during Pre-Construction/Design Phase

Following is the description of impacts envisaged and the recommended mitigation measures during Pre-construction/Design Phase:

6.2.1 Design & Layout Planning

Incompatible layout plan and engineering design of the project's structures can undermine the overall aesthetic beauty and ambience of the project area. Also low utilization of the available spaces and not designing the structures taking into account, the prospective and futuristic needs can result in structures with low social acceptability and functionality. This impact will be temporary and moderate negative in nature.

Mitigation:

All structural, layout and engineering designing of LRMTS should be in strict accordance with the applicable bylaws and engineering parameters.

6.2.2 Topography

The project area has a plain topography but excavation of land is involved for the construction of tunnel which may contribute to minor change in the topography of the area. The main impact generating activities during construction will be cutting and dismantling of existing pavements, including erosion of topsoil cover and soil erosion may occur on roadside due to excavation of earth/cutting operations. The changes due to construction of the proposed tunnel, however, will be of localized nature. This impact is temporary and moderate negative in nature.

Mitigation measures will include provision of embankments, designed by considering the Geotechnical investigation studies. Due consideration should be given to aesthetic improvement during the design phase.

6.2.3 Land Acquisition and Resettlement

The proposed project is elevated except at few junctions along the corridor, therefore land will be acquired at those specific points.

Mitigation:

- Mitigation measures will involve careful alignment and route selection by the designer to minimize the impact by avoiding the residences of these families.
- 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.

6.2.4 Air Quality and Noise

Due to the construction of the proposed project, air pollution, noise and associated health risks may increase. This impact is permanent and moderately negative in nature.

Mitigation measures will include:

- 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; and
- Plantation plan for tall species of trees on available spaces along rail track to minimize the effect of air and noise pollution.

6.2.5 Seismic Hazard

The Project Area is located in Seismic Zone 2A, where 2A (lower limit of moderate damage) represents peak horizontal ground acceleration from 0.08 to 0.16g. In this Zone, designing of various types of structures should be done on the basis of Peak Ground Acceleration (PGA). A low to moderate intensity earthquake impacting the project site can adversely impact the development. This factor requires special consideration of the designers keeping in view the earthquake of October 08, 2005. This will be a major negative impact.

Mitigation measures will include:

The proposed stations will be designed and constructed to withstand low to moderate earthquakes. For seismic hazard analysis, updated structural and seismic evaluations and all materials will be used accordingly.

6.2.6 Resource Conservation

The materials used in construction of proposed project (LRMTS) would include coarse aggregates (crush), fine aggregates (sand), steel, water, asphalt, reinforcement and cement etc. Almost all the materials to be used in the construction of proposed project are non-renewable and therefore their sustainable use is necessary for the future use.

Fuel will be used to operate construction machinery and asphalt and batching plants. Sustainable use of energy resources is very important not only to continue future use but also to help to reduce air emissions. For conservation of energy, efficiency of the engines and burning processes is very important.

Mitigation measures will include:

- Wastage of water should be reduced by training the workers involved in water use;
- Source of water should be carefully selected. Water use should not disturb the existing community water supplies;

- Ensure adequate insulation to reduce heat loss through batching plants;
- Regularly monitoring of CO and CO₂ content of the flue gases to verify that combustion systems are using practical excess air volumes; and
- Maintain clean heat transfer surfaces in asphalt batching plant.

The Resources Conservation Plan is attached as **Annex V**.

6.2.7 Physical and Cultural Resources

There are many physical/cultural resources in the project area such as Shalamar Garden, Chuburji and Tomb of Dai Anga in the project area.

- Incorporate technical design features to minimize the project construction activities to avoid any interference with cultural heritage site and public property as far as possible; and
- In case of unavoidable interference prior notification and consultation needs to be made to reach consensus on procedures and options (e.g. re-location/re-building) or any other form of agreed compensation.

6.2.8 Public Utilities

Due to the proposed project, affected public utilities may create disruption of public services and economics. This impact is however temporary and moderate negative in nature.

Mitigation measures will include:

- 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 well ahead of the commencement of construction work.

6.2.9 Social Issues

During the construction phase of the project, it might be difficult for the students to get access to their school/colleges if located on other side of track. Similarly, the patients may also face difficulty of access to the hospitals. Moreover, this will result in causing inconvenience to the nearby residents and affecting their daily life activities. There may also be a crossing problem for the pedestrians during the construction/operation stage of the project. Taking in to account the climate of Lahore the effect of sunlight would be minor. However, measures would be adopted to minimize the impact on sunlight and fresh air in the detail design. Security arrangements would be

made along the track and stations. This impact is temporary and moderate negative in nature.

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.

6.2.10 Ecological Impacts

Flora

Trees of varying species and sizes in the project area shall be affected by the proposed LRMTS.

The proposed mitigation measures will include:

- Plan for compensatory planting for four trees against each fallen tree of similar floral function;
- Transplantation plan of maximum trees/plants to be affected;
- 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.).

6.3 Anticipated Impacts during Construction Phase

Following is the brief description of impacts and their mitigation envisaged during the construction phase:

6.3.1 Topography

Project lies in the plain area but a large scale excavation is involved for the construction of Tunnel. So, the impact on topography will be significant in nature. The changes due to construction of the proposed Tunnel, however, will be of localized nature. This impact is temporary and minor negative in nature.

Excavations shall be kept confined to the specified location as per the approved engineering drawings and unnecessary excavations should be avoided as mitigation measure.

6.3.2 Soil

The project area is a plain terrain with paved road structure. Soil erosion and contamination may occur on roadside, at contractors' camps due to the following likely impacts:

- Excavation of earth/cutting operations, clearing of vegetation and land levelling activities can destabilize the surrounding land surface, particularly if the excavated area is left unfilled for long, which may lead to rainfall induced soil erosion;
- The unspent materials and debris produced from consumed up materials, if left as such and allowed to mix with soil underneath, can degrade the quality of receiving soils and may render them unfit for plantation later on;
- Leakages of oils, lubricants, chemicals, and other similar substances from their storage sites and from engines of the generators, machines, equipment and vehicles can spoil the receiving soils and may undermine ability of the spoiled soils to support growth of vegetation and plants;
- Non-provision of septic tanks with the temporary worksite toilets, constructed for the labour and others, can contaminate the effluent receiving soils because of raw nature of the effluents;
- Also washing of the gadgets, machinery and equipment without proper drainage of the washout water can adversely affect the soil quality. This impact is, however, temporary and minor negative in nature.
- Onsite storage of the construction materials such as sand, aggregate, crushed stone, cement, bricks, lubricants, fuels and iron bars on the land without an intervening barrier, can degrade soil quality and may smear them with fine particulates of the dumped materials;
- Improper on site storage of equipment and machinery such as wheelbarrows, mixers and compactors and disorderly parking of machinery and equipment may cause soil contamination from trickling or accidental leakages of oils and lubricants there from.

Mitigation measures will include:

- All spoils will be disposed of 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 labors should not be setup on the land earmarked for developing green belts and lawns;
- 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 should be completely removed offsite upon completion of construction and the site should be restored to original or near to original condition; and
- Washout from washing of equipment and gadgets should be drained into either a septic tank or a sand-gravel bed for removal of the grit and contaminants.

6.3.3 Land Acquisition, Resettlement and Compensation

Due to the construction of the LRMTS, land acquisition will occur. This will result in loss of infrastructure; commercial activities and disturbance to people. The compensation for the structures, plots, private and public properties etc. has to be made as per law.

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.

According to Land Acquisition Act 1894, the following points are to be considered while determining compensation to the Project affectees:

The market value of land at the date of publication of notification under section 4 sub section (1);

- *The damage sustained by the person interested, by reason of the taking of any standing crops, or trees which may be on the land at the time of the collector's taking possession thereof;*
- *The damage if any sustained by the person interested at the time of the collector's taking possession of the land by reason of acquisition injuriously affecting his other property, moveable, or immovable, in any other manner, or his earning;*
- *As a consequence of the acquisition of the land by the collector, the person affected is compelled to change his residence or place of business, the reasonable expenses incidental to such change.*

6.3.4 Construction Camps/Camp Sites

Due to the proposed camp sites, loss of vegetation and assets on the selected land and dissatisfaction of rehabilitation measures during and after completion of construction phase may occur. However, it will be a temporary and minor negative impact. For these impacts, mitigation measures have been developed to minimize the likelihood, extent or duration of their occurrence, and any associated adverse effects. **Table 6.3** summarizes potential impacts and proposed avoidance and mitigation measures associated with construction camps.

Table 6.3: Summary of Worker Camp Impacts & Mitigation Measures

Potential Impact	Proposed Avoidance and Mitigation Measures
<i>Environmental</i>	
<ul style="list-style-type: none"> • Temporary habitat loss or disturbance • Temporary visual intrusion • Noise emissions at a single location • Waste generation • Discharge of sanitary effluent and rainwater run-off to water courses 	<ul style="list-style-type: none"> • Individual trees and shrubs of high conservation value to be marked and preserved wherever possible or transplanted if the root conditions are suitable for such an operation. • Reinstate any temporary facilities to pre-existing conditions in ecologically sensitive areas.

Potential Impact	Proposed Avoidance and Mitigation Measures
	<ul style="list-style-type: none"> • Implement landscaping plan for all facilities in areas where high landscape value and visual vulnerability to the proposed activities warrants site-specific landscape restoration measures. • Limit the working hours of noisy activities when near identified sensitive receptors to normal daytime working hours. • Operate equipment in a manner sympathetic to the ambient noise environment. Do not leave equipment idling unnecessary. • Eliminate tonal, impulsive or low frequency noise through noise control engineering techniques where practicable (fitting of mufflers, damping, etc.), and substitute for a different method if necessary (e.g., instead of hammering actions, use hydraulics). • Provide adequate warnings of impending works to all potential receptors within a 1 km corridor surrounding the right-of-way via public notices and local news. • Implement Waste Management Plan to include procedures for the classification, storage and disposal of all construction wastes and the training of employees who handle hazardous materials. • Ensure that discharge of sewage from temporary construction facilities to surface courses does not impact surface water ecology. This will be achieved through the provision of treatment facilities and by enforcing the discharge

Potential Impact	Proposed Avoidance and Mitigation Measures
	standards.
Social	
<ul style="list-style-type: none"> • Worker camp sitting: consultation surrounding potential construction camp sites revealed concerns regarding the location of proposed sites for Worker Camps. • Tension between Communities and Workers: cultural differences, behavior of construction workers, potential disregard for local cultural norms, potential for prostitution and the attraction of “hangers on” at camp sites could lead to increased tension between local communities and the workers and camps. The scale of this impact will depend on successful implementation of mitigation measures and in part on the origin of the workforce staying in construction camps. Some communities have expressed particular concerns in this regard. 	<ul style="list-style-type: none"> • In order to minimize social disturbances as a result of construction workers, existing camps from previous projects will be identified as a first preference. State land will be a second preference for worker camp locations, followed by land where there is a willing lessee. • The project will seek to avoid sitting camps where their presence might contribute to any conflicts between residents. • Employment policies which aim to maximize job opportunities for local people will help to minimize tensions caused by different socio-cultural values. • Training will be provided to all staff on camp management rules and overall discipline and cultural awareness. This will include, in appropriate languages: <ol style="list-style-type: none"> 1. A briefing on Camp Rules 2. A community relations orientation to increase awareness about the local area, cultural sensitivities and the project Code of Conduct 3. Awareness-raising on health considerations, including STDs. • The construction contractor is required to develop a Construction Camp Management Plan to address: <ol style="list-style-type: none"> 1. Discipline

Potential Impact	Proposed Avoidance and Mitigation Measures
	2. Community liaison 3. Ethnic tensions 4. Market distortion (see employment and local sourcing mitigation) and 5. Communicable diseases. • A Code of Conduct and Camp Rules will be required within the Construction Camp Management Plan, which provides policies and a disciplinary framework with respect to worker behavior.
Camp Location	
The final location and number of sites will be determined by the construction contractors and agreed with the PMA.	Workers camps will be away atleast 1km from residential area. The construction contractor will be required to assess the environmental/social sensitivity of any additional or alternative sites prior to their approval for adoption.

Some additional mitigation measures will include:

- 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.

6.3.5 Health and Safety

a) Occupational Health and Safety

Health risks and work safety problems may result at the workplace if the working conditions provide unsafe and/or unfavorable working environment and due to storage, handling and transport of hazardous construction material. Workers should

be provided with safe and healthy working environment taking into account risks inherent to the particular sector and specific classes of hazards in project area.

Mitigation measures will include:

- Obligatory insurance against accidents for labourers/workers;
- 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, adequate footwear for bituminous pavement works, protective goggles, gloves etc;
- 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.

b) Community Health and Safety

The construction activities and vehicular movement at construction sites and access service roads may also result in road side accidents particularly inflicting local communities who are not familiar with presence of heavy equipment and machinery. This is a temporary and minor negative impact. Quality of ground water and surface water resources available in the nearby local communities may get contaminated due to the construction activities, oil spillage and leakage, roadside accidents etc. The labourers work with different transmittable diseases may cause spread out of those diseases in the local residents.

Mitigation measures will include:

- 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;
- 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 sanitary improvements and elimination of breeding habitat close to human settlements and by eliminating any unusable impounding of water;
- 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.

c) Emergency Response

Disasters such as earthquakes, flooding and other disasters such as fires may occur, and that must be considered for minimizing their impacts.

Mitigation measures will include:

An Emergency Response Plan for earthquakes and manmade disasters including violence and terror activities 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 be regularly conducted. The Emergency Response Plan is attached as **Annex VI**.

6.3.6 Air Quality

Air quality will be affected by fugitive dust emissions from construction machinery; dust from the unpaved surface and construction vehicles. Emissions may be carried over longer distances depending upon the wind speed, direction, temperature of surrounding air and atmospheric stability. Besides, multifarious construction activities and increased vehicular traffic (construction vehicles) would also contribute to the localized airborne dust. Once in the air, the larger sized particles, under influence of gravity, tend to settle down in the immediate vicinity of the source. The suspended particulate matter (SPM) of the size smaller than 10 micrometer (PM_{10}) tends to remain suspended in the environment for much longer and persistent time and is an environmental hazard. The objectionable impacts of settling of the suspended dust would be its dry deposition on vegetation, glass windows, motor vehicles, buildings, and other exposed surfaces. Exhausts from fossil fuel burning in the construction machinery will also deteriorate local air quality. Similarly, exhausts from generators can also have impacts on air quality in the vicinity.

The critical sources of dust pollution during the construction phase will be:

- Unpaved road surface;
- Transportation of materials and other construction activities that create dust emissions.

Vehicular emissions (CO , NO_x , SO_x , PM_{10}) affecting adversely on the environment and human health as outlined in **Table 6.4**

Table 6.4: Impacts of Air Pollution

#	Air Pollution Parameters	Impacts on Environment	Impacts on Human Health
1.	Carbon Monoxide (CO)	<ul style="list-style-type: none"> ▪ Toxic to human health ▪ Deterioration of air quality 	<ul style="list-style-type: none"> ▪ Heart attack by reducing the oxygen carrying capacity of

#	Air Pollution Parameters	Impacts on Environment	Impacts on Human Health
			<p>blood</p> <ul style="list-style-type: none"> ▪ Birth defects including mental retardation and impairment of fetus growth ▪ Dizziness, headache, and nausea ▪ Increase in reaction time of the drivers, a threat to the road safety
2.	Oxides of Nitrogen (NO _x)	<ul style="list-style-type: none"> ▪ Formation of photochemical oxidants ▪ Damage to materials and property, by acid rains, resulting from oxidation of oxides of nitrogen to nitric acid, after reacting with water vapors ▪ Retardation of growth in plants 	<ul style="list-style-type: none"> ▪ Reduction in oxygen carrying capacity of blood ▪ Impairment of Olfactory sense and night vision ▪ Dryness and roughness of throat
3.	Sulfur Oxides(SO _x)	<ul style="list-style-type: none"> ▪ Chlorosis and Plasmolysis in plants ▪ Damage to materials and property, by acid rains, resulting from oxidation of sulfur oxides to sulfuric acid, after reacting with water vapors 	<ul style="list-style-type: none"> ▪ Serious lung damage, particularly in sulphate form ▪ Respiratory diseases like chronic bronchitis

#	Air Pollution Parameters	Impacts on Environment	Impacts on Human Health
4.	Particulate Matter (PM ₁₀)	<ul style="list-style-type: none"> ▪ Damage to plants by choking the leaf pores and restricting photosynthesis ▪ Global cooling of earth by reflecting back the solar radiation ▪ Impairment of the atmospheric visibility affecting transportation safety ▪ Deterioration of aesthetic quality of atmosphere, land and water 	<ul style="list-style-type: none"> ▪ Increase in the frequency of respiratory infections such as bronchitis

Source: EIA and RAP Study of Akhori Dam Project, Attock

The overall impact on the quality of air during the construction phase will, however, be temporary and limited to the project's implementation phase only.

Mitigation measures will include:

- 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 should be carried out to suppress excessive dust emission(s);
- 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.

As all the traffic diversion routes are paved/metal roads, therefore, dust pollution or particulate matter won't be a problem. However, some of dust problems caused during the construction phase of the Project could be effectively mitigated by the implementation of simple procedures by the Contractor including but not limited to the following:

- Service roads (used for earth moving equipment and general transport) should be regularly sprayed with water during dry weather;
- All excavation work should be sprinkled with water;
- Construction workers should be provided with masks for protection against the inhalation of dust;
- Vehicle speed in the project area should be prescribed not more than 20 km/ hr and controlled accordingly; and
- Vehicles used for construction should be tuned properly and regularly to control emission of exhaust gases.

6.3.7 Noise and Vibrations

Noise is a by-product of human activity, and area of exposure increases as function of mobility and construction activities. Sources of noise during construction are heavy machinery such as bulldozers, excavators, stabilizers, concrete mixing plant, pneumatic drills, stone crushers and other equipments. Noise generated by construction machinery is likely to affect sensitive receptors located within 50 meter of the proposed Project. This impact is temporary and moderate negative in nature. **Table 6.5** illustrates maximum permissible noise levels for different situations.

Table 6.5: Maximum Limits of Noise Levels

Noise Level dB (A)	Situation
194	Lung damage
180	Ear drum rupture
150	Absolute limit with ears protected
150	Maximum of instantaneous noise
135	Absolute maximum with ears unprotected
100	Prolonged noise causing permanent damage
90	Factory work for an 8-hour day, 5 days a week
*85	Ear protection should be worn
80	Noise on building or construction sites
70	Normal road traffic near residential areas

Source: “Environmental Degradation” by Engr. Col. Mumtaz Hussain

*Above 85 dB (A) ear protection devices should be worn.

According to **Table 6.6** given below, which presents the damage risk criteria for hearing loss, noise level above 110 dB(A) can be tolerated for half an hour only.

Table 6.6: Damage Risk Criteria for Hearing Loss

Sr. No.	Maximum Allowable Duration per day (Hours)	Noise-Level in dB (A)
1	8	90
2	6	92
3	4	95
4	3	97
5	2	100
6	1 ½	102
7	1	105
8	½	110
9	¼ or less	115 (Max.)

Source: Occupational Safety and Health Administration, OSHA, USA

The likely impacts due to noise are:

- Persistently higher noise levels can produce psychological effects of distraction of attention, irritation and short temperedness in the exposed persons;
- Noisy settings and higher background levels can cause temporary threshold shift and the consequent habit of speaking loud, which may cause damage to vocal cords in the persons exposed;
- Noise produced from moving construction vehicles and blowing of pressure horns, at times, could be intolerable particularly during quiet hours of night; and
- Vibrations from machinery and equipment such as hand held compactors and concrete vibrators can produce easy fatigability and generalized aches in the persons operating these machines.

All mitigation measures mentioned below should be taken in order to minimize the impacts of noise in the project area. These measures include, but are not limited to the following:

- 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 working hours in the day, as far as possible;
- 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 berms, etc. in front of schools, hospitals and mosques; and
- Public hearings to discuss appropriate solutions and materials to control noise (e.g. mud or brick walls, bushes, etc.)

6.3.8 Solid Waste (Construction Waste and Hazardous Waste)

Due to construction activities waste will be generated at construction and contractors camp site. The construction waste will include wastewater, oil spillage from machinery, domestic waste and solid waste etc. The handling and storage of oil, asphalt/bitumen may be a source of environmental pollution as a hazardous waste. This will result in unhygienic conditions, health risk to work force and public at the camp site. The likely impacts of solid waste are:

- Insecure and unhygienic disposal of the solid wastes generated at the worksite, particularly garbage and trash may cause degradation of soil and land;
- Insecurely disposed off heaps of wastes containing kitchen garbage and food waste can serve as breeding grounds for the disease spreading vectors and rodents;
- Throwing away of solid wastes into water channels and the wastewater network can result into choking of the latter.

These impacts are temporary and minor negative in nature.

Mitigation measures will include:

- 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;
- 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 waters from construction machinery;
- 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.

6.3.9 Surface and Groundwater

There is no significant surface water resource of the project area so there will be no impact on surface water quality during the construction of the project area. There is a possibility that various materials like fuel, lubricant oil and other oily products, which are used during the construction phase may contaminate groundwater, if they are not handled properly. During the construction phase, the sanitary wastewater will be generated at the workers' camp(s). If this wastewater is allowed to stagnate in water ponds on the site, it can percolate into the soil, thereby, contaminating groundwater.

Persistent and prolonged withdrawal of groundwater higher than the safe yield limits of the aquifer can initiate early depletion of aquifer. This situation can result in reduced water supplies for other users who share the same groundwater resource. Abstraction of the groundwater over and above the safe yield limit can produce serious hydrological and environmental consequences. Over abstraction can lead to:

- Early depletion of the aquifer resources;
- Persistent lowering of the water table;
- Reduced availability or non-availability of the groundwater to the neighbouring communities sharing the same aquifer

These impacts are temporary and minor negative in nature.

Mitigation measures will include;

- 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;
- Regular water quality monitoring according to determined sampling schedule;
- Prohibit washing of machinery and vehicles in surface waters, provide sealed washing basins and collect wastewater in sedimentation/retention pond;
- 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.

6.3.10 Biodiversity Conservation and Natural Resources

Flora

Trees are vital ecosystem, which perform variety of functions for the improvement of environment such as reduction in air pollution, noise abatement, cooling effect on earth, supply of oxygen etc. It is obvious that the implementation of project activities will cause cutting of trees, existing within the proposed RoW. Trees/plants of different species will be affected. The cutting of these trees will cause a negative impact on the flora of the tract. Following impacts are expected on the flora of the project area:

- During the entire construction period dust laden polluted air will form a dust film on leaves thus blocking sunshine and stomata consequently hindering photosynthesis processes causing detrimental effect on the plant health;
- Exhaust of noxious gases from movement of heavy machinery will further pollute air which will adversely affect health and vigor of plants;
- Establishment of Contractors camps and warehouses for storage of equipment, material etc. shall involve clearing of vegetation from the area, causing a negative impact; and
- During construction activities the Contractor's workers may damage the vegetation and trees (for use as fire-wood to fulfill the camps requirements).

To minimize the impacts on flora, following measures will be adopted during construction stages:

- Only trees coming along rail track, shall be removed and efforts shall be made to save the suitable trees along 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;
- 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
- A tree plantation program will be formulated by the PHA along the GT Road & Thokar Niaz Baig, in consultation with the PMA at available sites.

Fauna

Impacts on mammals, reptiles, birds and aquatic animals are discussed below:

- The trees provide nesting and resting places to the fauna. The cutting of these trees will have a negative impact on the fauna as well;
- During the construction phase, there will be negative impact on the mammals and reptiles of the area, due to the construction activities involving excavation, access road, movement of labor, carriageway of goods and machinery to various sites along the project corridor. Mammals, such as dogs, cats, etc will avoid these areas for fear of being persecuted. Same will be the case with reptiles. Some reptiles might be killed during digging and piling operations;
- Eatable and refuse goods of the contractor's camps may attract wildlife that might be hunted by the workers;
- Due to establishment of camp sites, food storage, setting up of kitchens, production of sewage and wastewater may result in multiplication of rodents like rats, mice, and shrews etc. and vectors like mosquitoes, bugs and flies which will have a negative impact; and

- Birds will try to find shelter and food somewhere else and will tend to move away from the project area to the activities mentioned above for fear of being hunted or caught.

Mitigation measures include:

- 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;
- 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.

6.3.11 Disposal of Mucking Material

Inevitable earthwork operations during project construction will open up scars on the land around the project area. This impact is temporary and minor negative in nature.

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.

6.3.12 Disruption of Existing Public Utilities/ Infrastructure

There may be some disruption to the already existing utilities like electricity poles, underground telephone lines, power transmission lines, street lights etc. in the project area during the construction phase. These impacts are, however, temporary and minor negative in nature.

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 during the construction period.

6.3.13 Traffic Management

Due to the construction activities, proper traffic management may pose a challenge in the project area. This may result in traffic jams and cause inconvenience to the people passing through the project area due to movement of vehicles carrying construction materials. It will also increase the traffic load on the existing road network, thus deteriorating the existing condition of the road. Also, the movement of vehicles along the haulage routes may cause soil compaction and alteration of percolation, and damage to properties and utilities. This impact is temporary and minor negative in nature.

Mitigation measures will include:

- 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 stage.

6.3.14 Economic Activity

Due to the construction of the proposed Project, economic activity will be generated in the project area as the labourers and semi-skilled staff will have an opportunity to work for the construction of the proposed project. This will help in developing their skills and capacities. This is a moderate positive impact.

6.3.15 Lifestyle and Culture

There are chances of arising of issues related to cultural differences/conflict between the Contractor's workforce and the local inhabitants, conflicts arising due to the mix of local and migratory job seekers as the use of local resources and products will be increased. In this situation, local residents may resist contractor's workforce attitudes, cultural clashes particularly when local/international contractors are engaged, social disturbance and dissatisfaction with employing outsiders may arise. This impact is temporary and minor negative in nature.

This impact can be mitigated by adopting the following mitigation measures:

- 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.

6.3.16 Impacts of Heavy Vehicles on the Existing Road Network & Sensitive Receptors

The plying of heavy vehicles on the existing road network may result in air pollution (if unpaved roads), noise pollution due to tire-road friction especially near sensitive receptors (residential areas, school, health facility etc.), and damage to roads and traffic congestion. However, the impacts would be temporary and moderate negative in nature for which the following mitigation measures are proposed:

- 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;
- 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.

6.3.17 Physical and Cultural Resources

There are some physical/cultural resources in the project area such as Shalamar Garden, Chuburji and Shrine of Madhu Lal Hussain and other such sites. During construction, there is a chance of finding archeological remains.

In that case, the contractor shall immediately report through Supervision Consultant to Directorate General (DG) of Archeological Department, Government of Pakistan to take further suitable action to preserve those antiques or sensitive remains. Chance finds procedure is given in **Annex VII** and if need to be adopted in case of any accidental discover of cultural heritage.

6.4 Anticipated Impacts during Operational Phase

The anticipated potential environmental impacts related to the proposed Project have been studied for the operational stage of the Project and are discussed as under.

6.4.1 Ecology

a) Flora

During the operation stage, the trees and vegetation coming in the RoW of the proposed LRMTS would already have been removed. However, raising of new plants/trees at available spaces will have a positive and permanent impact. No negative impacts are envisaged on the flora during the operational phase. A large number of plants will be raised along the GT Road at available spaces. The presence of adequate flora, along the road, will absorb flue gases, emitted from a large number of cars, vehicles and public transport, which shall in turn improve air quality.

b) Fauna

In many ways, fauna of the project area is dependent upon flora for its resting, nesting and roosting activities. With the improved flora of the project area, due to raising of large number of trees, the fauna and especially the avi-fauna shall be attracted to the area. The birds, which were scared away due to noise and degradation of their habitat, shall return to the area. Plantation on both sides shall not only reduce the noise and air pollution but will also be a source of attraction for the birds.

6.4.2 Surface and Groundwater

No major adverse impact on groundwater is anticipated during the operational phase with the exception of some occasional oil spills, which may be restricted to the rail track, however, may be sometimes washed into groundwater during rains etc. Also, there will

be no abstraction of groundwater for any of the project activities during the operation phase.

6.4.3 Air Quality

The operational phase will not have air quality issues as LRMTS is designed as per Euro standards and is environmental friendly.

This impact is permanent and positive; however, the emissions from Metro Rail Transit System cannot be absolutely eliminated.

Mitigation measures will include:

- 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; plants should be selected in accordance to their ability to absorb emissions;
- Regular rail track maintenance to ensure good surface condition;
- Regular rail monitoring to control/ensure compliance with NEQS;

6.4.4 Noise

During the operational phase, new Metro Rail will be introduced which will follow the new traffic intelligence system and therefore, the noise levels are anticipated to decrease due to decrease in number of private vehicles and old un-tuned buses on G.T Road and Multan Road. This will be a minor positive impact.

6.4.5 Solid Waste

No hazardous waste is expected to be generated in operation phase except during road maintenance works. However, miscellaneous municipal wastes from stations, refreshment and ticketing booths comprising wrappings, papers, eatables, empty cans or bottles, food residues and other similar wastes that will be thrown out of rail or pedestrians along the rail track. The putrefaction of the organic component of the uncollected wastes may give rise to foul smells. The uncollected waste may also act as breeding grounds for the disease producing vectors and will affect the aesthetics of the project area. Mitigation measures will include:

- Solid Waste generated from stations will be properly disposed off through provision of waste bins and local solid waste collection and management system.

- Proper labelling 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 waste at all the stations of LRMTS.

6.4.6 Environmental Quality

Environmental quality is an indicator of regional quality of life, supporting the health and well-being of the public and the attractiveness and sustainability of the urban and natural environment. The LRMTS environmental improvement mechanisms include the effects within three general categories:

Technology Effect:	Reduced vehicle emissions due to the propulsion technology or fuel efficiency changes.
Ridership Effect:	Trips diverted from private vehicles which increase transit ridership.
System Effect:	Reduced vehicle emissions from reduced congestions.

These impacts are permanent and have a major positive impact on environment.