

CHAPTER - 14**Environmental Impact Assessment****14.1 Introduction**

The chapter covers the Environmental Impact Assessment carried out for the Janakpuri West – Dasrathpuri section. The section is the part of corridor to be executed under phase-III of DMRC. This report covers the existing Environmental Baseline Data, Environment Impacts, Environmental Management Plan, Environmental Monitoring Plan and Socio- Economic Assessment

For the proposed phase-3 of DMRC a comprehensive EIA has already been carried out for all the corridors, including the section between Janakpuri west and Dasrathpuri, for which this supplementary EIA is prepared. This EIA has been necessitated because the section from Janakpuri West to Dasrathpuri, which was earlier elevated is now proposed to be constructed underground. As a result, the adverse socio-economic impacts because of property acquisition and similar activities have been reduced significantly. Since, the revised alignment has only gone underground, the baseline environmental parameters like air, water, noise, soil etc. Essentially remain the same.

The basic concept of the assessment is to ascertain the existing baseline conditions and assess the impacts as a result of construction and operation of the project. The changes likely to occur in different components of the environment viz. physical, biological / ecological, environmental and socio-economic etc. have been studied, analyzed and quantified, wherever possible. DMRC has documented the baseline data for various parameters of physical (physiographic and soils), ecological (forestry, fisheries and wildlife), and environmental pollution (air, water, noise, and solid waste). The impacts are assessed for both the phases of project cycle namely:

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

The impacts are categorized as negative and positive and accordingly Environmental Management Plan (EMP) has been devised.

14.2 Policy, Legal & Administrative Framework

The proposed section of the alignment of 4.617 km with 3 stations would be governed by various Acts, Rules and Regulations set by the Ministry of Environment and Forests (MoEF) at the Central level and other regulatory agencies at the State and local level. Various environmental standards, specifications and guidelines of Central Pollution Control Board (CPCB) and state level agencies will also be applicable.

As per the most recent EIA Notification (2009), the urban transportation projects such as the Delhi Metro Project are not included in the Schedule of the notification, hence conducting an EIA or carrying out Public Hearing are not mandatory. However, to meet the requirements of Japan International Cooperation Agency (JICA), a funding agency for DMRC, EIA has been carried out for the proposed corridor.

14.3 Background

In general, the section is part of the alignment that starts at Jankapuri west in the west of Delhi in semicircular fashion and moves towards south of Delhi to reach its final destination to Mukundpuri that is located in the east of Delhi. The section for which EIA has to be carried out starts in the west i.e Jankapuri West itself for the length of about 4.617 km till Dasrathpuri station including the ramp area. The section is so selected that it will serve the maximum population, will entail less private land acquisition, least demolition of private and government structures, and least tree cutting. To minimize the enviro-socioeconomic impacts, the entire alignment has been kept underground. The route map of the proposed section (highlighted in blue) is depicted in the Figure 1 below:

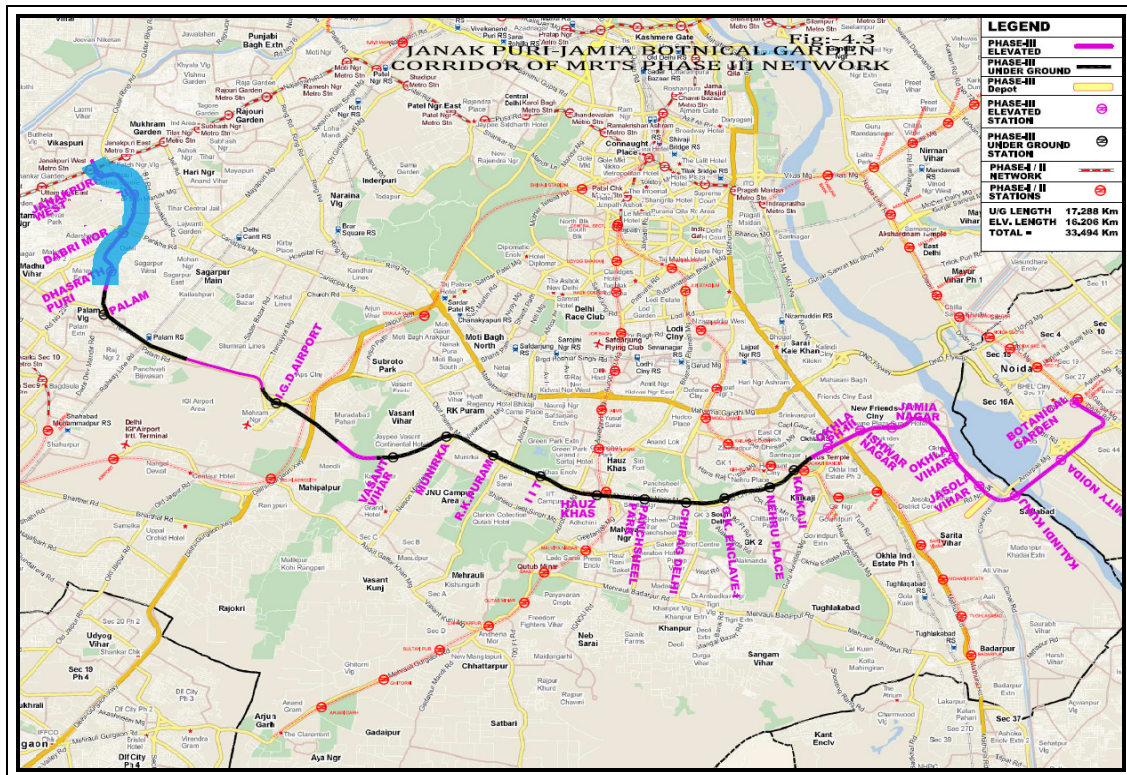


Figure.1: Site Route Map of the proposed Underground Section

14.4 Comparison of alternatives

The following justification under Table 1 below clearly demonstrates that the objectives of environment and social consideration are better served in the revised alignment:

Table 1: Comparison between previous and revised alignment

| S.No. | Previous Alignment | Revised Alignment |
|-------|--|---|
| 1. | <ul style="list-style-type: none"> Alignment: Elevated Total km: 5.325 No. of stations: 4 | <ul style="list-style-type: none"> Underground 4.617 3 |

| | | |
|----|---|---|
| 2. | Project Affected families (PAFs): 76 | 23 |
| 3. | The proposed ramp after Palam was in the middle of a busy road which was only of 20 m width. After construction only one lane carriageway remained on either side which was not adequate, in view heavy traffic plying on the road | Alignment being underground the ramp after Palam in the middle of busy road gets eliminated and entire carriageway on this route will be available for heavy traffic plying on this route without any constriction existing in carriage way. |
| 4. | A sewer line of dia 1.4 m was running parallel the alignment and was required to be diverted | Revised alignment resulted in reduction of distance from Jankapuri (West) to Palam station to 2325 m from 4617 m. Thereby, the diversion of the main sewer was avoided |
| 5. | There were 5 sharp curves between Dashrath Puri and Janakpuri (West) of radius 223 m, that would have necessitated a permanent speed restriction at all of the locations. Sharp curves also require frequent maintenance during operation stage apart, from causing screeching noise. | Five sharp curves of 223 got completely eliminated. Alignment from Palam to Jankapuri (West) will have very flat curves 1000 m radius except one curve of 407 m radius before Janakpuri (West) and there shall be no need for any speed restriction. Also, screeching noise will be considerably avoided. |
| 6. | Station at Dabri mor was proposed to be constructed over a flyover under construction at Punkha Road which was difficult and expensive in view of the heavy road traffic plying underneath the proposed station. | Since, the Dabri mor station is now proposed underground, the inconvenience and expenditure on this account is are avoided. |
| 7. | Previous alignment required interchange arrangements between line No.3 and line No. 8 and it was very complicated and inconvenient arrangement | As per Preliminary feasibility for the interchange arrangements at Janakpuri (West) the proposed alignment is better and interchange more convenient for commuters. |

14.3 Project Description

The underground section from Janakpuri West to Dasrathpuri is 4.617 km with the following stations namely (1) Janakpuri West (2) Dabri mor (3) Dasrathpuri. Out of the three stations Janakpuri (West) would be the interchange station. DMRC considered different alternatives and the final alternative was fixed based on Technical Feasibility, Socio-economic acceptability and Environmental sustainability for Metro Corridors. The entire underground section will be constructed by tunnelling using state of but Tunnel Boring Machine (TBM) and stations by cut and cover method. Details of each station are mentioned in the table 2 below:

Table 2: Station Details

| Stations | Janakpuri (West) | Dabri Mor | Dasrathpuri |
|---------------------------|------------------|-----------|-------------|
| Station length (m) | 271 | 245 | 245 |
| Station Width (m) | 21.57 | 21.57 | 21.57 |
| No. of entries and exists | 2 | 3 | 3 |

14.4 Location and Physiography

The metropolitan city of Delhi lies in the northern part of India, between 28.38°N latitude and 77.12°E longitude. It has an average elevation of 300 meters. All the monitoring stations to collect sample for environmental parameters are selected within 500 m from the track. The average elevation of Delhi and surrounding areas is about 178-200 M.S.L. The terrain has a slope of 1-3 m/km. The area receives two seasonal rainfalls. These are due to South – East and North - East monsoon. The proposed section passes through various residential and commercial area and around 40 sensitive locations like temple, school, hospital has been identified on the proposed alignment.

14.5 ENVIRONMENTAL BASELINE DATA

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 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. Below mentioned figure gives the monitoring location for the proposed section:

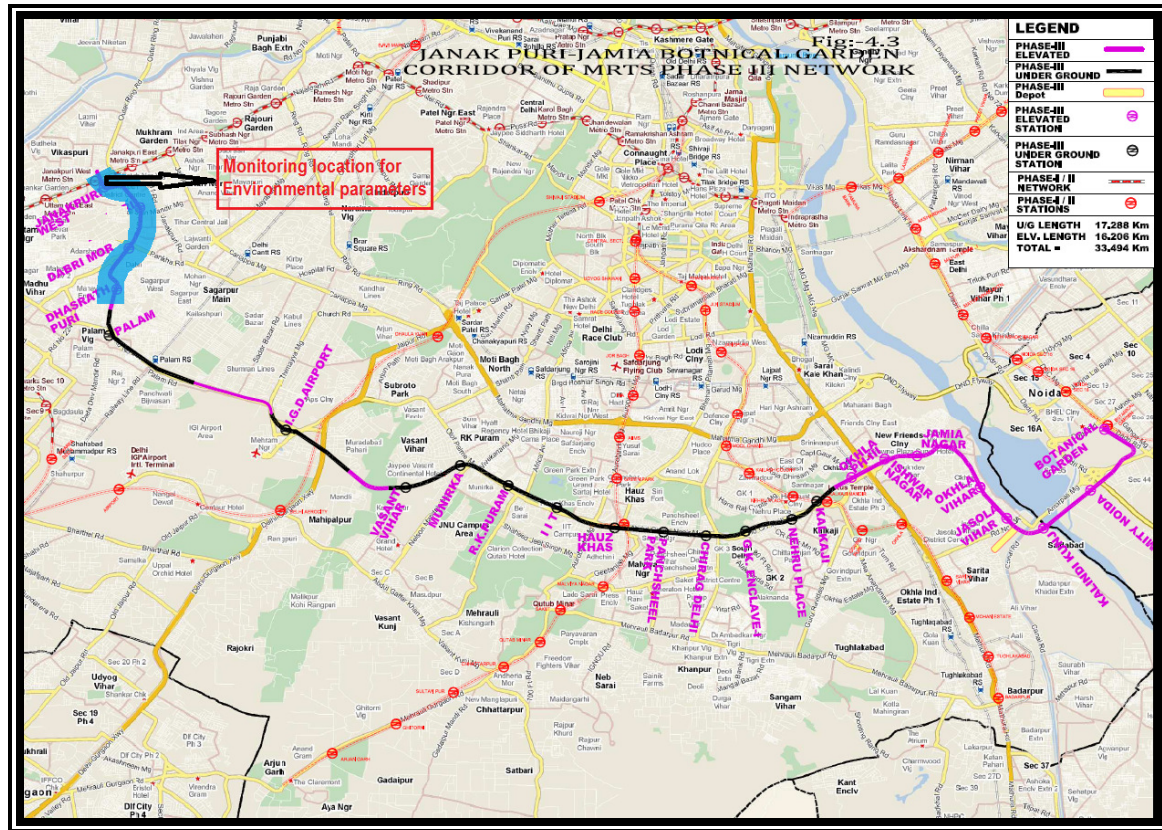


Figure 2: Monitoring location of environmental Parameter

14.5.1 Water Quality

In order to collect baseline data on the existing water quality, ground water sample was collected from Janakpur West along the alignment in the project study area and analyzed as per the procedure specified in standard methods for examination of water and wastewater published by American Public Health Association and the Bureau of Indian Standards (APHA/BIS). The results of the physio-chemical analysis are summarized in the Table 4 below. The test results when compared with the prescribed limits of various parameters as per IS 10500:1991 indicated that at some locations certain parameters are more than desirable limits. These values are shown in bold italics in the table below. Magnesium and total hardness at Janakpur West are more than permissible limit. Chemical Analysis of Water sample is tabulated in table 3 below:

Table 3: Water Quality at Project Site

| S.No. | Parameters | Janakpur (West) |
|-------|----------------|-----------------|
| 1. | Alkanity(mg/l) | 300 |

| | | |
|-----|-------------------------------|---------------|
| 2. | Arsenic(mg/l) | <0.010 |
| 3. | BOD (mg/l) | <2.0 |
| 4. | Copper (mg/l) | <0.02 |
| 5. | Chlorides (mg/l) | 935.61 |
| 6. | Chromium (mg/l) | <0.010 |
| 7. | Calcium (mg/l) | 116.8 |
| 8. | Cadmium | <0.010 |
| 9. | COD | <4.0 |
| 10. | Dissolved oxygen (mg/l) | 6.8 |
| 11. | Faecal Coliform | Absent |
| 12. | Fluorides (mg/l) | 0.67 |
| 13. | Magnesium (mg/l) | 183.71 |
| 14. | Manganese (mg/l) | <0.05 |
| 15. | Mercury (mg/l) | <0.001 |
| 16. | Nitrates (mg/l) | 28.14 |
| 17. | Nickle (mg/l) | <0.05 |
| 18. | Lead (mg/l) | <0.010 |
| 19. | pH | 7.638 |
| 20. | Sulphates (mg/l) | 356.16 |
| 21. | Sodium (mg/l) | 215.5 |
| 22. | Phenolic compounds (mg/l) | <0.001 |
| 23. | Potassium (mg/l) | 8.0 |
| 24. | Total Iron (mg/l) | 0.369 |
| 25. | Total Dissolved Solids (mg/l) | 2581.7 |
| 26. | Total Hardness (mg/l) | 1048 |
| 27. | Total Phosphate (mg/l) | <0.010 |
| 28. | Total Suspended Solids (mg/l) | <1.0 |
| 29. | Temperature | 26 |
| 30. | Total coliform | Absent |
| 31. | Zinc (mg/l) | 0.562 |

14.5.2 Geology and Soils

In order to ascertain the quality and nature of soil within the vicinity of the project site, soil sample was collected. The sample was collected about 60 cm depth. The sample was tested for physical and chemical properties. The results of soil analysis are presented in Table 4 below. As per the test results it is observed that soil is tending to become alkaline. Soil is high in nitrogen and the carbon contents. However phosphors and potassium content is low. Calcium and magnesium content is adequate and soil texture is of sandy silt.

Table 4: Soil Test Results

| S.No | Parameters | Janakpuri (West) |
|------|------------|------------------|
| 1. | pH | 7.654 |

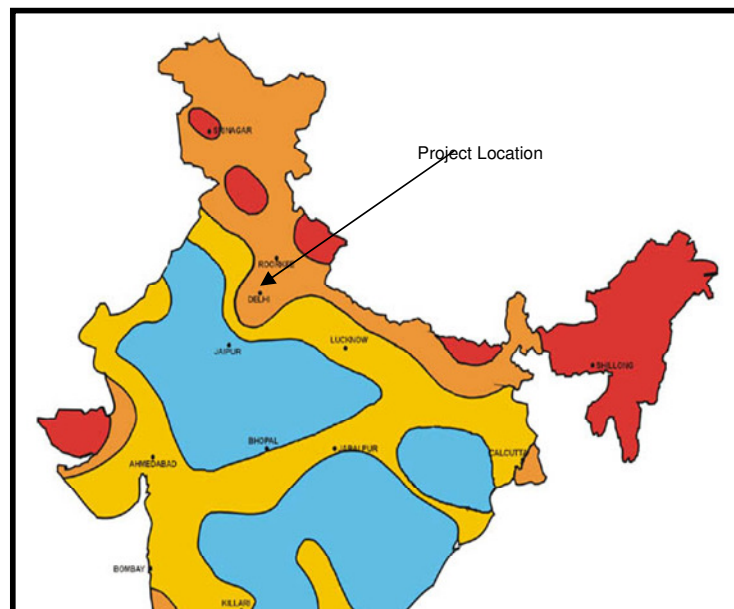
| | | |
|-----|-------------------------|-------|
| 2. | Organic Matter (%) | 11.06 |
| 3. | Nitrogen (kg/Hectare) | 5136 |
| 4. | Phosphorus (kg/Hectare) | 65.36 |
| 5. | Sodium (mg/100gm) | 11.2 |
| 6. | Calcium (ppm) | 1680 |
| 7. | Potassium (kg/Hectare) | 132 |
| 8. | Magnesium (ppm) | 90 |
| 9. | Electrical Conductivity | 3384 |
| 10. | Texture (%) | |
| 11. | Sand | 90 |
| 12. | Slit | 8.46 |
| 13. | Clay | 1.54 |

14.5.3 Seismicity

The country has been classified into different zones indicating the intensity of damage or frequency of earthquake occurrences. These zoning maps indicate broadly the seismic coefficient that could generally be adopted for design of buildings in different parts of the country. These maps are based on subjective estimates of intensity from available information on earthquake occurrence, geology and tectonics of the country. Delhi is located in zone IV of seismic zoning map of India (Figure 3 below). The zone has fairly high seismicity with general occurrence of earthquakes of 5-6 magnitude, a few of magnitude 6-7 and occasionally of 7-8 magnitude. Delhi thus lies among the high-risk areas.

Seismicity around Delhi appears to be associated with a major geological structure, known as the Delhi-Haridwar Ridge. This ridge constitutes an important tectonic block between 28° - 30° N and 76° - 79° E with a NE-SW trend. It coincides with the extension of the Aravalli Mountain belt beneath the alluvial plains of the Ganga basin to the northeast of Delhi towards the Himalayan Mountain. The first recorded major earthquake in this region occurred on 15th July 1720 of intensity 9.0. Subsequent other earthquake events occurred in 1803, 1819, 1905, 1934, 1937, 1945, 1949, 1958, 1960, 1966, 1975, 1980, 1994, of intensity between 7.0 to 9.0.

Figure 3: Seismic Zoning Map of India



14.5.4 Air Quality

Delhi, in terms of air pollution, is ranked among the most polluted cities in the world. The ambient air quality monitoring is carried out regularly by Central Pollution Control Board and Delhi Pollution Control Committee.

The atmospheric concentration of air pollutants was monitored at Janakpuri West during May 2011 by setting up ambient air quality monitoring stations. Air Monitoring was carried out for PM₁₀, PM_{2.5}, NO_x, SO₂, CO, and Pb. Results of the air quality monitoring are presented in Table 5 below. The results show that the concentration of PM₁₀ and PM_{2.5} exceeds the standards at all locations whereas other parameters are within permissible limits at all the locations.

Table 5: Ambient Air Quality Results

| Timing | PM ₁₀ (µg/m ³) | PM _{2.5} (µg/m ³) | NO _x (µg/m ³) | SO ₂ (µg/m ³) | HC (CH ₄) as (ppm) | Lead as (Pb) (µg/m ³) |
|-------------------------------|--|---|---|---|---|---|
| Janakpuri (West) | | | | | | |
| 02:00PM To 10 PM | 208 | 127 | 38.6 | 8.2 | 2.8 | BDL |
| 10:00 PM To 06:00 AM | 165 | 81 | 29.6 | < 5.0 | 2.2 | BDL |
| 06:00 AM To 02:00 PM | 180 | 105 | 36.1 | 7.5 | 2.4 | BDL |
| Average | 184 | 104 | 34.8 | 7.9 | 2.5 | BDL |
| Limits as per CPCB | 100 | 60 | 80 | 80 | - | 1 |

14.5.5 Noise Environment

The assessment of impacts of noise sources on surrounding community depends on:

- Characteristics of noise sources (instantaneous, intermittent or continuous in nature).
- Time of day at which noise occurs, for example high noise levels at night in residential areas are not acceptable because of sleep disturbance.

Noise level survey was conducted along the alignment with an objective to establish the baseline noise levels and assess the impacts of total noise expected due to the proposed metro. Noise levels was measured at Janakpuri (West) location where air monitoring was conducted. Hourly Noise levels were recorded at 2 m away from source as per standard practice. The noise levels so obtained are summarised in Table 6 below and hourly data is presented in Table 7 below. The observations indicate that the equivalent noise levels at all the sites are more than the limit prescribed for residential areas.

Table 6: Noise Levels

| Monitoring | L _{eq} | L ₁₀ | L ₅₀ | L ₉₀ | L _{day} | L _{night} | L _{dn} | L _{max} | L _{min} |
|------------|-----------------|-----------------|-----------------|-----------------|------------------|--------------------|-----------------|------------------|------------------|
|------------|-----------------|-----------------|-----------------|-----------------|------------------|--------------------|-----------------|------------------|------------------|

| Location | (24Hrs) | | | | | | | | |
|---------------------|---------|------|------|------|------|------|------|------|------|
| Janakpuri (West) | 70.5 | 76.3 | 73.3 | 71.1 | 72.0 | 62.3 | 72.1 | 77.2 | 48.1 |

Table 7: Hourly Noise Monitoring Data

| S.No | Parameters | Janakpuri (West) |
|------|------------|------------------|
| 1. | Mid Night | 53.0 |
| 2. | 1:00 AM | 48.9 |
| 3. | 2 | 48.1 |
| 4. | 3 | 49.2 |
| 5. | 4 | 50.7 |
| 6. | 5 | 51.7 |
| 7. | 6 | 54.2 |
| 8. | 7 | 58.4 |
| 9. | 8 | 62.4 |
| 10. | 9 | 67.2 |
| 11. | 10 | 68.3 |
| 12. | 11 | 70.8 |
| 13. | 12 Noon | 69.5 |
| 14. | 13 | 68.2 |
| 15. | 14 | 71.2 |
| 16. | 15 | 72.2 |
| 17. | 16 | 74.9 |
| 18. | 17 | 77.2 |
| 19. | 18 | 74.2 |
| 20. | 19 | 76.4 |
| 21. | 20 | 74.6 |
| 22. | 21 | 69.6 |
| 23. | 22 | 64.0 |
| 24. | 23 | 61.9 |

14.5.6 Ecology

An ecological study of the project area is essential to understand the impact due to project development activities on flora and fauna of the area. The project site is located in city area and it is free of any wildlife fauna. The proposed section requires temporary acquisition of DDA parks at Janakpuri (West) and Dabri mor Metro station and at both the parks well grown trees and bushes exists hence, it is expected that the trees and other plantations, mainly at the existing median will be affected during the site clearing operation (i.e. construction phase). In view of the above, manual count of the existing trees on the medians have been carried to know the numbers of the trees which are likely to be affected/cut during the construction phase.

14.5.7 Forests/Flora

Tree survey was carried out along the proposed alignment. As such no 'forest area' exists along the metro alignment or its corridors. An inventory of trees likely to be lost has been prepared and summarized in Table 8 below. The main species are Peepal, Papdi, Neem, Gulmohar, Bottlebrush, Amultas, Ficus- Panda, Kaner, Sheesham, Kikar, Shahtoot, Eucalyptus, Jamun, Ashok, Mango, Bhor etc. No rare or endangered species of trees have been noticed during field survey. Total no. of trees to be affected by proposed corridor is counted to be 772 in all. The number of trees affected includes the trees in the DDA park as well as trees on the median.

Table 8: Number of Trees on Alignment

| Location | Number of Trees |
|--|------------------------|
| DDA Park Janakpuri West Metro Station | 345 |
| DDA open land at Janakpuri District centre | 44 |
| P&T colony | 22 |
| DDA Park C-2 Janak Puri (Dabri Morh) | 261 |
| DDA Park C-2 Janak Puri (K V) | 21 |
| DDA land at Dasrathpuri bus stand | 20 |
| DDA Colony near Dasrathpuri bus stand | 8 |
| MCD Road from Dasrathpuri bus stand to Palam | 19 |
| BSES sub-station land at Dasrathpuri | 10 |
| MCD primary school at Dasrathpuri | 22 |
| Total no. of affected trees | 772 |

14.5.8 Archaeological Sites

There are about 174 buildings of national importance protected by Archaeological Survey of India in Delhi. On the proposed section of Janakpuri (West) – Dasrathpuri, no archaeological site exists. Thus, no impact is envisaged from proposed corridor on archaeological sites.

14.6 ENVIRONMENT IMPACTS

14.6.1 Positive Environmental Impacts

The introduction of DMRC Janakpuri West – Dasrathpuri section will also yield benefits from non-tangible parameters such as saving due to equivalent reduction in road construction and maintenance, vehicle operating costs, less atmospheric air pollution and socio-economic benefits of travel time, better accessibility, better comfort and quality of life. However, all benefits cannot be evaluated in financial terms due to non-availability of universally accepted norms. The parameters such as economic growth, improvement in quality of life, reduction in public health problems due to reduction in pollution, etc have not been quantified.

Various positive impacts that may result from construction of this section include:

- Employment Opportunities,
- Enhancement of Economy,
- Mobility,

- Safety,
- Traffic Congestion Reduction,
- Reduced Fuel Consumption,
- Reduced Air Pollution,
- Carbon Dioxide and Green House Gases (GHG) Reduction,
- Reduction in Number of Buses, and
- Saving in Road Infrastructure.

The quantified positive impacts of DMRC phase-III project, as a whole, are found in the main EIA report and may be referred to.

14.6.2 Negative Environmental Impacts

Some of the negative impacts associated with the metro rail project have been summarized below under the following headings:

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

➤ Impact due to project construction

(a) Soil Erosion, Waste disposal 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.

(b) Traffic Diversions and Risk to Existing Buildings

At Darshathpuri location, the proposed station is coming up at Dabri Mor to Palam flyover road. So during construction traffic would be diverted through service road parallel to the main road. This would have a temporary negative effect on the commerce of stores on either side of the main road.

(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 at the sites, in the temporary colonies of the construction workers.

(d) Impact on Air Quality

During construction phase, SPM (PM_{10} & $PM_{2.5}$) is expected to be the main pollutant associated with the earthwork activities and material handling, mainly confined to the project site, within a few metres from the source and within the site. During the construction of the proposed section poor air quality is likely scenario in the surrounding region. However, all preventive measure would be taken at the construction site to minimize the impact on air quality.

(e) Impact on Noise

Construction of facilities and structures would require the use of equipment, which may generate high noise levels and adversely affect noise sensitive receivers.

(f) Impact on vibration

Ground borne vibration can be a serious concern for the nearby neighbours of a transit system route causing building to shake and rumbling sounds to be heard. In contrast to airborne noise, ground-borne vibration is not a common environmental problem. In the proposed section during construction activities such as blasting, pile-driving and operation of heavy earth-moving equipment may result in vibration nuisance along the metro corridor.

(g) Impact on Utilities

The alignment is planned to run through underground. The alignment will cross drains/nalas large number of sub-surface, surface and utility services, viz. sewer, water mains, storm water, drains, telephone cables, overhead electrical transmission lines, electric pipes, traffic signals etc. However all impacts are temporary only, once the project is commissioned all utilities would be restored to their original status.

(h) Loss of Trees/ Forests

While there will be no encroachment into nature reserves, as the project area is in the urban centre, 772 trees likely to be lost. The total value of these trees lost is Rs.177.56 lakhs.

➤ **Impact due to Project Operation**

(i) 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.

(j) Noise

The main sources of noise from the operation of trains include: engine noise, cooling fan noise, wheel-rail interaction, electric generator and miscellaneous noise like passenger's chatting. However, since the proposed corridor is underground there will be no impact on the ambient noise. In addition, 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 may come down by about 7 to 9%.

(k) Vibration

During operation of metro factors such as high speed, stiff primary suspensions on the vehicle, and flat or worn wheels will increase the possibility of problems from ground-borne vibration

(l) 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.

(m) 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 have various components, viz. Persona use of Staff, Fire demand, Make up water for air conditioning and ventilation, and Wastage. The water demand at each station would be about 100m³ 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 Calcutta Metro norms.

(n) Railway station Refuse

The refuse from railway station 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. The refuse from stations includes:

- Garbage
- Rubbish from wrappers, discarded boxes, rags etc.
- Floor sweepings

It is assumed that about 64 gm per person per day of solid waste will be generated. 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.

(o) Visual Impacts

The construction of the above corridor will not 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.

14.7 Environmental Management Plan

The adverse environmental issues likely to develop during project construction and operation phases could be minimized by making necessary provision in the project design and adopting the following Environmental Management Plan (EMP):

- a) Compensation for Loss of Trees & Afforestation,
- b) Water Supply & Sanitation,
- c) Air Quality
- d) Oil Pollution Control
- e) Noise Control
- f) Vibration Control

a) Compensation for Loss of Trees and Afforestation

There are approximately 772 trees on the proposed alignment, which needs to be uprooted. The Compensation for Loss of Trees works out to Rs. 177.56 lakhs. For 772 trees 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 7720 plants are required to be planted.

b) Water Supply & Sanitation

The public health facilities, such as water supply, sanitation and toilets are much needed at project location. To maintain water quality following measures would be taken by DMRC:

- At construction depots and batching plants temporary drainage works would be maintained, removed and reinstated
- Provision of Sedimentation tanks of sufficient capacity to trap silt-laden water before discharge into the outlet drain
- Bentonite slurries or other grouts used in diaphragm wall construction piling and other concrete works would be collected in a separate slurry collection system.
- Oil separator/interceptors will be provided at Batching Plant and construction depot location for vehicle maintenance to prevent the release of oils and grease into the drainage system.
- Groundwater pumped out of wells, etc. for the lowering of ground water level in basement of foundation construction, and groundwater seepage pumped out of tunnels under construction should be discharged into storm drains.
- 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 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.

c) Air Quality

The major impact on air expected from the proposed corridor is due to high SPM content during project construction phase. Considering the same following methods have been devised by DMRC for containment of air pollution:

During transportation of Material

- Provision of wheel washing at the construction sites
- All construction equipment should be washed clean of visible dirt/mud before exiting the construction sites.
- Contractor shall ensure that vehicles with an open load carrying area used for moving potentially dust-producing materials shall have properly fitting side and tailboards.

At Construction site

- Contractor will provide storage facilities for dust generating materials and shall be closed containers/bins or wind protected shelters or mat covering
- Stockpiles of sand and aggregate greater than 20m³ for use in concrete manufacture shall be enclosed on three sides
- Effective water sprays will be used during the delivery and handling of all raw sand and aggregate and other similar material
- Areas within the Site such as construction depots and batching plants, where there is a regular movement of vehicles would have an approved hard surface that is kept clear of loose surface material
- The Contractor shall erect hoardings as specified in Employer's Requirements – Construction, securely around all construction work sites during the main construction activity, to contain dust within the site area and also to reduce air turbulence caused by passing traffic.

d) 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.

e) Noise

There will be minimal increase in noise level in ambient air due to construction and operation of this underground 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 25m from site. Suitable noise barriers can reduce the noise levels to 70 dB (A) at a distance of 15m from the piles. To meet the noise limits the Contractor shall use take the following preventive measures:

- (i) Minimize and Equip noise producing equipment with acoustically attenuating shields or shrouds
- (ii) Use construction equipment manufactured or modified to dampen noise and vibration
- (iii) construction of temporary physical noise barriers

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.

f) 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 60kg/m, 90 UTS, supported at every 60cm 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.

14.8 Environmental Monitoring Plan

The environmental monitoring programme is a vital process of any Environmental Management Plan (EMP) of development project for review of indicators and for taking immediate preventive action. This helps in signalling the potential problems resulting from the proposed project activities and will allow for prompt implementation of corrective measures. Historically, environmental monitoring has been integral part of works of DMRC towards better environmental management of air, noise, vibration, water quality etc both during construction and in operation. Generation of dust and noise are two main issues during any large construction activity. Degradation of water quality is another. The parameters are monitored in pre- construction, construction and operation phase and are based on the need to evaluate the deviation of environmental conditions from baseline environmental conditions due to construction and operation of the Metro. The environmental monitoring will be required during both construction and operational phases. Hence, following parameters are proposed to be monitored both during construction and operation phase:

- a) Water Quality,
- b) Air Quality,
- c) Noise and Vibration,
- d) Ecological Monitoring,

Details of the Environmental Monitoring plan are found in the main EIA report for Phase-III

14.9 Socio- Economic Assessment

The scope of socio-economic study is to include the impacts due to the proposed DMRC development of Janakpuri West – Dasrathpuri section. Based on the site survey, it will generate socio-economic data about project affected families and prepare an inventory of property. Based on the data, the project proponent shall develop measures to safeguard the PAFs from the loss occurred due to the proposed project with an objective of sustainable development. The study shall meet the requirement of Japan International Cooperation Agency (JICA) and other funding Institutions for funding of the proposed four corridors.

Development of proposed metro rail project involves acquisition of land for entry, exit and for other facilities of station and running section. Since, proposed alignment is underground, permanent acquisition of land and acquisition of private land has been kept to the barest minimum. The alignment has been so chosen that it remains mostly within the government land.

14.9.1 Potential Impacts

The major findings and magnitude of impacts of the proposed Delhi Metro Janakpuri West – Dasrathpuri section project are discussed in the following sections. The project impacts have been classified into different categories such as impacts on land, impacts on the affected families, impacts on structures and impacts on the common property resources.

a) Land Requirement and Acquisition

The proposed section of Delhi Metro Janakpuri West – Dasrathpuri section shall require land for different purposes. Land is mainly required for station buildings, platforms, entry/exit structures, traffic integration, car shed, power sub-stations, ventilation shafts, administrative buildings, property development and work sites etc. Since, the entire section is completely underground throughout the alignment except for station areas and allied auxiliary service areas, needs for land acquisition have been minimized. The details of land acquisition for the proposed section are mentioned under table 9 below:

Table 9: Land Requirement and Acquisition

| Length of the section (km) | Category of Land | | | | | | Total (Govt. + Pvt.) |
|----------------------------|-------------------|------------------|-----------------|----------------|----------------|----------------|----------------------|
| | Government | | | Private | | | |
| | Permanent (ha) | Temporary (ha) | Total | Permanent (ha) | Temporary (ha) | Total | |
| 4.316 | DDA – 19104.38 | DDA – 24263.1 | 43367.48 | 440.52 | 4928.33 | 5368.85 | |
| | MCD – 84 | MCD – 3566.69 | 3650.69 | | | | |
| | BSES – 1247.42 | BSES – 440.52 | 1687.94 | | | | |
| | | P&T- 3137.12 | 3137.12 | | | | |
| | | | 51843.23 | | | 5368.85 | 57212.08 |

b) Impact on Families

A socio-economic survey was undertaken for the proposed section to assess the socio-economic conditions of project-affected families/people and to examine the impacts of the proposed alignment on their conditions. On the basis of alignment drawings and field visits during November, 2012 it was observed that approximately 23 families are likely to be affected, as their land/house/shop shall be acquired for the construction and operation of the metro on which these families depend. Out of these 23 families, 16 families are residing at P&T government colony and since, in this acquisition both parties involved are government agency, DMRC need not carry out the R&R plan for the colony inhabitants and thus, have not considered the families residing at P&T colony for socio-economic survey. Of the remaining 7 PAFs only one family holds the property as Title Holder (TH) and the remaining 6 families are in Non Title Holders (NTH) category. The NTH category includes tenants, squatters and kiosks. Table 10 below gives details of project affected families

Table 10: Impact on Affected families

| Name of the section | Category of PAFs | | | Project Affected Persons | | |
|------------------------------|------------------|--------------------|-------|--------------------------|-------------|-------|
| | Title Holder | Non – title Holder | Total | Male | Female | Total |
| Janakpuri (West)-Dasrathpuri | 1 (14 %) | 6 (86 %) | 7 | 19 (49%) | 20 (51%) | 39 |

c) Impact on structures and magnitude

Table 11 indicates impact of the proposed project on the different types of structures i.e. residential, commercial, residential cum commercial and other types and type of affect (fully and partially). No industrial structure shall be affected due to the proposed section. The proposed project may impact upon 89 structures. Out of the total structures, 86% are residential, 8% are commercial and 1% are residential cum commercial. The remaining 6% of the total structures are of other types, which includes structures not included in these three categories i.e. school boundary wall, boundary wall of BSES transformer, parks etc.

Table 11: Impact on structures

| Name of the section | Affected structures | | | | Total |
|------------------------------|---------------------|----------------|----------------------------|----------------|-------|
| | Residential | Commercial | Residential cum commercial | Others | |
| Janakpuri (West)-Dasrathpuri | 77 ¹ | 8 ² | 1 ³ | 3 ⁴ | 89 |

| | | | | | |
|---------------------|-------|-------|-----------|---|--|
| | | | | | |
| Magnitude of Affect | Fully | Fully | Partially | 2 structures to be affected partially and remaining 1 Fully | |

Details of structures to be affected by proposed section are as below:

- ¹ Three blocks of P&T residential quarters with 77 flats, the colony has already been declared abandoned by MTNL
- ² Two MCD booths allocated to Physically Handicapped, food stall, furniture shop, a MLA office in two shops and two vacant shops
- ³ A dental clinic used for both residential and commercial purpose by the owner herself
- ⁴ A Samadhi, boundary wall of government school and boundary wall of BSES colony at Dasrathpuri station.

d) Civil Amenities to be affected

The common property resources will also be affected due to construction of the proposed section. The structures being used by public shall also be affected. The common property resources and structures related to public utilities shall be rehabilitated in accordance to the consent of local communities. As per the provisions of DMRC for rehabilitation of the project affected structures of public utilities and common property resources, such property shall be properly compensated. The same type and size of structures shall be made in the same location. The civil amenities to be affected at proposed section are as below:

- Civil amenities like telephone lines, drains etc are likely to be affected on temporary basis. The section involves permanent diversion of a Nala at Dasrathpuri Metro station.
- At Dasrathpuri location, the proposed station is coming up at Dabri Mor to Palam flyover road. So during construction traffic would be diverted through service road parallel to the main road. This would have a temporary effect on the commercial activities of stores on either side of the main road.

14.9.2 Baseline Socio-Economic Study

The alignment drawing and information provided by DMRC was the basis for identification of the affected families and project affected people due to the proposed project section. The study represents assortment of the affected households, which includes titleholders and non-titleholders. The group of non-titleholders included tenants, squatters, kiosk owners, etc. The interviewees interacted with the social teams involved for the purpose and disclosed the information required for the questionnaires format for data collection. The socio-economic analysis of surveyed household has been presented here. The data collected through the social survey generated baseline socio-economic information about the project affected families. The data has been compiled and presented in tabular forms.

a) Gender

The data on gender divide is very helpful indicator to know the participatory share of males and females in the society, which is also an important indicator for human development index. Table 13 shows the data on gender along the proposed section. As per the survey approximately 49% members in project affected families are male and 51% are female.

Table 12: Gender ratio of PAFs

| Name of the section | Gender | Surveyed PAFs |
|---------------------|--------|---------------|
|---------------------|--------|---------------|

| | Male | Female | |
|----------------------------------|--------------|--------------|----|
| Janakpuri (West)- Dasrathpuri | 19 (49 %) | 20 (51 %) | 39 |

b) Religious and Social Groups

Data on religious groups has been collected in order to identify people with the specific religious belief among the PAFs. The religious beliefs and social affiliation of the people are indicators that help understand cultural behavior of the groups. The social and cultural behavior will help understand the desires and preferences of PAPs, which is a prerequisite to rehabilitate the affected people and their families. As per the survey Majority of the population are Hindus constituted 86%, followed by those belonging to Sikhism (14%). A look at the data regarding the social groups reveals that the all affected families come from general caste category. No Scheduled Castes/ Schedule Tribes/ BCs / OBCs were found among the interviewed PAFs. The data on same is mentioned in table 14 below:

Table 13: Religion and Social Groups of PAFs

| Name of the section | Religious group | | | | | Total |
|----------------------------------|-----------------|--------|-----------|---------|------------------|-------|
| | Hindu | Muslim | Christian | Sikh | Others (specify) | |
| Janakpuri (West)- Dasrathpuri | 6 | 0 | 0 | 1 | 0 | 7 |
| % | 86 | 0 | 0 | 14 | 0 | 100 |
| | Social Group | | | | | Total |
| | SC | ST | OBC | General | | |
| | 0 | 0 | 0 | 7 | 7 | |
| % | 0 | 0 | 0 | 100 | | 100 |

c) Family Pattern

Family Pattern indicate the fabrics of sentimental attachment among the family members, social value, economic structures and financial burdens. The family particulars of the surveyed PAPs/ PAFs are given in Table 15 below. Out of total Project Affected Families, majority (71%) of the affected families follow nuclear family pattern, 29% are joint families.

Table 14: Family pattern of PAFs

| Name of the section | Type of the family | | | Total |
|----------------------------------|--------------------|---------|------------|-------|
| | Joint | Nuclear | Individual | |
| Janakpuri (West)- Dasrathpuri | 2 | 5 | 0 | 7 |
| % | 29 | 71 | 0 | 100 |

d) Educational Attainment

Education has been high priority in the city to avail benefits available and get distinguished in their class category. It is observed from the survey that approximately 26 % PAPs are illiterate, 31 %

educated up to primary level, 13 % to middle class level and 13 % have attained their education up to high school level. About 8% of the PAPs are graduates and 8 % post graduates and remaining 3% are non-school going children. Table 16 below mentions education level of PAPs at project affected land.

Table 15: Education Level of PAPs

| Name of the section | Education Level PAPs | | | | | | | |
|------------------------------|----------------------|---------|-----------|------------------|------|----|------------|-------|
| | Illiterate | Primary | Secondary | Higher Secondary | Grad | PG | Non School | Total |
| Janakpuri (West)-Dasrathpuri | 10 | 12 | 5 | 5 | 3 | 3 | 1 | 39 |
| % | 26 | 31 | 13 | 13 | 8 | 8 | 3 | 100 |

e) Occupational Pattern

The occupation and profession of the head of family has been considered during the social survey. The study recorded and assessed the capability, base for livelihood and skills of the family head, so that resettlement impacts can be assessed. Based on the impacts assessment, the income generation plan and rehabilitation plans shall be prepared accordingly. Among the interviewed head of the PAFs, majority of the PAFs 71.43% are involved in business, followed by labour class 14.29 % and professional 14.29 %.

Table 16: Occupational Pattern of PAFs

| Name of the section | Occupation | | | | | | |
|------------------------------|------------|-------------|----------|---------|--------------|--------|-------|
| | Labour | Agriculture | Business | Service | Professional | Others | Total |
| Janakpuri (West)-Dasrathpuri | 1 | 0 | 5 | 0 | 1 | 0 | 7 |
| % | 14.29 | 0 | 71.43 | 0 | 14.29 | 0 | 100 |

f) Family Annual Income

Income is the main economic determinant of the urban social structure. About 41.18% of families have their income range 1.5 lakh to 2 lakh, 17.65% of them have an income of Rs.25, 001-50,000/- and the same percentage has above two lakhs per annum. About 14.3% of the families have income of less than Rs. 25,000. About 28.6% of the PAFs have their income range Rs. 25,000 – 50,000, 14.3 % in the ranges of Rs.50,000 – 100,000 and the same percentage is of income range between Rs 1,50,000 – 2,00,000. Approximately 28.6 % of the PAFs have their income range of above Rs. 200,000.

Table 17: Family Annual Income

| Name of the section | Occupation | | | | | | |
|---------------------|------------|----------|----------|------------|----------|----------|-------|
| | > | 25,001 – | 50,001 – | 1,00,000 - | 1,50,000 | 2,00,000 | Total |
| | | | | | | | |

| | 25,000 | 50,000 | 1,00,000 | 1,50,000 | – 2,00,000 | and above | |
|-------------------------------------|--------|--------|----------|----------|---------------|--------------|-----|
| Janakpuri (West)- Dasrathpuri | 1 | 2 | 1 | 0 | 1 | 2 | 7 |
| % | 14.3 | 28.6 | 14.3 | 0 | 14.3 | 28.6 | 100 |

14.9.3 Resettlement Assistance Plan

The Metro Phase-III project falls in “Category A” based on World Bank Operational Policy (OP 4.01) and JICA guidelines for Environmental and Social Projects. Category ‘A’ includes sensitive sectors such as “Roads, Railways and Bridges” which are similar to metro lines or located in or near sensitive areas such as cultural, historical or of archeological value. Over the years R&R policies have been developed at national and organizational levels. The Acts and Policy relevant to the study are:

- Land Acquisition Act, 1894 (Amended in 1984);
- National Rehabilitation and Resettlement Policy, 2007;
- JICA Guidelines for Environmental and Social Consideration, April 2010
- Relocation & Rehabilitation Policy in respect of PAPs for all categories due to implementation of Delhi MRTS Project.

14.9.4 Eligibility and Entitlements

PAPs entitled for compensation and rehabilitation are (i) PAPs losing land and other assets with legal title/traditional land rights will be compensated, and PAPs will be rehabilitated (ii) tenants in case of shops ; (iii) owners of buildings, or other objects attached to the land; (iv) PAPs losing business, income, and salaries; (v) assistance to the non title holders(squatters, etc). The cut-off date for those who have legal title is the date of notification under section 4(I) of Land Acquisition Act 1894 (amended in 1984). The cut-off-date for those who do not have legal standing (squatters and encroachers) is 31/03/2007 for eligibility of assistance under the project as per Delhi Government notification: F.386 (7)/UD/BFUP/2010/1991-1205, Dt.03.02.2011. The entitlement matrix provides category wise details regarding the entitlements in relation to the R&R principles enumerated above. The following Table 19 presents the entitlement matrix for the proposed metro rail project.

Table 18: Entitlement Matrix

| Category of Loss | Relocation & Rehabilitation Policy in respect of PAPs for all categories due to implementation of Delhi MRTS Project | Responsible Agency |
|----------------------------|---|--|
| Loss of ownership of land | The price for acquisition of land is determined on the basis of market value. | District Collector Govt. of NCT |
| Loss of ownership of house | <ul style="list-style-type: none"> • DDA is responsible for rehabilitation of PAPs. • A LIG flat for PAFs losing plot size less than 100sq.m. • A MIG flat for PAFs losing plot size more than 100sq.m. • Rs.7882/- per Sq.m. for construction cost • Shifting allowance @ Rs 10,000/- | District Collector, DDA Govt. of NCT |

| Category of Loss | Relocation & Rehabilitation Policy in respect of PAPs for all categories due to implementation of Delhi MRTS Project | Responsible Agency |
|--|--|--|
| Loss of ownership of shop | <ul style="list-style-type: none"> DMRC is responsible for rehabilitation of PAPs Construction of shops Maximum size of 15 sq.m per PAP Rs.7882/-per sq.m. for construction cost Shifting allowance @ Rs 10,000/- | District Collector Govt. of NCT DMRC |
| Tenant in case of residential unit | Not eligible | Project Authority |
| Tenant in case of commercial unit | <ul style="list-style-type: none"> Construction of shopping complex Maximum size of 15 Sq.m per PAP Rs.7882/-per sq.m. for construction cost Shifting allowance @ Rs. 10,000/- Vulnerable to get Training @ Rs. 8000 /- Per PAP | Project Authority |
| Loss of jhuggies/hut (Occupancy before 31/03/2007) | <ul style="list-style-type: none"> Squatters will be rehabilitated as per relocation policy of slum dwellers. Shifting Allowance @ Rs 10,000 Training @ 8,000 | District Collector/DUSIB Govt. of NCT |
| Loss of jhuggies/hut (Occupancy after 31/03/2007) | Slum dwellers will be compensated for loss of structure as per valuation of the structure. | District Collector/DUSIB Govt. of NCT |
| Relocation of Kiosk | Shifting allowance @ Rs 10,000/- | Project Authority |
| Vulnerable affected person | Skill improvement training to be arranged and assistance of Rs 15,000/- (LS) | Project Authority |

14.9 INCOME RESTORATION

This development project will have an adverse impact on the income of PAFs. Accordingly it is the responsibility of DMRC as the owner of the project to provide adequate provisions for restoration of livelihood of the affected families. The focus of restoration of livelihood will be to ensure that the Project Affected Persons (PAPs) are able to at least “regain their previous living standards”. The entitlement matrix proposed for this project has adequate provisions for restoration of livelihood of the affected communities. The focus of restoration of livelihoods is to ensure that the PAPs are able to at least regain their pre project living standards. To restore and enhance the economic conditions of the PAPs, various assistances are incorporated in the RAP.

15.1 COST ESTIMATE

The detail of R&R budget is given in **Table 19**. The total cost for resettlement and rehabilitation will be **Rs. 581.48 lakhs**.

Table 19: Cost Estimate

| S.No. | Description | Entitlement | Unit | Quantity | Rate (Rs.) | Amount (Rs. In Lakhs) |
|-------|-------------|-------------|------|----------|------------|-----------------------|
|-------|-------------|-------------|------|----------|------------|-----------------------|

| | | | | | | |
|-----|--|---|---------|---------|---------|--------|
| 1 | Acquisition of private commercial and residential land (permanent) | Replacement cost | Sq.m | 440.52 | 34500 | 151.98 |
| 1.1 | Solatum 30 % | In consideration of compulsory nature of acquisition as per LA Act. | | | | 45.59 |
| 1.2 | Interst @12% | | | | | 18.24 |
| 1.3 | Acquisition of temporary private land | Temporary private land @6% of totla land cost per year for 3 years | Sq.m | 4928.33 | 34500 | 306.05 |
| 2 | Acquisition of structure | | | | | |
| 2.1 | Residential: Fully Affected (FA) | A G+2 storey house (189.94 sq.m) for a fully affected family (total 1 PAFs) | Sq.m | 189.94 | 7882 | 44.91 |
| 2.2 | Commercial (FA) | Construction allowance @ Rs. 7882 per sq.m | Sq.m | 110 | 7882 | 8.67 |
| | | | | | | |
| 3 | Shifting allowance | A lum sum shifting allowance of Rs. 10,000 | No. | 7 | 10000 | 0.70 |
| | | | | | | |
| 4 | Squatters | Eligible for rehabilitation as per the relocation policy of slum dwellers | No. | 1 | 334,000 | 3.34 |
| | | | | | | |
| 5 | Independent Evaluation | | Lum sum | | 100,000 | 1.00 |
| | | | | | | |
| 6 | Miscellaneous | | Lum sum | | 100,000 | 1.00 |
| | | | | | | 581.48 |

15.2 BACKGROUND

Monitoring & Evaluation are critical activities in involuntary resettlement. Monitoring involves periodic checking to ascertain whether activities are progressing as per schedule while evaluation is essentially to assess the performance of PAPs at the end of the project. For this purpose, a monitoring and evaluation (M&E) program is required to be developed to provide feedback to project management which will help keep the programs on schedule and make them successful. Monitoring provides both a working system for effective implementation of the RAP by the project managers, and an information channel for the PAPs to assess how their needs are being met.

15.3 INTERNAL MONITORING

The internal monitoring for RAP implementation will be carried out by DMRC. The main objectives of internal monitoring are to:

- measure and report progress against the RAP schedule;
- verify that agreed entitlements are delivered in full to affected people;
- identify any problems, issues or cases of hardship resulting from the resettlement process, and to develop appropriate corrective actions, or where problems are systemic refer them to the management team;
- monitor the effectiveness of the grievance system
- periodically measure the satisfaction of project affected people.

Internal monitoring will focus on measuring progress against the schedule of actions defined in the RAP. Activities to be undertaken by the DMRC will include:

- Liaison with the Land Acquisition team, construction contractor and project affected communities to review and report progress against the RAP;
- Verification of land acquisition and compensation entitlements are being delivered in accordance with the RAP;
- Verification of agreed measures to restore or enhance living standards are being implemented;
- Verification of agreed measures to restore or enhance livelihood are being implemented;
- Identification of any problems, issues, or cases of hardship resulting from resettlement process;
- Through household interviews, assess project affected peoples' satisfaction with resettlement outcomes;
- Collection of records of grievances, follow up that appropriate corrective actions have been undertaken and that outcomes are satisfactory;

15.3 REPORTING REQUIREMENTS

The Chief Engineer (General) of DMRC, who is responsible for supervision and implementation of the RAP, will prepare quarterly progress reports on resettlement activities. The Independent Evaluation Consultant will submit mid and end term evaluation report to DMRC and determine whether resettlement goals have been achieved, more importantly whether livelihoods and living standards have been restored/ enhanced and suggest suitable recommendations for improvement.

15.4 Conclusion

On the basis of field study and information collated from P&P through interaction the compensation has been worked out of be Rs. 581.48 lakh. This includes the cost of acquisition private land on both permanent and temporary basis, the residential and commercial structures. The compensation of squatters and shifting for all the affected families.