

# **QUTAB MINAR – GURGAON MRTS CORRIDOR ENVIRONMENTAL IMPACT AND SOCIO ECONOMIC ASSESSMENT**

## **1.1 ENVIRONMENTAL BASELINE DATA**

1.1.1 The environment includes water, land, air, ecology, noise, socio – economic issues etc., The information presented in this section stems from various sources such as reports, field surveys and monitoring. Majority of data on water quality, vegetation, air and noise quality was collected during field studies in the April 2004. This data has been further utilized to assess the incremental impact if any due to the project. The development / compilation of environmental baseline data is essential to assess the impact on environment due to the project. For the first phase, the study area of the Metro –section from Qutab Minar in Delhi to Gurgaon Sushant lok have been proposed and this chapter have been prepared for the above section only.

1.1.2 **General Environment**-The average elevation of Delhi & Gurgaon plains is around 198-200-m above MSL. Many small watercourses intersect the terrain causing a variation in relief. However, average gradient of terrain is gentle, of the order of 1 to 3-m/km. The area has mature topography with isolated hillocks. Geology of the area is discussed in detail in Chapter-08. The depth of water table is observed between 3 and 7-m below ground level. Delhi receives two seasonal rainfalls. These are due to South – West and North –East monsoons. About 75% of rainfall occurs during July to September due to South – West monsoon. North – East monsoon is achieve during December– April. The annual rainfall is 714mm. 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. The mean monthly maximum temperature are highest in April – May – June (43-45<sup>0</sup>C) and lowest during January (3<sup>0</sup>C). Air humidity varies through out the year but seldom drop below 20%. Winds are light to moderate 0.9 to 4.1m/sec while directions are mostly from North, North-East and North – West. Sky is moderately cloudy during July – August and generally cloud free for rest of the year.

1.1.3 **Water and Soil** -The water and soil samples have been tested for chemical analysis. The results so obtained are summarised in Tables 1.1 and Table 1.2. Most of the parameters are within the permissible limits except the two values i.e TDS and Nitrates which are exceeding the limits. Based on this data, it could be concluded that sub soil and underground water are unlikely to undergo any deteriorating effect due to proposed MRTS structures and foundation.

The texture of soil is mainly sandy. The higher concentration of phosphate and organic matter is an indication of good fertility value. As metro will be above ground hence it will not be in contact with soil and water.

**TABLE 1.1  
CHEMICAL ANALYSIS OF WATER SAMPLES**

S. No.	Parameter	Nathupur area	Qutab Minar/ Andheria More area	Sultanpur area
1	pH	8.11	8.09	7.22
2	TDS (mg/l)	517.68	513.48	726.66
3	TSS (mg/l)	6.9	4.8	15.5
4	Calcium as Ca (mg/l)	107.31	57.65	72.07
5	Chloride as Cl (mg/l)	103.89	131.87	55.94
6	Sulphates as SO <sub>4</sub> (mg/l)	6.27	2.09	61.5
7	Fluorides as F (mg/l)	0.22	0.65	0.15
8	Iron as Fe (mg/l)	0.09	0.11	0.4
9	Nitrates as NO <sub>3</sub> (mg/l)	33.57	26.5	89.82
10	BOD (mg/l)	ND	ND	ND
11	Phosphates as PO <sub>4</sub> (mg/l)	ND	ND	ND

ND - Not Detectable

**TABLE 1.2  
PHYSIO-CHEMICAL CHARACTERISTICS OF SOILS**

S.No.	Sample /Parameter	Sampling locations		
		Nathupur area	Qutab Minar/ Andheria More area	Sultanpur
1	pH	8.01	8.13	8.14
2	Texture			
	Sand (%)	84	77.52	89
	Silt (%)	12.18	17.27	7.9
	Clay (%)	3.82	5.21	3.1
3	Nitrogen (kg/hectare)	999.75	855.09	1191.29
4	Phosphorus(kg/he ctare)	158.66	45.46	782.61
5	K (meq/100gm)	0.43	0.56	0.9
6	Ca(meq/100gm)	15.94	10.97	10
7	Mg (meq/100gm)	1	8.07	10.51
8	Na (meq/100gm)	0.87	2.04	1.39
9	Organic matter (%)	0.7	1.55	0.89

**1.1.4 Forestry-**Tree survey was carried out along the proposed alignment. As such, no forest area exists along the MRTS alignment or its corridor. Most of the trees were planted along the roads in the past. The main species are Pipal, Neem, Kikar, Mango, Ashok, Ficus and Bakaan, etc. No rare or endangered species of trees have been noticed during field studies. An inventory

of trees, likely to be lost is presented in **Table 1.3**. About 755 trees are existing on the proposed alignment from Qutab Minar (30.95 km) to Sushant lok (47.003).

**TABLE 1.3**  
**LOSS OF FLORA**

S.No.	Chainage in Km		No. of trees			
	From	To	Left	Middle	Right	Total
1.	30.95	35.525	133	86	104	323
2.	35.525	36.919	38	41	104	183
3.	36.919	39.388	20	68	60	148
4.	39.388	40.546	8	19	3	30
5.	40.546	42.816	6	1	16	23
6.	42.816	44.214	2	0	1	3
7.	44.214	45.240	2	0	0	2
8.	45.942	47.025	7	36	0	43
<b>TOTAL</b>			216	251	288	755

**1.1.5 Air Quality-**The atmospheric concentrations of air pollutants show a rising trend. As a part of this study ambient air quality monitoring (AAQM) has been carried out by setting up ambient air quality monitoring stations at five locations as shown in Table 1.4 for the parameters SPM, CO, HC, and NOx. The results so obtained are reported below. The ambient air quality data indicates much higher values of suspended particulate matter, than the prescribed limits established by CPCB at all the monitoring stations. However the values of NOx and CO are within the permissible limits.

**TABLE 1.4**  
**AIR QUALITY AT PROJECT SITE ( $\mu\text{G}/\text{M}^3$ )**

S. No.	Location	SPM $\mu\text{g}/\text{m}^3$	HC $\text{mg}/\text{m}^3$	NOx $\mu\text{g}/\text{m}^3$	CO $\text{mg}/\text{m}^3$
1	Near Chattarpur proposed station	510-612	1.24-1.68	58-76	1.6-2.24
	Average (24 hour)	544	1.46	67.6	1.94
	% Variation from standard	8.8%	--	--	--
2	Near Arjan garh commercial area of the proposed alignment.	608.10 - 697.40	<0.1	28 - 41	1.4-2.4
	Average (24 hour)	652.8	<0.1	34	1.8
	% Variation from standard	30.56%	--	--	--
3.	Commercial area in Sikandarpur area	518-712	1.1-1.6	65-75	1.8-3.6
	Average (24 hour)	598	1.36	72	2.53
	% Variation from standard	19.6%	--	--	--
4.	Residential area in sushant lok	305-646	<0.1	14.00-35.20	1.2-1.4
	Average (24 hour)	504	<0.1	22.06	1.3
	% Variation from standard	152%	--	--	--
Prescribed limit Residential area		200 $\mu\text{g}/\text{m}^3$	---	120 $\mu\text{g}/\text{m}^3$	5 $\text{mg}/\text{m}^3$
Other areas		500 $\mu\text{g}/\text{m}^3$	--	120 $\mu\text{g}/\text{m}^3$	2 $\text{mg}/\text{m}^3$

Average value of parameter of above four locations	574 $\mu\text{g}/\text{m}^3$	0.75mg/ $\text{m}^3$	48.9 $\mu\text{g}/\text{m}^3$	1.89mg/ $\text{m}^3$
--	------------------------------	----------------------	-------------------------------	----------------------

Note: \* SPM values are high due to dusty atmosphere

**1.1.6 Seismicity**-The project area falls in Zone-IV of Seismic Zoning Map of India. The India Meteorological Department (IMD) has considered suitable seismic factor for design purpose for Civil Engineering structures. This factor needs to be appropriately incorporated while finalising civil designs.

**1.1.7 Noise**-RITES have measured noise levels at different places in Delhi and Gurgaon along the project alignment at 2.0-m away from source as per standard practice. The noise levels so obtained are summarised in Table 1.5. It could be concluded that the noise levels recorded at various places are higher than prescribed permissible levels of 65-dBA (day) and 55-dBA (night).

**TABLE 1.5**  
**NOISE LEVELS MONITORED ALONG THE PROJECT ALIGNMENT (Leq)**

Location	Time	L <sub>eq</sub>	L <sub>max</sub>	L <sub>10</sub>	L <sub>50</sub>	L <sub>90</sub>	L <sub>min</sub>	L <sub>day</sub>	L <sub>night</sub>	L <sub>dn</sub>
Near Chhatarpur proposed station	08:00-10:00	66.07	72.33	71.08	63.13	60.49	59.93	71.35	51.50	68.89
	12:00-14:00	69.70	72.33	71.15	68.73	66.59	66.37			
	16:00-18.00	76.30	78.67	78.01	76.07	73.23	72.00			
	Average	70.69	74.44	73.41	69.31	66.77	66.10			
Near Ghitorni village/Arjun Garh	08:00-10:00	67.33	69.37	69.07	66.47	64.95	60.44	73.55	51.67	70.65
	12:00-14:00	75.77	77.73	77.45	75.00	73.19	56.74			
	16:00-18.00	77.83	79.77	79.46	77.00	75.77	61.31			
	Average	73.64	75.62	75.33	72.82	71.30	59.50			
Sikandarpur area	08:00-10:00	80.37	82.70	82.46	77.80	76.54	60.44	84.07	53.15	78.84
	12:00-14:00	86.52	89.27	88.60	86.53	80.97	56.74			
	16:00-18.00	85.32	87.07	86.59	85.10	82.94	61.31			
	Average	84.07	86.35	85.88	83.14	80.15	59.50			
Residential area near Sushant lok	08:00-10:00	60.45	63.70	62.06	58.03	55.56	54.13	59.46	49.88	59.31
	12:00-14:00	56.75	59.43	58.38	56.67	53.64	53.00			
	16:00-18.00	61.16	64.33	62.88	59.97	56.40	54.67			
	Average	59.45	62.49	61.11	58.22	55.20	53.93			

Note: L<sub>10</sub>, L<sub>50</sub> and L<sub>90</sub> are the sound level, which is exceeded 10%, 50% & 90% of the total time

## 1.2 SOCIO ECONOMICS

**1.2.1** A detailed socio-economic study has been carried out for Qutab Minar –Sushant lok, Gurgaon MRTS corridor. The study is conducted through socio – economic survey by field visit and analysis.

**1.2.2 Dislocation Due to the Proposed Corridor:** In order to keep acquisition of private land to the barest minimum, the alignment has been so chosen, that it remains mostly within the government land. However, at some of the station locations such as Sultanpur, Ghitorni, Andheria More, Qutab Minar station and at other locations in total only 3.725ha of private land is required for entry, exit and other facilities of station and running section. The details of land permanently required for the project are given in Table 1.6

**TABLE 1.6**  
**LAND REQUIREMENT (Delhi Portion)**

Agency	Purpose	Land Area Required in ha
Government	At stations & other locations	11.2707
Private	At stations & other locations	5.3150
Total		16.5857

**1.2.3 Sampling Design-**In order to collect the primary data the questionnaire technique has been used in the field. The sample survey has been carried out for about 60% of the total affected Project affected families. Almost all the PAFs are engaged in commercial shops are pucca shops in nature engaged in different types of activities. These have been covered for the purpose of this study. The following table shows the approximate number of PAFs getting affected due to this project.

**TABLE 1.7**  
**DETAILS OF PAPS ALONG THE PROJECT ALIGMENT (Delhi Portion)**

Sl. No.	Location	Type of family	Total no.s
1	Near proposed Sultanpur station	PAPs	10
2	Near proposed Ghitorni station	PAPs	1
3	Near proposed Arjangarh station	PAPs	7
4	Stabling-cum-Maintenance Depot.at Ghittorni	PAPs	2
<b>TOTAL NO. OF PAFs</b>			<b>20</b>

**1.2.4 Socio - Economic Profile of the PAFs -**Out of these surveyed families 65% are joint and 35% are nuclear. 90% constitutes Hindu, 10% are Muslim. About 55% belong to General category, 35% are OBC and balance is Scheduled Castes. No Scheduled tribe families are observed during the survey. Most of the commercial shops are Pucca. Most of these affected families will be loosing their commercial activities either in part or full. Mixed age group have been observed along the PAFs in the project alignment. Only 10% are illiterate in the surveyed families. 75% of the people are having the house hold income in the range of 50,000 –10,0000/- and about 25% of the families are in the range of 100,000 –1,50000.

Data collected from the sampled households are Tabulated below which shows the family pattern (Table 1.8), religious group (Table 1.9), Caste distribution (Table 1.10), Age-wise distribution (Table 1.11), Literacy level (Table – 1.12), Family size (Table 1.13) and Income range (Table 1.14), land utilization (Table 1.15) and Type of structure (Table 1.16) of Project affected people. Most of families are engaged in self-employment, i.e., doing business. Few of the people are in either private or Government service.

**TABLE 1.8  
FAMILY PATTERN**

SI No.	Pattern	Frequency	Percentage	Cumulative
1	Joint	10	65	65.00
2	Nuclear	6	35	100.00
3	Individual	0	0	100.00
	TOTAL	16	100.00	

**TABLE 1.9  
RELIGIOUS GROUP**

SI No.	Religious group	Nos.	Percentage
1	Hindu	14	90
2	Muslim	2	10
3	Christians	0	0.00
	TOTAL	16	100.00

**TABLE 1.10  
CASTE DISTRIBUTION OF PAFS**

SI No.	Caste	Frequency	Percent	Cumulative
1	General	9	55.00	55.00
2	OBC	6	35.00	90.00
3	SC	1	10.00	100.00
4	ST	0	0	100.00
	TOTAL	16	100.00	100.00

**TABLE 1.11  
AGE-WISE DISTRIBUTION OF PAPs**

SI No.	Age Group	Frequency	Percent	Cumulative
1	0 - 4 Years	14	12.4	12.4
2	6 - 15 Years	28	24.8	37.2
3	16 -25 Years	20	17.7	54.9
4	26 - 40 Years	22	19.5	74.3
5	46 –60 years	27	23.9	98.2
5	Above 60 Years	2	1.8	100.0
	TOTAL	113	100.00	

**TABLE 1.12  
LITERACY AMONG THE PAPs**

SI No.	Literacy level	Frequency	Percent	Cumulative
1	Illiterate	10	9	9
2	Primary	37	33	42
3	Secondary	37	33	74
5	Graduate	29	26	100
6	Post Graduate	0	100	100
	TOTAL	113	100.00	

**TABLE 1.13  
FAMILY SIZE**

SI No.	Size	Frequency	Percent	Cumulative
1	1	0	0.0	0.0
2	2	0	0.0	0.0
3	3	0	0.0	0.0
4	4	4	25.0	25.0
5	5	4	25.0	50.0
6	6	2	12.5	62.5
7	6-10	6	37.5	100.0
	TOTAL	16	100	100

**TABLE 1.14  
INCOME RANGE**

SI No.	Range	Frequency	Percent	Cumulative
1	0-25000	0	0	0
2	25001-50000	0	0	0
3	50001-100000	12	75	75
4	100001-150000	4	25	100
5	150001-200000	0	0	100
6	>200000	0	0	100
	TOTAL	16	100	100

**TABLE 1.15  
LAND UTILIZATION**

SI No.	Range	Frequency	Percent	Cumulative
1	Owned	10	63	63
2	Leased	6	37	100
3	Encroached	0	0	100
	TOTAL	16	100	100

**TABLE 1.16  
TYPE OF STRUCTURE**

SI No.	Range	Frequency	Percent	Cumulative
1	Kuccha	4	25	25
2	Semipucca	0	0	25
3	Pucca	7	44	69
4	Open Land	5	31	100
Report	TOTAL	16	100	100

The socio-economic survey for the PAPs likely to be affected due to the proposed development was carried out and during the survey resistance shown by the occupants of the shops.

### 1.3 POSITIVE ENVIRONMENTAL IMPACTS

1.3.1 Based on project particulars and existing environmental conditions (Section 1.1), potential impacts have been identified that are likely to result from the proposed MRTS 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 (Section 1.1), 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 is mostly elevated such that both the land requirement and change of land use is minimum. The change in land use in Delhi Portion is estimated to be 16.5857ha (includes both government and private land).

b) **Loss of Trees-** The details of 755 trees likely to be lost are reported in Table 1.3. The total value of these trees lost is Rs. 5.285 lakhs as reported in Table 1.17.

**TABLE 1.17  
LOSS OF FOREST PRODUCTS**

Total loss of Trees (Nos.)	755
Average cost of one tree (Rs.)	700
Total loss (Rs. lakhs)	5.285 Lakhs

There will be no encroachment into nature reserves, as the project area is in the urban centre.

c) **Loss of Historical and Cultural Monuments-** No historical/cultural monuments will be affected as a result of the proposed development.



### 1.4.3 Impacts Due to Project Construction

- a) **Soil Erosion and Health Risk at Construction Site-** Runoff from unprotected excavated areas can result in excessive soil erosion, especially when erodibility of soil is high. Mitigation measures include careful planning, timing of cut-and-fill operations and re-vegetation. Problems could arise from dumping of construction spoils (concrete, bricks), waste materials (from contractor's camp) etc. causing surface and ground water pollution. Hence, it is proposed to have mix concrete directly from batching plant for use at site. Batching plants should be located away from the site preferably, outside, Delhi or Gurgaon. Health risks during construction activity include disease hazards to workers due to lack of sanitary facilities like safe disposal of human waste and garbage clearance and disposal facility. In order to avoid such a situation, proper mitigation measures should be incorporated, which should include proper water supply, sanitation, drainage, healthcare and human waste disposal facilities in labour camps. In addition reduced contaminated water spillage and adoption of disease control measures should be adopted to reduce the health risks.
- b) **Traffic Diversions and Risk to Existing Buildings-** During construction, traffic diversions on roads will be essentially required. As most of the construction activities will be confined to centre of the road and most of the roads are double lane, it will be appropriate that the side lanes may also be utilised for traffic and also for smooth progress of construction activities. Advance information on communication systems will be an advantage to users of any particular road. As most of the proposed sections are elevated and located in the middle of the road with deck width being much less than the existing road width, hence risk to the existing buildings all along the route will be practically negligible.
- c) **Impact on Water Quality-** Construction activities may have 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 percolate 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 impact on either ground or surface water quality is anticipated in the present project.

### 1.4.4 Impacts due to Project Operation

- a) **Oil Pollution-** Oil spillage during change of lubricants, cleaning and repair processes, in the maintenance Depot cum workshop for 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 includes: engine noise, cooling fan noise, wheel-rail interaction, electric generator and miscellaneous noise like passenger's chatting. An attempt has been made to predict the rise in ambient noise at different distances. The roughness of the contact surfaces of rail and wheel and train speed are the factors, which influence the magnitude of rail - wheel noise. The vibration of concrete structures also radiates noise. Hence total noise level would be about 80.4-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-** CPHEEO has recommended 45-litres/day, water supply to persons working at railway stations. All the stations are in urban area. Water requirements at stations has various components, viz. Personal use of Staff, Fire demand, Make up water for air conditioning and ventilation, and Wastage. The water demand at each station would be about 100m<sup>3</sup> per day. Adequate provision of drinking water has to be made for passengers at the railway stations. Platform washing requirement has been worked out at the rate of 2-lit per sqm. Fire fighting water requirement has been taken as per Phase-I norms.
- e) **Railway Station Refuse-** The refuse from railway station includes; Garbage, Rubbish, and Floor Sweepings. The total refuse generated at all the stations of the present section under consideration is estimated to be about 2.79 tonnes/day with the assumption that only about 25% of the passengers visiting various stations will be producing refuse. For the maintenance of adequate sanitary facilities, containers/collection bins not exceeding 120-litres and equipped with side handles will be appropriately designed and installed at stations and platforms.
- f) **Visual Impacts-** The construction of Qutab Minar to Gurgaon, Sushant lok 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 1.18.

**Table 1.18**  
**CHECKLIST OF IMPACTS**

Parameter		Negative Impact	Positive Impact	No Impact
A)	Impacts Due To Project Location			
i)	Change of Land Use and Ecology Impact on Historical/Cultural Monument	*		
ii)				*
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, Quick Service and Safety, Less Fuel Consumption, Reduction in Air Pollution, Better Roads, and Employment Opportunities		*	
ii)			*	
iii)			*	
iv)			*	
v)			*	
vi)			*	

## 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) Compensation for Relocation/Resettlement,
- e) Water Supply & Sanitation,
- f) Oil Pollution Control
- g) Noise Control
- h) Vibration Control
- i) Lighting Provisions

- a) Compensation for Loss of Land: The land likely to come under project is 16.5857ha. The cost of land for compensation is taken under the project cost.
- b) Compensation for Loss of Trees: There are 755 trees on the proposed alignment, which are required to be uprooted. The Compensation for Loss of Trees works out to Rs. 5.285lakhs.
- c) Compensatory Afforestation and Fencing: According to the survey, about 755 trees are likely to be lost due to the project. 10 times the number of trees are to be planted as per the Department of Forests, Delhi Administration stipulations. Hence, about 7550 plants are required to be planted. The total area required for afforestation of these trees comes to about 5.285ha. It is presumed that government land will be provided for afforestation, hence no land cost will be involved. Compensatory afforestation cost (excluding fencing) for 5.285ha. will be about Rs. 7,92,750/- @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. 1,30,000/- Thus, the total cost works out to Rs. 9.22 lakhs. The recommended plant species for afforestation include: Eucalyptus, Neem, Sisso, Chichwa, Phulai, Chaitum, Siris, Ashok, Jamun, and Amaltas.
- d) Compensation for Relocation/Resettlement: The project involves relocation of shops in commercial area at various locations. Most of the locations only Govt./Pvt. Land is to be acquired where no structures are existing. However, at few locations chattarpur area, Sultanpur proposed station and Ghitorni, structures to be relocated due to this project. The relocation / Payment of compensation will be made as per Government Policy.
- e) 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 upto 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 DDA/ Municipal Corporation of Delhi & Haryana Urban development Authority (HUDA). The collection and safe disposal of human wastes 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. The total of 110 bins of 50-120 litres capacity will be required which can be accommodated at different stations and platforms. The total cost for bins works out to be Rs. 2.2 lakhs.
- f) 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.

- g) Noise: There will be an increase in noise level in ambient air due to construction and operation of this MRTS 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 machineries, wherever possible, should be done to avoid continuous exposure of workers to noise. At work places, where automation of machineries 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 upto 100 dB (A) at a distance of 25-m from site. The noise levels could be reduced by using a combined sound absorbent. This can reduce the noise levels to 70 dB (A) at a distance of 15m from the piles. Safety precautions 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 route 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.

- h) Vibration Control: Noise 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 addition, we have proposed to provide skirting on coach shells covering the wheel, which will screen any noise coming from rail - wheel interaction from propagating beyond the viaduct. 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.

- i) **Lighting Provisions:** It is proposed to provide the illumination of 250-lux under the elevated structure and at station buildings 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.

- 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 (total 10 years). 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. The main monitoring stations could be at Qutab Minar, Sikandarpunr, IFFCO Chowk, and the Sushant lok Proposed station. The cost for water quality analysis works out to be Rs.5.76 lakhs.
- 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 at least three years after the completion of the project (total 10 years). The proposed monitoring programme for field monitoring and laboratory analysis of air and noise is given in Table 1.19. The cost for ambient air quality and Noise levels monitoring works out to be Rs. 33.00 lakhs.

**TABLE 1.19**

**PROPOSED MONITORING PROGRAMME FOR AIR AND NOISE QUALITY**

Monitoring	Monitoring Parameters	Proposed Site	Sampling Duration	Frequency	Cost (Rs. lakhs)
Ambient Air Quality	SPM, SO <sub>2</sub> , NO <sub>x</sub> and CO	Qutab Minar Sultanpur Sikandarpur, IFFCO Chowk Sushant Lok	Twice a week, 4 weeks in a season	Seasonal	10x2x4x4x5x2000 = 32.00
Noise Levels	dB (A)	-do-	Once a week	Seasonal	10x4x5x500 = 1.0
<b>TOTAL COST</b>					<b>33.00</b>

## 1.8 ENVIRONMENTAL MANAGEMENT SYSTEM

1.8.1 The Environmental Management System constitutes provision of an Environmental Division, which would be staffed by an Environmental Engineer/Officer. The task

assigned would 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 has been estimated as Rs. 30.60 lakhs. However, it may be mentioned that this division will be for the entire MRTS. Therefore, the cost is attributable to another system.