ENVIRONMENTAL IMPACT ASSESSMENT REPORT OF DWARKA SECTOR – 9 TO IGI-AIRPORT CORRIDOR

1 ENVIRONMENTAL BASELINE DATA

1.1.1 With rapid strides in economic development, particularly in urban areas, the need for rationalising and upgrading the transport system is imperative. In the process of development, there has been intensive use of natural resources. Very often the process of development has adversely affected the environment, leading to ecological imbalances. The importance of conserving and enhancing the environmental assets has assumed urgency. Apart from land use, conservation of flora and fauna and planning urban transportation is an important aspect of eco-development.

The compilation of environmental baseline data is essential to assess the impact on environment due to the project activities. The environment includes water, land, air, ecology, noise, socio – economic issues etc. The information presented in the Chapter has been collected from desk research, other secondary sources and field studies. Majority of data on water quality, vegetation, air and noise quality was collected during field studies in February-March 2006.

1.1.2 General Environment

The average elevation of Delhi plains is around 198-200-m above MSL. River Yamuna flows across the eastern flank of the city. Many small watercourses intersects the terrain causing a variation in relief. However, average gradient of terrain is gentle, of the order of 1 to 3m/km. The area has mature topography with isolated hillocks. The groundwater table in Delhi has depleted to about 20-30 meters in various areas across the city. Compared to a level of 30-40 feet at the time of Independence, the water table has dropped to 350 feet at certain places. It is said to be falling at 10 feet per year on an average. The ground water occurs in silty to sandy layers of the alluvial sediments. The permeability varies from 0.5 to 8m per day and transmissivity from 10 to 100sqm/day. The hydraulic gradient is reported 1.3 to 2.0 km/m. Delhi has an extreme climate, which is very cold in winter and hot in summer. The winters begin in November and are at its peak around the time of the New Year and the 1st half of the January. After the middle of March, the weather begins to turn warm and soon it becomes hot so that from April to June one experiences extreme heat as the temperature climbs to 45^{o}C at times. The monsoon arrives towards the end of June. Delhi has a small rainy season in winter also. Average yearly rainfall of Delhi is 73cm, 80% of which is received during June-August. The relative humidity at Delhi does not exceed 70% for significant periods of time in the year.

1.1.3 Water and Soil

The water and soil samples had been tested for chemical analysis. The results so obtained are summarised in **Tables 9.1** and **Table 9.2** respectively. Total dissolved solids, and flouride in the water sample are on higher side and need treatment if used for drinking. Most of the other parameters are within the permissible limits. Composition of soil shows predominance of sand over silt and clay. pH of the soil sample indicates that soil is alkaline

in nature. Based on this data, it could be concluded that sub soil and underground water are unlikely to undergo any deteriorating effect due to proposed Metro structures and foundation.

Table 9.1 Chemical Analysis of Water Sample

S. No.	Parameters	Dwarka	Desirable Limit	Tolerance Limit 'Cl-A'
1	pH	7.32	7-8.5	6.5-8.5
2	TDS (mg/l)	854	500	500
3	TSS (mg/l)	2	-	-
4	Calcium as Ca (mg/l)	41	75	-
5	Chloride as Cl (mg/I)	140	200	250
6	Sulphates as SO_4 (mg/l)	19	200	400
7	Fluorides as F (mg/l)	3	1	1.5
8	Iron as Fe (mg/l)	0.18	0.1	0.3
9	Nitrates as NO_3 (mg/l)	12	45	20
10	BOD (mg/l)	0.77	-	2
11	Phosphates as PO_4(mg/l)	ND	-	Absent

Table 9.2 Physico-Chemical Characteristics of Soils

S. No.	Sample / Parameter	Sample Collected Near Dwarka
1	PH	7.98
2	Texture	
	Sand (%)	62.84
	Silt (%)	4.98
	Clay (%)	32.18
3	Nitrogen (kg/hectare)	209
4	Phosphate (kg/hectare)	190
5	K (mg/100gm)	0.130
6	Ca (mg/100gm)	0.464
7	Mg (mg/100gm)	0.696
8	Na (mg/100gm)	2.55
9	Organic matter (%)	0.270

1.1.4 Flora of the Project area

Tree survey was carried out along the proposed alignment. Trees are to be cut on the land where the stations are proposed and on the land that will be permanently acquired at station locations. The main species along the alignment are Pipal, Neem, Kikar, Eucalyptus, Ashok, Ficus and Bakaan, etc. No rare or endangered species of trees had been noticed during field studies. About 14 trees exist on the proposed alignment.

1.1.5 Air Quality

As a part of this study ambient air quality monitoring (AAQM) had been carried out by

setting up ambient air quality monitoring station at Dwarka area for the parameters SPM, CO, SO_2, and NOx. The results so obtained are reported in **Table 9.3**. The ambient air quality data indicates much higher value of suspended particulate matter, than the prescribed limits established by CPCB at the monitoring station. However, the values of SO_2, NOx and CO are within the permissible limits. The CPCB ambient air quality standards are reported in **Table 9.4**.

Table 9.3 Air Quality at Project Site (µG/M^3)

S.No.	**Location**	**SPM µg/m^3**	**NO_X µg/m^3**	**SO_2 µg/m^3**	**CO mg/m^3**
1	Near Dwarka	520-560	14-18	7-9	1.1-1.5

Note: * SPM values are high due to dusty atmosphere

Table 9.4 Ambient Air Quality Standards

S. No.	**Category of Area**	**Concentration In µg/m^3**			
		SPM	**No_2**	**So_2**	**CO**
1.	Industrial and Mixed use	500	120	120	5000
2.	Residential and Rural	200	80	80	2000
3.	Sensitive	100	30	30	1000

1.1.6 Seismicity

The project area falls in **Zone-IV** of Seismic Zoning Map of India. Delhi region shows active and prolonged seismic history. Earthquakes of 3 to 6.7 magnitude on Richter scale have occurred in past around Delhi. Suitable seismic factor as per the Indian Meteorological Department (IMD) needs to be considered for design purpose for Civil Engineering structures and while finishing civil designs.

1.1.7 Noise

Noise levels were measured at Dwarka area at 2.0-m away from source as per standard practice. The noise levels so obtained are summarised in **Table 9.5**. It could be concluded that the noise levels recorded are higher than the prescribed permissible levels of 65-dBA (day) and 55-dBA (night). The noise level standards are documented in **Table 9.6**.

Table 9.5 Noise Levels in Project Area (Leq)

Location	Time	L_{10}	L_{50}	L_{90}	L_{eq}	Lmax	L_{min}
Near Dwarka	8-9 AM	69.9	59.2	51.3	67.9	94.2	42.2
	9-10 AM	72.2	61.2	53.0	70.2	67.4	43.6
	12-1 PM	70.6	59.8	51.8	68.6	95.1	42.6
	1-2 PM	69.9	59.2	51.3	67.9	94.2	42.2
	4-5 PM	71.6	60.7	52.5	69.6	96.5	43.2
	5-6 PM	69.1	58.6	50.7	67.2	93.2	41.7
	12-1 AM	56.7	55.6	48.2	63.8	88.5	39.6
	1-2 AM	61.7	52.3	45.3	60.0	83.2	37.3

Note: $L_{10,}$ L_{50} and L_{90} are the sound level, which is exceeded 10%, 50% & 90% of the total time

Table 9.6 Noise Levels Standards dB(A)

S. No.	Standard For	Day	Night
1	Industrial Area	75	70
2	Commercial Area	65	55
3	Residential Area	55	45
4	Silence Zone	50	40

1.2 SOCIO-ECONOMIC ASSESSMENT

Development of proposed metro rail project involves acquisition of land for entry, exit and for other facilities of station and running section. For the acquisition of private land to the barest minimum, the alignment has been so chosen, that either it is underground or remains mostly within the government land. For different components of this corridor 3375 sqm of DDA land shall be acquired. No relocation is required at any other place.

1.3 POSITIVE ENVIRONMENTAL IMPACTS

Based on project particulars and existing environmental conditions (**Section 9.1**), potential impacts have been identified that are likely to result from the proposed Metro project and where possible these have been quantified. The positive environmental impacts are listed below:

- Traffic congestion reduction,
- Quick service and safety,
- Less fuel consumption,
- Reduction in Air Pollution,
- Better roads, and
- Employment opportunities,

1.4 NEGATIVE ENVIRONMENTAL IMPACTS

1.4.1 Based on project particulars and existing environmental conditions, potential negative impacts likely to result from the proposed development have been quantified. Negative impacts have been listed under the following headings:

- Impacts due to project location,
- Impacts due to construction works, and
- Impacts due to project operation.

1.4.2 Impacts Due to Project Location

a) Change of Land use

The alignment changes from underground to elevated section. For different components of this corridor 3375 sqm of DDA land shall be acquired.

b) Loss of Trees

Due to the proposed metro construction approximately 14 trees are likely to be lost. The total value of these trees lost is **Rs. 9800** as reported in **Table 9.7.**

Table 9.7 Loss of Forest Products

Total loss of Trees (Nos.)	14
Average cost of one tree (Rs.)	700
Total Loss (Rs. Lakhs)	**9800**

c) Loss of Historical and Cultural Monuments

No historical/cultural monuments will be affected as a result of the proposed development of project.

1.4.3 Impacts Due to Project Construction

(a) Soil Erosion and Health Risk at Construction Site

Run off from unprotected excavated areas, and underground tunnel faces can result in excessive soil erosion, especially when the erodability of soil is high. Mitigation measures include careful planning, timing of cut and fill operations and re-vegetation. In general, construction works are stopped during monsoon season.

Problems could arise from dumping of construction spoils (Concrete, bricks) waste materials (from contractor camps) etc, causing surface and ground water pollution. However, it is proposed to have ready mix concrete directly from batching plant for use at site. The other construction material such as steel, bricks, etc. will be housed in a fenced yard. The balance material from these yards will be removed for use/disposal. Mitigation measures include careful planning, cleaning redressing, landscaping and re-vegetation.

Health risks include disease hazards due to lack of sanitation facilities (water supply and human waste disposal) and insect vector disease hazards of local workers and disease hazards to the local population. Mitigation measures should include proper water supply, sanitation, drainage, health care and human waste disposal facilities. In

addition to these, efforts need to be made to avoid water spills, adopt disease control measures and employment of local labour. Problems could arise due to difference in customs of imported workers and local residents. These risks could be reduced by providing adequate facilities in worker's camps and by preferably employing local labour.

(b) Traffic Diversions and Risk to Existing Buildings

During construction, minimum traffic diversions on roads will be required as the stretch is very small. At the grade and elevated section is mostly on barren land. In underground portion, the building line is considerably away from the proposed cut and cover and tunnels. Hence, no risk is foreseen to adjacent buildings.

(c) Impact on Water Quality

Construction activities may have an adverse impact on water bodies due to disposal of waste. The waste could be due to: the spillage of construction materials, dumping of used water from the stone crusher, oils and greases and labour camp. But the quantities of such spills are very negligible. Care, however, needs to be taken to provide adequate sanitary facilities and drainage in the temporary colonies of the construction workers. Provision of adequate washing and toilet facilities with septic tanks and appropriate refuse collection and disposal system should be made obligatory. Contamination of ground water can take place, if the dump containing above substances gets leached and percolates into the ground water table. This is not the case with the present project, as the activity does not involve usage of any harmful ingredients. Moreover, activities are of short duration. Hence, no adverse impact on either ground or surface water quality is anticipated in the present project.

(d) Disposal of soil during construction

Construction of underground metro projects is a specialised and complex task. Owing to paucity of space in the busy cities and for safety reasons, elaborate measures need to be adopted for collection, transfer and disposal of excavated soil. Soil collection, transportation, disposal and its treatment needs to be carried out in a systematic manner. Soil collection should be in containers from the dredging sites/places. These containers should be such that soil should not spill during movement to disposal site. The excavated soil will be first collected at dumping ground and then transferred to disposal sites. Dumping areas are essential to store the excavated earth temporarily for back filling at later date and final disposal. Surplus earth would have to be transported to the nearby site of DMRC requiring earth filling. It is desirable to first clean the disposal area site of vegetation biomass that exists over it. The surface of these sites needs to be treated so that leached water does not contaminate soil and ground water. The faces and top should be treated/vegetated to avoid erosion.

During construction about 8476 $m^3$of soil is likely to be excavated. Out of this 848m^3 (10%) is likely to be reutilized in filling. The balance 7628m^3 (90%) will be disposed off.
A truck has carrying capacity of about 8-10 tones. The density of soil is about 2.5t/m^3 hence about 3.2m^3 of earth could be carried in every trip. About 2384 truck trips will be

required in a span of 2 years i.e. 3 trips per day. It is desirable to first clean the disposal area site of vegetation biomass that exists over it. The surface of these sites needs to be treated so that leached water does not contaminate soil and ground water. The faces and top should be treated/vegetated to avoid erosion.

1.4.4 Impacts due to Project Operation

a) Oil Pollution

Oil spillage during change of lubricants, cleaning and repair processes, in the maintenance of rolling stock, is very common. The spilled oil should be trapped in grit chamber for settling of suspended matter. The collected oil should either be auctioned or incinerated, so as to avoid any underground water contamination.

b) Noise

The main sources of noise from the operation of trains include: engine noise, cooling fan noise, wheel-rail interaction, electric generator and miscellaneous noises like passenger's chatting. As most of the section is underground, there will be no impact on the ambient noise. However, due to reduction of vehicular traffic, the road traffic noise will come down. Hence, total noise level would be about 75-dB (A). However, due to reduction of vehicular traffic, the road traffic noise as compared with existing levels will come down by about 7 to 9%.

c) Accidental Hazards

In view of the hazards potential involved due to failure of system and accident the on-site and off- site emergency measures have been formulated and will be implemented.

d) Water Supply

Public Health facilities such as water supply, sanitation and toilets are very much needed at the stations. CPHEEO has recommended 45 litres per day, water supply to persons working at stations. The people working on stations will be about 30. The water demands on stations will be for following components: -

- Personal use of Metro staff,
- Fire demands, and
- Wastage.

The water demand on stations works out to be about 1,30,000 litres/day. Water requirement for the Dwarka station and the IGI airport station has been included in the Barakhamba-Cannaught Place–Dwarka section and New Delhi-IGI airport section respectively.

e) Metro Station Refuse

The refuse from metro stations includes; garbage, rubbish, and floor sweepings. The collection and removal of refuse in a sanitary manner from the station is of importance for effective vector control, aesthetic improvement, and nuisance and pollution abatement.

There is no shop/ facilities for cooking at MRTS stations hence there is no generation of garbage. RITES has assumed about 3 gm/ person/ day of refuse generation at Metro Stations. The management of solid waste at Dwarka station and IGI airport station has been included in the Barakhamba-Cannaught Place–Dwarka section and New Delhi-IGI airport section respectively.

f) Visual Impact

The construction of the above corridor will bring about a change in visual look of the streets through which it will operate. An architecturally well-designed structure, which could be aesthetically pleasing and able to reduce impact due to visual disfiguration have been incorporated in present corridor. Since a low profile would cause least intrusion, the basic elevated section should be optimised at the design stage itself.

1.5 CHECKLIST OF IMPACTS

1.5.1 A typical checklist identifying anticipated environmental impacts is shown in **Table 9.8**

Table 9.8 Checklist of Impacts

	Parameter	Negative Impact	Positive Impact	No Impact
A)	**Impacts Due To Project Location**			
i)	Change of Land Use and Ecology	*		
ii)	Impact on Historical/Cultural			*
iii)	Monument			*
B)	**Impact Due To Project Construction**			
i)	Soil Erosion, Pollution and Health Risk at Construction Site	*		
ii)	Traffic Diversions and Risk to Existing Buildings			*
iii)	Impact on Water Quality			*
C)	**Impact Due To Project Operation**			
i)	Oil Pollution	*		
ii)	Noise and Vibration	*		
iii)	Accidental Hazards	*		
iv)	Water Supply	*		
v)	Railway Station Refuse	*		
vi)	Visual Impacts			*
D)	**Positive Impacts**			
i)	Traffic Congestion Reduction,		*	

Parameter		Negative Impact	Positive Impact	No Impact
ii)	Quick Service and Safety,		*	
iii)	Less Fuel Consumption,		*	
iv)	Reduction in Air Pollution,		*	
v)	Better Roads, and		*	
vi)	Employment Opportunities		*	

1.6 ENVIRONMENTAL MANAGEMENT PLAN

1.6.1 Based on environmental baseline conditions, planned project activities and its impacts assessed, the set of measures to be taken during implementation and operation to avoid or offset adverse environmental impacts or to reduce them to acceptable levels, together with the action which needs to be taken to implement them are enumerated in this section.

1.6.2 Mitigation Measures

Based on project description, Environmental Baseline Data and Environmental Impacts, it is proposed to prepare the Environmental Management Plan for the following:

a) Compensation for Loss of Land,
b) Compensation for Loss of Trees,
c) Compensatory Afforestation and Fencing,
d) Water Supply & Sanitation,
e) Oil Pollution Control
f) Noise Control
g) Vibration Control

a) Compensation for Loss of Land

The land likely to come under project is 3350sqm. The cost of land for compensation is taken under the project cost.

b) Compensation for Loss of Trees

There are approximately 14 trees on the proposed alignment, which needs to be uprooted. The Compensation for Loss of Trees works out to **Rs. 9800.**

c) Compensatory Afforestation and Fencing

According to the survey, about 14 trees are likely to be lost due to the project. 10 times the number of trees is to be planted as per the Department of Forests stipulations. Hence, about 140 plants are required to be planted. The total area required for afforestation of these tress comes to about 0.10ha. It is presumed that government land will be provided for afforestation; hence no land cost will be involved. Compensatory afforestation cost (excluding fencing) for 0.10 ha. will be about **Rs. 15000** @about Rs.1,50,000 per ha. Fencing shall be provided in order to save the saplings from the animals. The cost towards fencing is estimated to be about **Rs. 16000 .** Thus, the total

cost works out to be **Rs. 31000.** The recommended plant species may be as per the following **Table 9.9**.

Table 9.9 Recommended Tree Species for Reforestation

S. No.	Local Name	Botanical Name
1.	Neem	Azadirachta indica
2.	Sisso	Dalbergia sisso
3.	Eucalyptus	Eucalyptus
4.	Kikar	Acacia nilotica
5.	Ashok	Sarasca indica
6.	Jamun	Syzygium cumini

d) Water Supply & Sanitation

The public health facilities, such as water supply, sanitation and toilets are much needed at project location. Water should be treated before use up to WHO drinking water standards. In addition, water will be required for contractor's camps during construction, for which additional arrangements have to be made in consultation with the Municipal Corporation. The collection and safe disposal of human waste are among the most important problems of environmental health. The water carried sewerage solves the excreta disposal problems. The sewerage disposal systems should be adopted for sewage disposal. For safe disposal of station refuse, bins of 50-120 litres capacity will be required which can be accommodated at stations and platforms. The cost for bins at Dwarka station and IGI airport station has been incorporated in the Barakhamba-Cannaught Place –Dwarka section and New Delhi-IGI airport section respectively. .

e) Oil Pollution Control

Oil tends to form scum in sedimentation chambers, clog fine screens, interfere with filtration and reduce the efficiency of treatment plants. Hence oil and grease removal tank has to be installed at source. Such tanks usually employ compressed air to coagulate oil and grease and cause it to rise promptly to surface. Compressed air may be applied through porous plates located at the bottom of the tank. The tank may be designed for a detention period of 5 to 15 minutes. Adding Chlorine in an amount of 2.0-mg/l will increase the efficiency of removal.

f) Noise

There will be an increase in noise level in ambient air due to construction and operation of this Metro corridor. However, noise levels in the core city will go down. The increase in levels is marginal, hence local population will not be adversely affected. However the exposure of workers to high noise levels especially, near the engine, vent shaft etc. need

to be minimized. This could be achieved by job rotation, automation, protective devices, noise barriers and soundproof compartments, control rooms etc.

The workers employed in high noise level area could be employed in low noise level areas and vice-versa from time to time. Automation of equipment and machinery, wherever possible, should be done to avoid continuous exposure of workers to noise. At work places, where automation of machinery is not possible or feasible, the workers exposed to noise should be provided with protective devices. Special acoustic enclosures should be provided for individual noise generating equipments, wherever possible.

Pile driving operation can produce noise levels up to 100 dB (A) at a distance of 25-m from site. Suitable noise barriers can reduce the noise levels to 70 dB (A) at a distance of 15m from the piles. A safety precaution as stipulated in IS: 5121 (1969) 'Safety Code for Piling and other Deep Foundation' need to be adopted.

Noise level from loading and unloading of construction materials can be reduced by usage of various types of cranes and placing materials on sand or sandy bag beds. Sound barriers are usually effective along routes having fast traffic. The reduction in noise level increases with height of barrier. Ballast-less track is supported on two layers of rubber pads to reduce track noise and ground vibrations.

g) Vibration Control

Vibration emanates from rail - wheel interaction and the same can be reduced by minimizing surface irregularities of wheel and rail, improving track geometry, providing elastic fastenings, and separation of rail seat assembly from the concrete plinth with insertion of resilient and shock absorbing pad.
While designing track structure for Mass Rapid Transit System, all the above points have been taken into consideration in the following ways:

- To prevent development of surface irregularities on the rail, a fairly heavy rail section of 60-kg/m, 90 UTS, supported at every 60-cm has been proposed. Further, rail grinding at regular intervals by rail grinding machine and also lubrication of rail by vehicle-mounted lubricator have been contemplated.

- Rail will be continuously welded and also will be laid to fine tolerances, so that any noise/vibration on account of irregular track geometry could be reduced.
- The vibration generated from rail-wheel interaction will be greatly absorbed by the elastic fastening system proposed to be used.

- In sensitive areas, track on floating slab can be provided so as to avoid propagation of noise to adjacent structures. Additional screening of noise can be arranged by providing parabolic noise reflecting walls on each sides of the track, as being provided by DMRC in ongoing rail corridor.

1.7 ENVIRONMENTAL MONITORING PLAN

1.7.1 Environmental Monitoring

The environmental monitoring will be required for the construction and operational phases. The parameters need to be monitored are: Water Quality, Air quality and Noise levels. Cost of Environment monitoring is attributable to another system of the entire metro.

a) Water Quality

Water quality parameters shall be monitored one year before the construction, during the construction phase and also for at least three years after the completion of the project. Monitoring shall be carried out at least four times a year to cover seasonal variations. The parameters for monitoring would be: pH, Dissolved Oxygen, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Coliform Count, Total Dissolved Solids, Chlorides, Nitrates, Sulphates, Total Nitrogen, Total Phosphates, oils and greases etc

b) Air Quality and Noise Levels

Ambient air quality and Noise levels should be monitored one year before the construction, during the construction phase and for three years after the completion of the project.

The cost for water quality, air quality and noise level monitoring has been included in the Barakhamba-Cannaught Place–Dwarka section and New Delhi-IGI airport section respectively.

1.8 ENVIRONMENTAL MANAGEMENT SYSTEM

The Environmental Management System constitutes provision of an Environmental Division, which should be staffed by an Environmental Engineer/Officer, an Environmental Assistant and two other assistants (miscellaneous works). The task assigned should include supervision and co-ordination of studies, monitoring and implementation of environmental mitigation measures. An Environmental Adviser shall review progress of the division every year. Cost of such an establishment is attributable to another system of the entire metro.

1.9 COST ESTIMATES

1.9.1 All costs involved in environmental mitigation, management and monitoring to be put on the account of the proposed project are summarised in **Table 9.10**

Table 9.10 Environmental Costs

S. No.	Item	Rs.
1	Compensation for loss of trees	9800
2	Compensatory Afforestation	31000

S. No.	Item	Rs.
3	Compensation for Resettlement	Has been included in the Barakhamba-Cannaught Place–Dwarka section and New Delhi-Airport Section
4	Monitoring of Water	Has been included in the Barakhamba-Cannaught Place–Dwarka section and New Delhi-Airport Section
5	Monitoring of air and noise during construction & operation	Has been included in the Barakhamba-Cannaught Place–Dwarka section and New Delhi-Airport Section
6	Provision of bins for Railway Station Refuse	Has been included in the Barakhamba-Cannaught Place–Dwarka section and New Delhi-Airport Section
	TOTAL	**40000**
7	Miscellaneous items @10%	4000
	GRAND TOTAL	**44000**

1.9.2 The Environment Management Plan should be implemented in phases, so that optimum benefit could be achieved and it should be synchronised with the construction schedules.