

**GURUGRAM METRO RAIL LIMITED**

# **Metro Connectivity from Millennium City Centre to Cyber City**

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)**

**MARCH 2026**

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## List of Abbreviations

AFC	Automatic Fare Collection	HUDA	Haryana Urban Development Authority
AIDS	Acquired Immune Deficiency Syndrome	HVPLN	Haryana Vidyut Prasaran Nigam Limited
AOI	Area of Influence	IT	Information Technology
ARP	Aerodrome Reference Point	LMP	Labour Management Procedure
BIS	Bureau of Indian Standards	MCG	Municipal Corporation of Gurugram
BOCWA	Building and Other Construction Workers Act	MoEF&CC	Ministry of Environment, Forest and Climate Change
CBTC	Communication Based Train Control	MoHUA	Ministry of Housing and Urban Affairs
CMP	Comprehensive Mobility Plan	MRTS	Mass Rapid Transit System
CPCB	Central Pollution Control Board	NAAQS	National Ambient Air Quality Standards
CPR	Common Property Resources	NABL	National Accreditation Board for Testing and Calibration Laboratories
DPR	Detailed Project Report	NBC	National Building Code
EHS	Environmental, Health and Safety	NDMA	National Disaster Management Authority
EIA	Environmental Impact Assessment	NGO	Non-Governmental organization
ERP	Emergency Response Plan	NOC	No Objection Certificate
ESCP	Environmental and Social Commitment Plan	NOCAS	No Objection Certificate Application System
ESF	Environmental and Social Framework	PHPDT	Peak Hour Peak Direction Trip
ESIA	Environmental and Social Impact Assessment	PMC	Project Management Consultant
ESMF	Environmental & Social Management Framework	PPE	Personal Protection Equipment
ESMP	Environmental & Social Management Plan	PWD	Public Works Department
ESIRT	Environmental and Social Incident Response Toolkit	R&R	Resettlement & Rehabilitation
ESS	Environmental and Social Standards	RAP	Resettlement Action Plan
ESZ	Eco-Sensitive Zones	RDSO	Research Designs and Standards Organization
FGDs	Focus Group Discussions	RESCO	Renewable Energy Service Company
FI	Financial Intermediary	RoW	Right of Way
GBV	Gender Based Violence	RWA	Resident Welfare Association
GMDA	Gurugram Metropolitan Development Authority	SEA	Sexual Exploitation and Abuse
GoH	Government of Haryana	SEP	Stakeholder Engagement Plan
GoI	Government of India	SH	Sexual Harassment
GPN	Good Practice Note	SIA	Social Impact Assessment
HIV	Human Immunodeficiency Virus	SPCB	State Pollution Control Board
HMRTC	Haryana Mass Rapid Transport Corporation Limited	ToR	Terms of Reference
HSVP	Haryana Shehari Vikas Pradhikaran	VEC	Valued Environmental Components
		VVVF	Variable Voltage Variable Frequency
		WPA	Wildlife Protection Act

## Chapter 0: Executive Summary

### 1. Introduction

Gurugram city is known as the "Millennium City" due to its remarkable shift from an agricultural region to a major financial and industrial hub in India. This transformation has seen the rise of multinational corporations, IT firms, business centres, and towering skyscrapers, making Gurugram a significant driver of India's economy. The city's rapid growth can be attributed to extensive urbanization and robust economic development owing to its strategic location proximal to New Delhi and its airport, in the National Capital Region (NCR).

Gurugram has been improving its transportation infrastructure, but with urban mobility needs evolving, there's a demand for an efficient Mass Rapid Transit System (MRTS). With the focus on enhancing urban public transport in Gurugram City, Gurugram Metro Rail Limited (GMRL) is implementing the Gurugram Metro Rail Project (GMRP), which will connect Millennium City Centre station to Cyber City station. GMRP involves the construction of approximately 30.85 km of elevated metro line in Gurugram, with 28 metro stations, depots, rolling stocks, and electric, telecommunication, signalling and control systems.

The ESIA report is prepared based on the design finalised by the Detailed Design Consultant (DDC) and on the Detailed Project Report (DPR) design, in accordance with the World Bank (WB) Environmental and Social Framework (ESF), as outlined in Term of References (ToR).

### 2. Applicable Regulatory and Guidance Framework

The applicable regulatory framework for the ESIA comprised of the following:

- Applicable international, national, state and city level environmental and social (E&S) policies, regulations and guidance's including environmental policy, EIA notification (in case of Buildings more than threshold area as per notification) and acts, Water and Air Acts, Noise Rules, regulations on various type of Wastes, Wetlands and Eco sensitive areas, biodiversity, The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act, GMRL Policy for Direct Purchase of Private Land/Property through Mutual Negotiations, Scheduled Castes and Scheduled Tribes (Prevention of Atrocities) Act, The Sexual Harassment of Women at Workplace Act and others)
- Indian labour and related laws including The Building and other Construction Workers (Regulation of Employment and Conditions of Service Act, The Factories Act, Child Labour (Prohibition and Regulation) Act, Minimum Wages Act, Workmen's Compensation Act & Rules, The Street Vendors Act.
- WB ESF, World Bank Group (WBG) Environmental, Health, and Safety (EHS) general guidelines, and the Environmental and Social Standards (ESSs) have been thoroughly reviewed and incorporated into the applicable regulatory framework.

### 3. Project Description

The GMRP corridor is 30.85 km in length and has 28 elevated stations. The primary corridor, spanning 27.20 km is from Millennium City Centre to Cyber City, includes 26 stations. A spur of 1.85 km is proposed to connect Dwarka Expressway from Basai Village with a single station. A new spur of 1.85 km<sup>1</sup> with one station from Sector 5 to integrate city metro with Gurugram Railway Station.

The DPR of GMRP had adopted the same system as that of Rapid metro, existing metro of Gurugram from Sector 56 Gurugram to Cybercity. Accordingly, only a stabling depot spread over 5.5 Hectares was planned at Sector 101 as it envisaged the use of existing Rapid Metro infrastructure. As per Gol approval, the GMRP corridor is independent corridor with no track integration with Rapid Metro as such a full-fledged depot is required. The stabling depot planned earlier was located in Sector 101 near Basai. Sector 101 is a low-lying area mainly filled with wastewater and reeds; and this area is frequented by migratory birds. Considering these concerns and requirement of a full-fledged depot, the area alternatives for depot location along the corridor were analysed and a depot spread over 22.37 Hectares is now being planned in Sector 33, Gurugram. The depot will be developed with all requisite repair facilities, stabling and inspection facilities and associated support infrastructure and facilities. As per the approved cost estimate for GMRP covering civil, electrical, signalling and telecommunications works, rolling stock, etc., the estimated total cost including Taxes & Duties at Sept' 2021 price level is Rs. 4808.02 Cr (Rs. 48082.2 million). Other features of the project are:

- The GMRP corridor is fully elevated and planned on the median of the existing roads, thereby minimizing the private land requirement.
- Gauge<sup>2</sup>: Gauge adopted for the metro is Standard Gauge 1435 mm which permits sharper curves and is favourable for metro alignment in urban scenarios, resulting in less property demolition and acquisition.
- Formation: Ballast less track<sup>3</sup> is proposed for elevated stretches and depot to optimize maintenance and risk to vehicles on the road. This will help in reducing fugitive dust emissions during operation.
- Rolling Stock<sup>4</sup>: The rolling stock proposed for the corridor aims to improve energy efficiency and resource utilization. Communication Based Train Control (CBTC) is proposed which is mainly used for MRTS networks, this system works on the moving

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<sup>1</sup>The alignment for the proposed 1.80 km spur from Sector 5 to integrate the metro with Gurugram Railway Station is yet to be finalized. Upon finalization of the design, an ESIA study will be undertaken, and the ESIA report along with other required E&S documents will be prepared for the proposed spur.

<sup>2</sup> Gauge is the gap between the two rails on which the train runs.

<sup>3</sup> A ballast less track, or slab track, is a railway track where the rails are fixed on a solid surface, like concrete or asphalt, instead of being laid on loose stones.

<sup>4</sup> Rolling stock refers to all railway vehicles that move on a railway line, including both powered and unpowered units.

or virtual block principle to reduce headways, increase transport capacity, provides adequate safety level, and reduces demand on passenger evacuation systems.

- Traction System<sup>5</sup>: 750 V DC third rail traction system is proposed for the metro corridor. The modern rolling stock with 3-phase VVVF drive has been proposed, which is the electricity driven mass rapid transit system. The cars are equipped with 3 phase AC traction motors with regenerative braking system; by which the trains can 'generate' electricity when brakes are applied. The regenerative braking will be the main brake power of the train and will regain the maximum possible energy and pump it back to the system and thus fully utilize the advantage of 3 phase technology.

#### 4. Analysis of Alternatives

The Analysis of Alternatives is structured to follow a 'narrowing approach' involving a series of logical steps, starting with the high-level strategy alternatives followed by description of more detailed technology alternatives considered. Using this commonly adopted narrowing approach, the Analysis of Alternatives considers alternatives in the following sequence:

- Strategy Alternative: Based on Conceptual Transport Alternatives as per Comprehensive Mobility Plan (CMP), 2020 (Developed by School of Planning and Architecture, New Delhi), mass transport systems, comprising both rail-based and road-based systems have been considered to cater to public transport demand in Gurugram city. Metro rail systems are observed to be more environment friendly with lesser long-term pollution in the Delhi region reeling from air pollution, and more safety, and higher speeds of transport.
- 'Zero' or 'No Project' alternative: Here, without project scenario i.e., continuing the existing situation compared with the scenario where the proposed project is implemented.
- Alternative for the Location of Metro Depot, for Location of Millennium City Centre Station and Alternatives for Corridor from Sector 5 to Sector 3.

GMRP will yield tangible and non-tangible savings due to equivalent reduction in road traffic and certain other socio-economic benefits. The introduction of the MRTS will lead to a significant decline in the number of buses, Intermediate Public Transport (IPT), and private vehicles, resulting in lower air pollution and improved traffic flow. With fewer vehicles, road movement will become faster and more efficient, making city travel smoother and more sustainable. It will lead to a reduction in fuel consumption, vehicular emissions, travel time, and accidents, contributing to a cleaner and safer urban environment. Additionally, modifications have been made in the alignment resulting in a reduction in the number of affected structures from 261 to 210.

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<sup>5</sup> A traction system in metro operation is the electrical system that provides the power to propel metro trains.

## 5. Environmental and Social Baselines Conditions

Baseline data was collected for Land, Water, Air Environment, Noise & Vibration, Biological Environment, Sensitive Receptors, Archaeological Monuments and Socio-Economic profile of the study area between November 2023 and October 2024.

**Land Environment:** The GMRP alignment begins near Millennium City Centre Station at 28°27'34.40"N, 77°4'36.86"E and ends near Cyber Hub at 28°30'1.29"N, 77°5'43.10"E, with an average elevation of 257 m above sea level. The study area covered by vast alluvial and sandy tracts, remnants of the Aravali Mountain chain. Soil quality analysis revealing sandy clay loam with good fertility. Land use is predominantly built-up area (44.71%) and agricultural land (29.7%). According to the revised seismic zoning map of India (IS 1893), the GMRP falls under High Damage Risk Zone (Zone IV), which is the second most severe seismic zone.

**Water Environment:** Surface water from Yamuna River is supplied by Gurugram Water Supply (GWS) and NCR Water Supply Channel serves as the primary water source for the city. Groundwater is a crucial water source for Gurugram, predominantly extracted by private entities like housing societies and individual houses.

Groundwater is heavily exploited, with levels averaging 39.89 meters below ground level. Surface water samples indicated organic pollution, while groundwater samples showed some parameters exceeding acceptable limits but still within permissible ranges.

Bajghera, Chandu, Budhera and Daultabad villages in Gurugram Tehsil are identified as highly flood-prone; however, the GMRP alignment does not pass through these villages. Critical Areas Prone to Storm Water Stagnation near to the GMRP alignment are identified. These include major intersections and chowks such as 1) Hero Honda Chowk and the area opposite TPS-1, 2) Subhash Chowk, 3) Bakhtawar Chowk, 4) Umang Bhardwaj Chowk to Himgiri Chowk, 5) Khandsa Chowk, 6) Basai Chowk and its associated flyover 7) near ESI Hospital towards Sector 9A. 8) Sector-4/7 Chowk and 9) Presidium School Flyover and Krishna Chowk in Palam Vihar.

**Meteorology:** Gurugram experiences a subtropical climate with four distinct seasons. January is the coldest month and May & June are the hottest months. The average annual rainfall in Gurugram district is 505.4 mm mainly between July and September. Humidity is high during South-West Monsoon. The winds are predominantly from West and North-West direction.

**Air Environment:** Monitoring was conducted at 12 locations near the GMRP alignment and depot for four weeks from November 2023 to January 2024. The air quality monitoring results indicate that PM10 & PM2.5 exceeding the permissible limits for residential, Industrial and Sensitive areas at all locations and Parameters SO<sub>2</sub>, NO<sub>2</sub>, and CO were noted within the permissible limits. As per the monitoring results, the AQI in the project area varies from 199 to 322, which indicates the air quality category as moderate to very poor.

**Noise:** Noise level survey was carried out at 20 locations near the GMRP alignment and depot. From the results, it is observed that Leq for day and night at 10 locations were exceeding the permissible limits for silence zone as per National Ambient Noise Standards. At remaining locations, the noise levels were within the permissible limits for residential zones. The main source of noise in the project area is the traffic movement on the road.

**Vibration:** Vibration monitoring was carried out at 10 locations for 24 hr at each location. Vibration levels vary from 54 to 79.9 VdB, and the vibration levels are predominantly due to the road traffic.

**Biological Environment:** The state has a forest cover of around 3.63% of its geographical area, mainly comprising of Tropical and Mixed Dry Deciduous Forest and Tropical Thorn Forest. Forest areas are distributed along roads, drains, railway lines, and flood protection bunds, forming strips on either side of roads. The unclassified forest (i.e. areas possessing forest-like characteristics but not officially classified or notified as protected forest areas) of area 3.25 ha (8.02 acres) is located near Sector 10 Metro Station. Sector 10 Metro Station and part of the alignment falls in the unclassified forest.

The project area includes floral species like Neem, Babool, Gulmohar, Peepal and Eucalyptus etc. The animals found in Gurugram district are Common langur, Golden Jackal, Leopard, Jungle Cat, Indian Grey Mongoose, Nilgai, Monkey, Sambar. The mammals include squirrel and mouse; and reptiles include common garden lizard and rat snake.

Sultanpur National Park and Najafgarh Jheel are located within 10 km radius from the GMRP alignment. MoEF&CC has notified an area of 5 km from the boundary of the Sultanpur National Park as Eco-Sensitive Zone. The nearest point of the alignment is the end point of the Spur at Dwarka Expressway which is approximately 8.2 km from the National Park. Najafgarh Jheel is the largest surface water body in Delhi located at about 4.7 km from the end point of the Spur at Dwarka Expressway.

Sector 101, Basai is a Key Biodiversity Area (KBA) as per Important Bird Area (IBA), 2004. As per WB ESS 6, this area falls under modified habitat. This area is predominantly covered with species of Water Hyacinth and beds of Typha. Tree species of Kabuli Kikar are predominantly present in the vicinity of Water spread Area. Avifauna visiting this area along with their International Union Conservation Status (IUCN) Status and Indian Wildlife Protection Act (IWPA), 1972 Schedule are detailed in ESIA report. As per the 2004 assessment by BirdLife International available on the DataZone portal<sup>6</sup>, the primary water source for the site was a breached water channel carrying wastewater and partially treated sewage from the Gurgaon Water and Sewage Works. During the RITES site visits conducted between August 2023 to October 2025, it was observed that the main source of water inflow originated from a damaged drain carrying treated wastewater from nearby STP. However, the flow of water has stopped due to the repair of the damaged drain, which was also confirmed through consultation with an NGO located within this area. Currently, the site is filled with soil and is being used for Agriculture purposes. As per Master Plan 2031 of Gurugram, Sector 101 is categorised as “Public Utilities” like Water Works, Disposal Works and Grid Sub-Station. The Sector 101 land comprises both privately owned plots and land under the jurisdiction of the Basai Panchayat.

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<sup>6</sup> <https://datazone.birdlife.org/site/factsheet/18172-basai-wetlands>

The Basai Village Metro Station is proposed near Basai Pond and the GMRP alignment passing near the pond (Ch. 11690 to Ch. 11789). Basai Pond is primarily used by local residents for cattle bathing. The pond's water quality has significantly deteriorated due to indiscriminate solid waste dumping. During the monsoon season, the water level rises close to the pond's outer boundary, while in other seasons, it recedes to approximately 10 meters away. However, during the Detailed Design Stage, careful measures have been taken to ensure that placement of pillars are restricted to the outer edge of the Pond to minimize impacts on the water spread. Even though the impacts are minimal, mitigation measures have been outlined in the Environmental and Social Management Plan (ESMP) to address any construction related concerns.

**Sensitive Receptors and Cultural Heritage:** Sensitive receptors located within the Right of Way (RoW) include temples, schools and hospitals. One temple and one pond fall within the RoW, while 18 temples, 21 schools/colleges, 21 hospitals and 9 parks are located within 100 m of the GMRP alignment. The nearest archaeological monument is the Mosque of Ala Vardi Khan, 490m from the GMRP alignment. Centrally Protected Monument of ASI are protected "with Prohibited area of 100m around it and further 200m regulated area around as per AMASR act 2010. As the Mosque is 490m away from the alignment, no impact is anticipated due to the project. If any chance finds such as artifacts, fossils, or human remains discovered during the GMRP construction, then chance-find procedures as given in the ESMP will be followed.

**Socio-Economic Survey:** The socio-economic survey covered 154 households, representing a total population of 852 members. The largest age group comprised (46.24%) of the population, aged between 19-45 years, with a nearly balanced gender ratio of 52.58% males and 47.42% females. Most families (77.92%) were nuclear, with an average household size of 5.53 members. The religious composition of the surveyed population comprised 86.36% Hindu, 11.04% Muslim and 2.60% Sikh, while the social composition consisted of 40.91% Other Backward Classes (OBC), 33.77% general category and 25.32% Scheduled Castes (SC).

Educational attainment varied, with 32.16% of population being illiterate and 19.72% completing high school, while approximately 10% were graduates or attained higher education. Approximately 25.82% of the population was working, mainly in business/trade (19.13%) with smaller numbers in labour and services. The rest were mostly students, homemakers or elderly. Vulnerable groups constituted about 9.62% of the population, including elderly, widows, differently-abled and women-headed households.

Housing conditions showed that 24.68% of households owned their homes, while 75.32% resided in rented accommodations. The majority of houses (79.22%) were pucca structures, with access to basic amenities like electricity (91.56%), piped water (81.82%) and separate toilets (78.57%). Average monthly incomes predominantly ranged from Rs. 10,001 to Rs. 20,000 (54.55%).

Community awareness of the project stood at nearly 49%, with positive expectations including reduced travel time and traffic congestion. However, concerns were raised about potential impacts such as loss of land, livelihood and structures..

## 6. Stakeholder Consultations

Between December 2023 and October 2024, a series of formal and informal consultations were conducted with a total of 194 stakeholders. These included 69 project-affected persons (PAPs) including vulnerable groups, 63 other interested parties including NGOs, 13 police officials including female officers and 49 women transport users. The discussions focused on project design, transparent & timely communication, livelihood impacts, traffic management, safety & security and gender inclusive facilities in metro design. Major concerns raised included potential income loss, safety issues, traffic management, and the provision of gender-sensitive facilities at metro stations.

## 7. Assessment of Environmental and Social Risks and Impacts

The risks and impacts associated with the project have been thoroughly assessed in line with the WB ESSs. Each ESS outlines specific areas of concern, ensuring that all potential issues are identified, evaluated and addressed comprehensively in ESIA report.

The project provides opportunities to improve resource use, better planning and management to contribute to the overall improvement of the environment (including air quality), and access to planned infrastructure, services, greens, safe and less polluting modes of transport, and better facilities in Gurugram. Environmental Risk is “High” given the high-risk investments to be implemented in the complex and dense urban settings of Gurugram city in the NCR, some near sensitive environmental features. Possible environmental risks to the biophysical environment potentially include (a) land and surface and ground water pollution, and likely disturbances to habitats/landscapes KBA/IBA in Sector 101, Basai, 2 drains and designated forest patches in the city); (b) Based on project site assessment there are no environmental liabilities; (c) visual impacts related to the permanent change of the city’s skyline. In addition, during construction and operation stages, the project will result in air, water and land pollution impacts (due to dust, heat, light, noise, and wastes/wastewater), on communities and some impacts on local fauna and flora. The aspects during construction and operations include:

- Generation of substantial debris, and muck during the demolition of existing structures, construction and operations & maintenance (O&M) including shifting of utilities.
- Dust and emissions to air (resulting in pollution, health impacts and odour) due to demolition, excavation, cutting, back filling, compaction operations and other construction activities, and O&M works.
- Noise and vibration and other disturbances to residents and businesses during material movement, construction demolitions, and laying of rising main.
- Temporary flooding of excavated areas during monsoons.
- Land and water contamination due to construction waste and operation phase waste and sludge handling including from the depot.
- Spillage of chemicals, fuel and oil.
- Safety hazards to labours (Occupational Health and Safety (OHS)) and public (Community Health and Safety (CHS)).

- Increased traffic inconvenience (emissions, congestions, longer travel times, blockage of access), during transport of project staff and materials to the site during construction.
- Biodiversity impacts including tree cutting, disturbance to habitats/landscapes at KBA/IBA in Sector 101, Basai, and Nuisance and menace of pigeon at metro stations.

The Social Risk is “High” as the GMRP alignment and stations are sited in dense urban settings of Gurugram City and shall impact 24.84 ha. of land including a) 1.32 ha of private land (residential and commercial); b) about 23.52 ha of government land for construction of station, viaduct and depot; c) about 210 structures, of which 30 owned by title holders, 01 managed by a trust, 02 informal settlers (encroachers), 75 informal occupiers (squatters), 44 Street Vendors structures (holding license from MCG), 01 vendor holding Excise & Taxation Department License and 57 other structures. Of 30 titleholder structures, 28 are fully affected and 02 will be partially impacted; and d) Total Depot land is 22.37 ha. Additionally, 5 ha of land (Govt.) is needed on a temporary basis for construction yards.

GMRL has used the principle of mitigation hierarchy to minimize impacts on land and structures by ensuring that the alignment passes over the median of existing roads. A DDC has been appointed to refine the alignment, station’s locations and entry/exit points. Accordingly, the land requirement may slightly change.

Besides, there might be need for land taking for infrastructure required for first and last mile connectivity such as bike spaces, charging stations, etc. In addition to land related issues, other social impacts may include: (i) land-use changes and densification of urban fabric; (ii) pedestrian-vehicular conflicts and other Community Health & Safety (CHS) issues, (iii) Occupational Health & Safety (OHS) risks during construction, O&M stages (iv) possible vibration impacts on existing buildings potentially involving some of cultural heritage value, (v) potential aggravation of risks in case of disasters (such as earthquakes, fires, manmade disasters, etc.) with envisioned densification along the corridor, (vi) labour influx and Social Exploitation and Abuse/ Sexual Harassment (SEA/SH) risks are likely from migrants to communities. Further, civil work for at least 3-4 years is likely to result in impacts on livelihoods, disrupt access to communities. Another key aspect to understand and mitigate during operation relates to Life and Fire Safety (L&FS) and preparedness and response / users evacuation measures during emergencies, including but not limited to elderly and disabled users.

Based on the relevance of each ESS, and national/ state Legal, Regulatory and Institutional Framework, ensuing sections summarize the E&S risks and impacts likely due to the proposed interventions followed by the mitigation measures considered.

### **Assessment and Management of E&S Risk and Impact (ESS 1)**

Given the nature of activities, 8 out of the 10 ESSs are relevant and ESS7 and ESS 9 are not relevant to the project. Considering a variety of investments including Metro Rail, last mile connectivity and multi-modal integration, an ESIA is finalized for GMRP with suitable mitigation instruments ESMP and RAP.

Associated facilities identified for the project include any future road widening activities carried out for project corridor by other agencies. The likely key risks associated with these facilities are presented in **Table 0-1**.

**Table 0-1: Associated Facilities and Key Risks**

S. No.	Associated Facility	Key Risks	E&S Management Documents	Timing/Status
1	Future road expansions (by other agencies)	Environmental impacts (change in land use, noise and air pollution etc.) Social impacts (land acquisition, livelihood disruption, etc.)	ESMP Document	Before and during construction activities take place

**Labour and Working Conditions (ESS 2)**

The project will involve direct workers (GMRL) employees and consultants for work related to its core functions (consultants preparing detailed design for the corridor, stations, feasibility for multimodal integration and first/last mile connectivity related studies; for undertaking surveys for Land acquisition, preparing ESIA and mitigation plans; other consultants undertaking various related studies). The project’s civil works contracts will involve skilled, semi-skilled, and unskilled workers who are expected to contribute a major proportion of contracted workers’ besides migrant labour. Primary supply workers will be relevant as the project through civil work contractors, will procure construction material for civil works. Community workers are not envisaged at present. A Labour Management Procedure (LMP) covering all requirements of ESS2 including child labour, labour influx, labour disputes, discrimination & exclusion, gender-based violence (GBV)/SEA/SH, OHS, Noise etc has been prepared by the GMRL. Contractor’s Management Plans shall reflect the requirements of the LMP as applicable to respective activities. OHS management Plan will be updated by contractors before site mobilisation. Training programs are planned for project staff, including two orientation sessions and eight ESMP training sessions. Contractor will arrange training for staff/employees on Environmental Management Systems, Hazard Awareness, Health & Safety, Drainage, Noise, Waste, and Wastewater Management, incident reporting, emergency response and Project Management.

**Resource Efficiency and Pollution Prevention and Management (ESS 3)**

The project will recycle wastes and wastewater, aim at energy and water efficiency, and use raw materials consistent with ESS3 and relevant national policies. C&D waste will be recycled and recycled material will be used. Energy Efficient measures will be implemented. Materials will be sourced from authorized suppliers due to local mining bans. Pollution prevention measures including improved storage, management of fuels, construction materials, and various types of wastes (such as solid, C&D, hazardous, e-wastes) will help to mitigate air, water, land and noise pollution in areas where the alignment and stations are located near water bodies. Water sprinkling on local roads and worker sites, along with wheel washing

facilities and coverings for materials and trucks, will be implemented to control dust. Additionally, measures to prevent soil erosion will be put in place. The contractor will take necessary steps to prevent the release of pollutants and implement mitigation measures to minimize air pollution.

No contaminated sites have been identified during the ESIA Study in the project area. However, if required, contamination assessments and site-specific cleanup plans will be developed in accordance with applicable guidelines. An outline for Site Clean-Up/Remediation Plan for Contaminated Sites are provided in Annexure 7.1. Risks of alien species and pesticide use will be avoided in landscaping. Visual and environmental impacts, including light, shadow, vibration, noise, and air pollution, are evaluated and mitigation measures to be implemented are suggested. The ESIA includes noise and air quality modelling, greenhouse gas (GHG) emissions estimation, runoff risk assessment, and waste management plans. Noise: Construction noise from internal combustion engines, earth-moving, and material-handling equipment will impact nearby residences and workers, with noise levels ranging from 76-88 dB(A) at 15 m, and the noise levels decreases with distance. During construction, Noise barriers and personal protective equipment will mitigate impacts. During operation, metro train noise, primarily from wheel/rail roughness and propulsion equipment. Cumulative noise levels exceeding permissible limits at certain locations. Proposed noise barriers at various locations (sensitive areas like schools and hospitals), with budgetary estimate of INR. 522.11 Lakh (USD 625,200.57).

Vibration: The GMRP is located in seismic Zone IV, requiring structures to withstand significant seismic forces with high-quality materials and dynamic analysis. During construction, vibration impacts are from pile driving and construction equipment; which will be mitigated by implementing vibration reduction measures such as proper design & maintenance of Track & Rolling stock, Ballast less Track, resilient soft base plates between rail and track slab, resilient rubber between base plate and track slab etc. During operation, vibrations are primarily due to train axle loads and acceleration forces. Sensitive receptors (temples, schools, and hospitals) are identified along the GMRP which are prone to vibration impact and no vibration impact is anticipated on Heritage structures. Mitigation measures include track and rolling stock design enhancements, use of resilient materials, metro rail grinding, and vibration monitoring at sensitive sites. During the construction stage, stakeholders will be informed to promptly report for any damages. GMRP sections shall be designed to minimize vibration and regular maintenance<sup>7</sup> shall be planned to reduce the impact.

GHG Emissions: These are estimated based on the reduction in road traffic and the corresponding decrease in CO<sub>2</sub> emissions, after accounting for emissions from grid electricity consumption and the benefits of the regenerative braking system. The net carbon credits

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<sup>7</sup>Regular monitoring and preventive maintenance of the project infrastructure will be conducted by GMRL to ensure its efficient and safe operation.

eligible due to the project in Year 2041 are approximately 89 tCO<sub>2</sub>e/day (equivalent to 32,530 tCO<sub>2</sub>e/year).

Management plans are proposed for water supply, rainwater harvesting, wastewater treatment, oil pollution control, green belt development and solid waste disposal at the Depot.

#### **Community Health and Safety (ESS 4)**

The H&S of the communities are important during the construction stage, mainly as these will occur along/on/under main traffic corridors where the density of development and traffic will be higher. H&S risks and public inconvenience due to the shifting of utilities, material transport, storage, construction and maintenance activities, and modal interchanges are important and CHS plans (incl. Traffic Management, GBV and SEA/SH, etc) will be prepared. The ESIA assessed the risks to communities (eg: inconvenience, noise, disturbance, and pollution), pedestrian-vehicular conflicts and disturbance during construction, vibration and safety of structures and all other H&S issues including traffic-related safety and diseases during all stages. Construction and O&M will be planned, designed and implemented to comply with the WBG's EHS guidelines. L&FS standards will be internalized besides universal access. The proposed project corridor is situated in seismic Zone IV of the seismic zoning map of India. Accordingly, the design of all structural components the suitable seismic coefficient in line with the provisions of 1893, to ensure seismic resilience.

#### **Land Acquisition, Restrictions on Land Use and Involuntary Resettlement (ESS 5)**

Even though design features such as elevated tracks over medians of existing roads and stations will help to minimize impacts, it is estimated that the project impacts 24.84 ha. of permanent land including a) 1.32 ha of private land (residential and commercial); b) about 210 structures. It shall also involve physical and economic displacement of shops/street-side vendors (including vendors holding licenses issued by MCG)/sanitary shop owners, particularly at stations locations; and c) Total Depot land is 22.37 ha, with approximately 21.73 ha being government land. Of this, 17.38 ha of government land remains vacant at the depot. Additionally, 5 ha of land (Govt.) is needed on a temporary basis for construction yards. Land will be purchased in accordance with the GMRL Policy for Direct Purchase of Private Land/Property through Mutual Negotiations.

As part of the ESIA, key gaps have been identified, including: (a) the recognition of non-titleholders (such as encroachers and squatters) as PAPs, and (b) the establishment of cut-off dates for non-titleholders and c) the consideration of depreciation for affected structures. To address these gaps, a RAP has been prepared, incorporating appropriate mitigation measures.

#### **Biodiversity Conservation and Sustainable Management of Living Natural Resources (ESS 6)**

The project will affect approximately 2777 trees along the GMRP corridor and depot. It is proposed to plant 10 saplings for each tree to be removed. In total 27,770 saplings proposed for compensatory afforestation at an estimated cost of INR 189.34 lakh (USD 226,728.43). Native and indigenous tree species are recommended for planting.

KBA/IBA in Sector 101, Basai: Part of the spur alignment passes near this site. The main source of water was from damaged drain carrying treated wastewater from nearby STP. During the site visit, it was observed that flow of water has stopped due to the repair of the damaged drain, and the site has been filled with soil and is being used for Agriculture. The likely impacts of the project on KBA are noise, vibration, dust emissions, waste disposal, potential soil and water contamination from leaks or spills from fuel storage, material storage, hunting of birds, light pollution during nights etc. The bird's resting area is 308 m away from the alignment as such no noise and vibration impact are anticipated. To protect the KBA, mitigation measures proposed include are restrictions on material storage including fuel storage & proper planning for usage on construction machinery, erosion control measures, prohibition on hunting, regular monitoring, sanitation facilities for workers, and proper waste & Wastewater management practices. Conduct an Integrated Biodiversity Assessment (with critical habitat assessment) to prepare a biodiversity management plan and bird friendly design guidelines for implementation.. By implementing these measures will reduce the project impact on KBA/IBA in Sector 101, Basai.

Basai Pond: The alignment passes near the pond. No avifauna was observed during the baseline study. Basai Pond is primarily used by local residents for cattle bathing. To mitigate impacts on the pond, a ramp will be constructed prior to pillar and viaduct works in the pond area, serving as a barricade against project activities.. The likely impacts of the construction activities on the pond are as follows and will be mitigated as per the ESMP.

- Temporary deterioration of water quality
- Increased turbidity and reduction in pond area
- Disruption of natural drainage patterns
- Temporary restriction of cattle access to one side of the pond
- Soil erosion due to excavation, especially during the monsoon
- Potential fuel spills and disposal of construction waste
- Utility bursts (e.g., sewer or drainage lines) near the alignment, causing accidental discharge into the pond

During the operation phase, measures should be implemented to prevent the disposal of effluent, treated wastewater, and solid waste into the pond.

Sultanpur National Park: Approximately 8.2 km from the alignment and outside the 5 km Eco-Sensitive Zone; no impact is anticipated on national park due to the project.

Najafgarh Jheel is located approximately 4.7 km from the alignment, and no anticipated impact due to the project. Further, the Aravalli Range lies around 3 km from the alignment, and no impact is expected since the alignment does not pass through the range.

Significant height barriers such as Elevated Dwarka Exp, Rail Over Bridge, High Rise Buildings and HTL already exists near the GMRP alignment. Moreover, Gurugram-Rewari Railway line is located near the area.

The GMRP will not impact the flying path of the birds as the traction system proposed is third rail system, being ground-based, it maintains open airspace and helps preserve natural flight

paths, reduces the risk of electrocution and collision. Thus, there will be no impact anticipated on flying path of avifauna due to GMRP corridor.

Pigeons in metro networks pose significant challenges and risks such as health hazards from droppings, safety dangers from falling eggs and debris, operational disruptions and increased maintenance burdens affecting hygiene and passenger safety. Mitigations measures proposed in ESMP like changes in structural design, netting & barriers, deterrents, regular cleaning etc need to be implemented for handling pigeons' issues at metro stations.

### **Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities (ESS7)**

The GMRP is located in Gurugram District, which does not fall under Schedule V area of the Indian Constitution Furthermore, the affected population does not meet the four key characteristics required to trigger the provisions of ESS 7.

### **Cultural Heritage (ESS 8)**

The presence of physical/cultural heritage in project area cannot be ruled out as the city has protected monuments, temples, churches. The project will avoid impacts on protected monuments and in line with national regulations.

One temple will be impacted due to the GMRP; which necessitate its reconstruction with community involvement. One archaeological site namely "Mosque of Ala Vardi Khan", which is 490 meters from the GMRP is well beyond the prohibited and regulated zones of the monument. INTACH-listed structures, along the alignment include temples, mosques and a church, lie outside the critical impact zone of 100 meters and are safe from project effects. Chance finds of archaeological significance may occur during construction, managed under the Indian Treasure Trove Act, 1878, involving notification to the Collector and potential government acquisition. Procedures for handling chance finds is prepared as part of ESIA. All impacts and mitigation measures aim to preserve cultural heritage and comply with legal requirements.

### **Stakeholder Engagement and Information Disclosure (ESS 10)**

The Project undertook a preliminary stakeholder analysis of potential stakeholders. These involve a) PAPs including landholders, non-titleholders, and street vendors particularly at certain station locations, b) other interested parties, such as local communities, interest groups of Basai Pond and KBA/IBA in Sector 101, Basai and key institutional stakeholders with whom the project will interact with in relation to land acquisition or during construction. These include agencies/departments such as Municipal corporations, national highways, religious entities, educational institutions, that fall en-route etc. and for the support activities, and c) Disadvantaged and vulnerable groups such as those physically challenged/differently able and other vulnerable groups/households who might be impacted in varying degrees.

Consultations have been carried out with PAPs, other interested parties, and disadvantaged & vulnerable groups and their issues and suggestions are incorporated in the ESIA.

**Cumulative Impacts:** The cumulative E&S impacts of the GMRP are expected to be short-term, localized, and largely reversible, primarily occurring during the construction phase. These include temporary increases in dust, noise, and traffic congestion, which can be effectively mitigated through the strict implementation of the ESMP, including dust suppression, noise barriers, traffic management, and environmental monitoring. Importantly, the project is expected to deliver substantial long-term benefits, including a reduction in GHG emissions by encouraging a shift from private vehicles to cleaner, energy-efficient metro services which will subsequently have positive impact on the air quality of NCR. It will also improve urban mobility, enhance accessibility across key city zones, and support the broader goals of sustainable and environmentally responsible urban development.

Gurugram Metropolitan Development Authority (GMDA) coordinates all infrastructure projects in Gurugram District and performs the role of Unified Metropolitan Transport Authority (UMTA) for the district's infrastructure development. GMRP partners include GMRL, Municipal Corporation of Gurugram and GMDA, who jointly own the project.

Government of Haryana established a High-Power Committee to fast-track the GMRP. The Chief Secretary of Haryana holds quarterly meetings to review the GMRP progress. All concerned authorities attend these meetings and work together to resolve project bottlenecks.

GMRL officials actively collaborate with all involved agencies. They regularly hold meetings, document minutes of meetings (MoMs) and organize follow-ups to ensure successful project completion.

## 8. Environmental and Social Management Plan (ESMP)

ESMP for the design/ pre-construction, construction and operation stages of the project has been developed based on the assessment conducted. It presents the management of E&S impacts adopting mitigation hierarchy: (a) Anticipate and avoid risks and impacts; (b) Where avoidance is not possible, minimize or reduce risks and impacts to acceptable levels; (c) Once risks and impacts have been minimized or reduced, mitigate; and (d) Where significant residual impacts remain, compensate for or offset them, were technically and financially feasible. ESMP will be incorporated in the bid documents so that the contractor allocates the required resources and mechanisms to implement these measures. The ESMP for the GMRP is structured into four key phases:

**Design Phase:** The DDC focuses on minimizing visual and environmental impacts through aesthetic design and avoidance of structures in important areas, flood control, green building practices, and inclusivity features for all user groups. Energy and water efficiency, natural disaster safety, traffic management, and stakeholder engagement are prioritized.

**Pre-Construction Phase:** The contractor is responsible for developing and implementing various plans, including Environment, Health & Safety (EHS), Occupational Health and Safety Management Plan (OHSMP), community health and waste management and Noise, vibration, dust reduction; environmental management of area near sensitive features. Pre-construction tasks include detailed geotechnical investigations, compensatory afforestation for affected trees, and continuous monitoring. Engagement with affected communities and stakeholders is essential.

**Construction Phase:** Utility services must be safeguarded, and workers provided with appropriate safety gear. Mandatory training on GBV and SEA/SH risks will be conducted. The contractor is required to implement strict safety protocols, including dust control, noise suppression, and efficient waste management. A traffic management plan, environmental monitoring, and emergency preparedness measures will be strictly enforced.

**Operation Phase:** Regular maintenance, effective noise control, and proper waste management practices are essential. Also, energy-efficient lighting, emergency response systems, and security measures will be implemented to enhance safety and sustainability. Environmental monitoring will be conducted at all stations and depots, with a focus on noise, vibration, and waste impacts. An Incident Management Plan, Emergency Response Plan for Construction and O&M and a grievance mechanism will ensure ongoing safety and compliance. GBV awareness and traffic management support will continue during operation.

## **9. Environmental and Social Monitoring Plan**

During the construction phase, E&S monitoring will be carried out to check the quality of the environment and triggering of social impacts during ongoing construction activities. It will be carried out through a contractor and GMRL will be responsible for the review of the implementation of monitoring. Monitoring will include assessment of Ambient air quality, water and treated wastewater quality, Ambient noise, Ground water quality, soil quality, vibration and ecology. This monitoring shall also include OHS aspects, community safety, and workers safety, labour and working conditions, livelihoods impact, consultations as part of Construction Supervision and Quality Control by the General Consultant (GC).

During the operation phase, environmental monitoring will be conducted to understand the impacts on environmental attributes due to project activities. It will be carried out through the contractor and GMRL will be responsible for the review of implementation. Monitoring will include Ambient air quality, outlet treated water quality, Ambient noise, Ground & Surface water quality, Soil quality, Wastewater quality, Solid waste, vibration and ecology monitoring.

To ensure adherence to the ESMP, an independent E&S monitoring agency shall be appointed during construction and operation phase. This agency shall concurrently monitor Health and safety (OHS, CHS) aspects throughout the Project and ensure corrective actions at the earliest. Mid-term and End-term evaluations of implementation of ESMP and RAP shall be carried out.

## **10. Capacity Building**

Capacity building will be required at all stages including planning, construction, and operation. It will include various workshops and seminars for GMRL project staff, Contractors staff, supervisors, consultants, E&S and OHS experts, labourers, stakeholders, etc. The topics for training will include Health and Safety, Environmental management and ESMP implementation, regulatory requirements, Monitoring requirements, Gender equality, biodiversity and wildlife awareness, and others.

## 11. Implementation Arrangements

The implementation arrangement for GMRL consists of the GC, Contractor and the Environmental and Social Management Unit (ESMU) consist of Environmental Health & Safety Expert and Social cum R&R cum Gender Expert, supported by Patwari in GMRL. In addition, GC will have a Senior Env., Social Safeguard Expert and Chief Safety Expert supported by OHS Expert.

The ESMU is responsible for overseeing the ESMP and the Environmental Monitoring Plan (EMoP). Contractors will submit monthly, quarterly, and annual environmental compliance reports to the GC, which reviews and forwards them to the GMRL. The contractor must also maintain photographic documentation of key construction activities.

## 12. Grievance Mechanism (GM):

The types of grievances stakeholders may raise include, but are not limited to:

- Construction related impacts: cracks, damages to structures; dust damaging crops/trees
- H&S risks.
- Negative impacts on the environment and biodiversity
- Negative impacts on communities, which may include, but not be limited to financial loss, physical harm, and nuisance from construction or operational activities and GBV, SEA/SH.

The project related grievances will be segregated from the main grievances, through unique coding options, so that it can be tracked and reported effectively. Separate modes of grievance registration at project sites will be designed and awareness building activities and appropriate signages will be promoted.

The GM will have two Grievance Committees for redressing E&S matters. Grievances can be submitted through various platforms including a dedicated telephone line, email, letters, grievance or suggestion boxes, online form on the GMRL website. GMRL is in the process of developing dedicated grievance channels which will be incorporated into the E&S documentation upon finalization. All complaints will be categorized under Land, Environmental Issues, Social Issues, Occupational Health and Safety Issues, Contractor Issues, Project Execution. Each grievance will be acknowledged within two days and resolved within 30 working days following a thorough investigation by the Grievance Committee. When grievances (excluding those related to compensation) are brought to the Grievance Committee, they shall be resolved within 30 days of receipt. Grievances related to compensation may take more time; however, GMRL will strive to resolve them within three months of receipt. If complainants remain dissatisfied with the resolution at either level, they may seek legal recourse at any stage of the project.

## 13. Estimated Budget for Implementation and supervision of ESMP

The total project cost will cover design, construction, and operation of the ESIA. The budget includes compensatory afforestation, environmental monitoring, establishment of environmental division, training, rainwater harvesting, Effluent Treatment Plant, Noise

barriers, bio-digesters, etc. The total residual cost of ESMP implementation during design/pre-construction (6 months to 1 year), construction (4 years) and operations stages (3 years) is INR 2418.92 Lakh (INR 241.89 million, USD 2.89 million). Annual cost of INR 136.50 lakh (INR 13.65 million, USD 163,458) every year during operation phase.

#### **14. Aspects for inclusion in Environmental and Social Commitment Plan (ESCP)**

The disclosure and consultation of this ESIA, inclusion of the ESMP are part of procurement documents for agreement from the contractor on E&S requirements, and updation of ESIA and ESMP for the project after finalizing the detailed design shall be included in ESCP.

Design should be responsive to the ESF and measures shall be incorporated to meet the suggested standards. Bidding documents and contracts to include ESMP and Monitoring Plan to enable the contractor to allocate appropriate time, resources (manpower and budget) for implementing ESMP, update as required, get approvals, disclose and implement the ESMP for Proposed GMRP. For tenders that had been invited for construction of Viaduct and 14 Elevated Stations from Millennium City Centre to Sector 9 and Spur to Dwarka Expressway and ramp to Depot at Sector 33, funded by GMRL, corresponding measurement will be taken should any gap has been identified in the ESMP for this contract.

A comprehensive assessment should be made to assess flooding risks, vibration effects, and visual impacts; additionally, the biodiversity of the KBA/IBA in Sector 101, Basai, will also be re-examined during rainy season. These studies will incorporate resilient designs and infrastructure essential for the project. In addition, GMRL shall have adequate capacity to implement and monitor the project E&S requirements, ESMP, Monitoring Plan, Capacity Building requirements and ESCP.

Monitor all emissions/discharges/ disposal of wastes (including sludge, slurry) from project facilities during construction and operation stages and ensure that the discharges from project facilities into the environment are as per the latest limits suggested by MoEF&CC, HPCB, WB EHS and National Green Tribunal whichever is stringent for each parameter. Prepare Disaster Management Plan (DMP) including Standard Operating Procedures for natural disasters and project-specific emergencies (as part of DPR, ESIA). Operations should also follow the latest DMP for Haryana.

The ESIA for GMRP has been prepared for 29.05 km and 27 stations. The first civil works packages for approximately 15.5 km of the corridor have been tendered by GMRL with their own funding. The final scope of financing from other sources including Multilateral Development Banks (MDBs) is still under discussion. As such, the ESIA, the ESIA Summary and the ESCP may be updated, as needed, based on further assessment, including determination of associated facilities and E&S Risk management in line with ESS1. Likewise, a RAP has been prepared for the entire corridor and applies to all PAPs identified in the corridor and at stations locations including those affected by associated facilities. The RAP will be updated to cover any PAPs who might be identified during implementation.

#### **15. Recommendations and the Way Forward**

Stakeholder consultation is a dynamic process. Consultations were carried out for the preparation of the draft ESIA report. Consultations have been carried out with various

stakeholders including PAPs, other interested parties and disadvantaged and vulnerable groups during the preparation of ESIA for project. Consultations will be carried out during the life cycle of the GMRP. Draft and Final ESIA, ESMPs (in English, with translated summary of ESIA in Hindi) will be disclosed on the website of the implementing agency, namely GMRL, and on the funding agency website. Consultations will also be carried out after a month of disclosure of ESIA and ESMP on the website of GMRL. The suggestions of the stakeholders will be incorporated, and the final version of the documents will be re-disclosed again on GMRL website and the World Bank.

## Chapter 1: Introduction

### 1.1 Background

Gurugram city is known as the "Millennium City" due to its remarkable shift from an agricultural region to a major financial and industrial hub in India. This transformation has seen the rise of multinational corporations, IT firms, business centres, and towering skyscrapers, making Gurugram a significant driver of India's economy. The city's rapid growth can be attributed to extensive urbanization and robust economic development owing to its strategic location proximal to New Delhi and its airport, in the National Capital Region.

Gurugram has been improving its transportation infrastructure, but with urban mobility needs evolving, there's a demand for an efficient Mass Rapid Transit System (MRTS). GMRL intends to utilize financial support from the World Bank for the Sustainable Multimodal and Resilient Transport for Haryana (SMART-H, PHASE 1). The initial phase focuses on enhancing urban public transport in major cities, beginning with the GMRP, which will connect Millennium City Centre station to Cyber City station<sup>8</sup>.

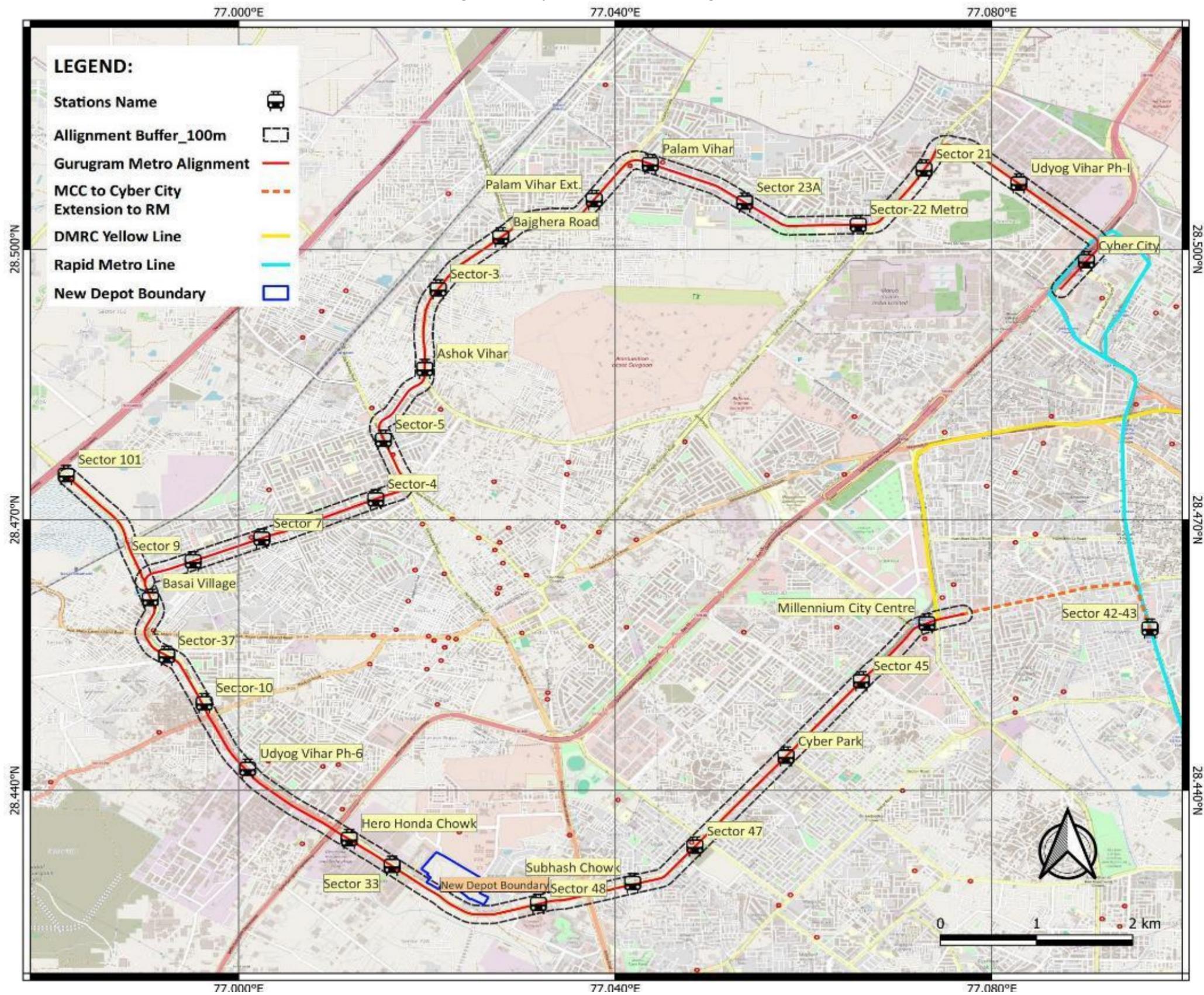
### 1.2 Study Area

The study area for this ESIA is 100 meters on both sides of the GMRP alignment, which starts from Millennium City Centre and joins Rapid Metro at Cyber City. The alignment is shown in **Figure 1-1**.

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<sup>8</sup> GMRL entrusted RITES Limited for conducting the ESIA study for the Metro Connectivity from Millennium City Centre (formerly HUDA City Centre) to Cyber City, Gurugram, in August 2023. The ESIA report is prepared based on the design finalised by the Detailed Design Consultant for Priority Section 1 (from Ch. -593 to Ch. 12603, including Spur to Dwarka Expressway) and the Detailed Project Report (DPR) design for Priority Section 2 (from Ch. 12604 to 26650/26637), covering the project alignment, station locations and entry/exits points. The ESIA will be reviewed and updated, if necessary, after the finalization of the project design by the DDC to reflect any changes, before undertaking any works or activities on sites.

Figure 1-1 Proposed Metro Corridor Alignment



### 1.3 Objective of the Study

The study envisages assessing the magnitude and sensitivity of direct, indirect and cumulative impact on the environment, cultural and socio-economic characteristics in the area of influence due to development of metro rail and its associated facilities, in accordance with pertinent policies and applicable legal and regulatory framework of the Government of India (GoI), Government of Haryana (GoH) and the WB's ESF. The specific objectives of ESIA Study are:

- To identify and assess E&S risks and impacts, considering all relevant direct, indirect, and cumulative E&S risks and impacts of the subproject and its associated facilities.
- To assess applicability and relevance of various legal and regulatory provisions in construction of GMRP and relevance of ESS as per ESF of the WB.
- To consult with and assess stakeholder's perceptions of diverse set of stakeholders particularly those impacted (including those disadvantaged and vulnerable) and others in the vicinity of the corridor and elicit their concerns suggestions for incorporation in the final design as necessary
- To assess current institutional arrangements for implementation, monitoring and grievance redressal and assess capacity constraints, if any and propose institutional responsibilities to implement the ESMP and Monitoring Plan and the budget required for the same
- To provide inputs to devise comprehensive and commensurate plans such as ESMP and RAP to address the identified risks and impacts.
- To identify risks related to GBV hotspots and SEA following WB's Good Practice Note (GPN) on SEA/SH.

**Note:** Metro project does not fall under any schedules of the Environmental Impact Assessment as per the (EIA) notification of Ministry of Environment, Forest, and Climate Change (MoEF&CC), hence Environmental Clearance for this project is not required. However, construction of building for commercial purposes (shopping complex, offices etc) having built area equal to or more than 20,000 sqm. (if so for depots, station area development etc) shall require prior EC from State Environment Impact Assessment Authority (SEIAA).

### 1.4 Approach of the Study

The ESIA study approach has been focused to meet the objectives within the agreed scope, and timeframe while maintaining professional quality and meeting the client's expectations. The approach has been collaborative and coherent to complete the project within the time limit. RITES study team has maintained regular communications with all project stakeholders including key stakeholders and other community groups. The general approach is based on:

- A clear understanding of the project's wider objectives and the scope of work;
- The study has been conducted in accordance with the policies, laws, government orders, and guidelines of the GoI and the GoH;
- Studying the WB ESF policy and ESSs;
- The WB GPN on SEA & SH and also the WB GPN on Assessing and Managing the Risks of Adverse Impacts on Communities from Project-Related Labor Influx;

- Formulation of an appropriate work plan based on understanding of the important issues and likely time requirements;
- Mobilisation of suitable team of experts;
- Coordination with GMRL officials to ensure that matters are discussed openly and resolved quickly;
- Use of effective project management and coordination systems.

## 1.5 Methodology

Based on understanding of the objectives and the detailed Terms of Reference (ToR) for the project, an appropriate methodology that addresses the specific requirements of the project has been proposed and followed.

### 1.5.1 Area of Influence (AOI)

Impacts were assessed both within area of impact of 100 meter either side of the alignment and project's area of influence up to 10 km. This area of influence encompasses project associated facilities, construction camps, labour camps, access roads, material sourcing areas etc.

A 100% census and socio-economic survey have been done for all affected structures & families residing within the Right of Way (RoW) of the corridor; and station building, entry/exit of stations. The RoW requirements are as follows:

- Alignment/Viaduct: 16 m (i.e., 8 m on either side from the centreline of the alignment/viaduct, including 3m for working space).
- Stations: 3m from the outer periphery of the stations.
- Entry/Exit Points: 3m from the outer periphery of the entry/exits.
- Depot: Up to the outer boundary of the depot area.

### 1.5.2 Environmental and Social Impact Assessment

The standard methodology for the data collection, impact assessment and formulation of mitigation plans has been adopted to carryout ESIA.

#### A. Literature Review

RITES team has collected and reviewed all existing policies, legislative frameworks, alignment drawings & station layout, reports, data, and documents from GMRL related to the project. Study team has also reviewed the ESF & all relevant GPN of WB.

#### B. Site Reconnaissance

The RITES survey team has conducted field visits for alignment, station, entry/exit locations of the proposed project and has identified the facilities/infrastructure which are categorized as associated facilities. During site visits, the team has verified the available project drawings on ground and consulted with various stakeholders to create awareness about the project. Accordingly, all features falling along the alignment & station are identified for E&S assessment. The team has identified the baseline monitoring locations for air, water, soil, noise and vibration. The survey team has visited the potentially affected E&S sensitive receptors, property/community structures indicating their nature and types, viz. household

structure, commercial and social structure, religious structure, office and educational, hospital, infrastructure, agricultural farms, ponds, parks and trees etc. during the field visit. The field visit has helped in identifying the AOI with due consideration of the E&S settings and helped to develop the survey & consultation questionnaires for social survey.

### **C. Data Collection**

E&S baseline data is collected from primary and secondary sources. Emphasis is given on collection of the data from primary sources; however secondary data is also collected wherever required. The secondary sources include the documents from various government and non-government organizations, DPR and other project documents/reports etc. Baseline data for following aspects is documented:

- ❖ Physical Environment: Land, Water, Meteorology, Air, Noise, Vibration, and Sensitive Receptors
- ❖ Biological Environment: Biodiversity (Flora/ Fauna including migratory species), Habitat Study, Forests, Protected Areas and other natural Habitats
- ❖ Socio-Cultural Environment: Demography, Socio-economic Status, and Cultural aspects

Information on physiography, geological features and seismicity of the project area, physical and chemical characteristics of soil, water quality, ambient air quality, meteorological (temperature, relative humidity, wind rose, rainfall), noise and vibration data are collected. Primary data is collected for air, noise, vibration, water and soil quality of the area of influence during non-monsoon season and the monitoring results are compared with applicable standards.

Identification of the Valued Environmental Components (VECs) and social issues associated with the project and identification of environmental hotspots like urban forest, river, surface drainage, key biodiversity areas, archaeological/ historical/ religious structures in and around the project area has been conducted.

Information on flora and fauna, including critically endangered, threatened, near threatened, and vulnerable species, as well as sensitive habitats such as biodiversity areas, urban forests, and national parks, etc. has been studied through visual inspection and review of secondary data within the study area.

Socio-economic aspects in the project area were assessed using a range of indicators, including gender-disaggregated population data, social composition, educational levels, employment and income patterns, public health status and the use of common property resources.

The data was collected through a baseline survey comprising a household census and socio-economic survey of PAFs. Public consultations were also conducted to gain qualitative insights and understand community perspectives. Additionally, secondary data from official sources such as government publications and district statistical handbooks were reviewed.

**D. Public Consultation**

Stakeholder mapping was carried out to assess the relative influence of various individuals and groups on the project, as well as the project's impact on them. This process enabled the identification of stakeholder groups, the nature of their interests, and group-specific concerns and potential risks. The stakeholders consulted included affected parties (both titleholders and non-titleholders), other interested groups (such as RWA members, the public, street vendors, police officials, and women transport and metro users), and disadvantaged/vulnerable individuals or groups (including women, elderly people, and informal settlers).

Observations recorded during these consultations have been used as input for gap analysis in existing practices and contributed to development of the ESIA, RAP, LMP and SEP. The SEP provides detailed information on stakeholder groups and outlines engagement strategies, specifying methods of engagement based on the type of stakeholders including PAPs, vulnerable groups and other interested parties.

**E. Impact Assessment**

Based on the project particulars and the existing E&S conditions, all potential impacts arising from the GRMP have been identified and, wherever feasible, quantified. The assessment covered significant positive and negative impacts, including direct and indirect, immediate and long-term, cumulative, and unavoidable or irreversible impacts.

The magnitude of adverse impacts was also evaluated, and appropriate safeguard instruments were identified in accordance with the principles outlined in the WB' ESF, as well as applicable laws and regulations of the GoI and the GoH. Additionally, the key project benefits have been quantified in monetary terms, and a summary chart has been prepared to outline the positive and negative impacts associated with the project's location, design, and operational phases.

**F. Analysis of Alternatives**

The examination of project alternatives included a detailed assessment of site options, outlining the rationale for site selection and providing a comparative analysis of the alternatives considered, rejected, or selected based on merit. The evaluation considered site suitability with respect to E&S risks and impacts. Furthermore, both 'With Project' and 'Without Project' scenarios were analysed to understand the potential implications of project implementation versus non-implementation.

**G. Mitigation Measures**

A set of mitigation measures has been proposed to reduce negative E&S risks and impacts through:

- Modifications in design, construction practices, maintenance, and operation to avoid or minimise adverse risks and impacts.
- Additional actions to be adopted to protect the biophysical and social environment, as well as individuals directly affected by the project.

The nature, extent, and timing of these mitigation measures are aligned with the significance of the predicted impacts. Feasible and cost-effective mitigation strategies have been

identified to reduce adverse effects to acceptable levels. The responsibilities of the implementing agency, along with the timelines for implementation, have been clearly outlined. Relevant drawings and technical specifications necessary for executing the proposed mitigation measures are also included.

### **1.5.3 Environmental and Social Management Plan (ESMP)**

The ESMP for the project has been developed to address all identified risks & impacts and corresponding measures for the entire project lifecycle from design to operation.

This includes specific actions such as compensatory afforestation, provisions of infrastructure facilities in labour camps, waste management, measures for worker and community safety, etc. Cost estimates for each of the proposed mitigation measures have been incorporated into the report. Environmental monitoring during both construction and operational phases is essential, and the frequency of such monitoring has been specified along with the estimated costs and the required organizational structure for implementation. Additionally, the institutional arrangements have been identified for the effective implementation of the ESMPs.

A separate RAP has been prepared, which outlines: (a) the socio-economic profile of the affected settlements; (b) the type and extent of loss of assets including land and structures; (c) principles and legal framework applicable for mitigation of these losses; (d) the entitlement matrix; (e) income and livelihood restoration program; (f) relocation and resettlement budget; (g) the institutional framework for implementation of the plan, including monitoring and evaluation mechanisms.

A detailed list of individuals and organizations involved in the ESIA is provided in **Annexure 1.1**.

## Chapter 2: Policy, Legal and Institutional Requirements

This chapter delineates the legal and regulatory requirements pertaining to E&S considerations. It outlines the permits and licenses required at various stages of the project, in accordance with applicable International, National and State level laws and regulations. Additionally, it highlights the applicability and relevance of ESSs to the project.

### 2.1 Applicable Regulations at International, National and State Level

Several key regulations are applicable to the GMRP to ensure compliance with environmental protection, social welfare and safety standards. These include the Environment (Protection) Act, 1986 (as amended in 1991), the Environment (Protection) Rules, 1986 and the Forest (Conservation) Act, 1980. Additionally, the guidelines for Noise and Vibrations issued by the Research Designs and Standards Organisation (RDSO), Ministry of Railways, in September 2015, are relevant for mitigating environmental impacts associated with the MRTS.

Social aspects are governed by legislation such as the RFCTLARR Act, 2013, and the Building and Other Construction Workers Act (BOCWA), 1996.

Furthermore, compliance with various standards and rules is essential to ensure environmental sustainability, workers safety and social responsibility throughout the project lifecycle. These include regulations related to noise and vibration control, plastic waste, e-waste, battery waste, solid waste management, and labour laws.

The important acts, rules and notifications issued by the GoI the GoH and relevant International Conventions applicable to E&S aspects of the project are presented in **Annexure 2.1**. The applicability of the WB ESS to the project is provided in **Annexure 2.2**.

### 2.2 Key Statutory Clearances

From the perspective of a metro project, several key clearances, authorizations, and permits are required to ensure legal compliance, environmental protection, and operational safety. These include approvals such as Tree Cutting Permission under the Forest (Conservation) Act, 1980, from the State Forest Department or Municipal Corporation, as well as and Consent to Establish and Consent to Operate for facilities such as depots, workshops, and other infrastructure.

The project is also required to comply with regulations pertaining to environmental clearances, forest clearance, land use change, and the proper management and disposal of various waste types, including construction debris, hazardous waste, e-waste and plastic waste. Permits are required for the extraction of construction materials such as stone, aggregates, sand and earth from approved quarries, and establishment of construction-related facilities like batching plants, casting yards and material storage areas.

Labour related approvals including employment licenses and fire & electrical safety certifications are equally critical to ensure smooth project execution and adherence to statutory requirements.

A comprehensive table outlining the required clearances and authorizations under applicable Acts, Rules and Notifications along with the responsible authorities, applicable procedures, and their relevance to the project is provided in **Annexure 2.3**.

### 2.3 Gap Analysis

To ensure compliance with the WB's ESF requirements, the project has adopted specific measures to address gaps between GoI legislation and the WB's ESS. The identified gaps, along with recommended corrective measures, are briefly outlined below and presented in **Annexure 2.5**.

Although metro projects are exempted from the requirement of Environmental Clearance (EC) under national law, the project has undertaken an ESIA and prepared ESMP in line ESS1. In addition, a Labour Management Procedure (LMP) has been developed to fill existing gaps in national and state frameworks. The LMP includes provisions for occupational health and safety (OHS), establishment of worker-specific grievance mechanisms (GM), prevention of gender-based violence (GBV), and implementation of a Code of Conduct (CoC) applicable to all categories of workers. Recognizing the absence of a comprehensive national framework on resource efficiency, the project has also adopted international principles to promote the efficient use of water, energy, and other natural resources, as detailed in the ESMP.

The ESMP further outlines a set of community health and safety measures, including a Community Health and Safety Plan, Traffic Management Plan, and Labour Influx Management Plan, addressing critical issues not comprehensively covered by existing legislation. The RFTLARR Act considers depreciation in the valuation of structures and does not recognize non-titleholders as PAPs. These gaps have been addressed by adopting provisions for compensation at full replacement cost excluding depreciation and by including non-titleholders in the project's entitlement matrix. Biodiversity impacts beyond protected areas are also addressed through specific actions included in the ESMP to ensure environmental safeguards are upheld.

The provisions related to Indigenous Peoples are not applicable, as the project area does not fall under the Scheduled V area, and the affected population does not meet the relevant criteria. Additionally, a Chance Find Procedure has been integrated into the ESMP to manage any potential impacts on culturally significant, though unprotected, religious or social structures. Stakeholder Engagement Plan (SEP) has also been prepared, incorporating a dedicated GM and ensuring proactive disclosure of project-related information to promote transparency and meaningful stakeholder participation throughout the project lifecycle.

## Chapter 3: Project Description

### 3.1 Metro Corridor

#### 3.1.1 Alignment

The GMRP corridor is 30.85 km in length and has 28 elevated stations. The primary corridor, spanning 27.20 km is from Millennium City Centre to Cyber City, includes 26 stations. A spur of 1.85 km is proposed to connect Dwarka Expressway from Basai Village with a single station. A new spur of 1.85 km with one station from Sector 5 to integrate city metro with Gurugram Railway Station; and this alignment is yet to be finalised & is not part of this ESIA Study. The ESIA study has been carried out for main corridor and spur line. The alignment details are provided in the **Table 3-1**.

**Table 3-1 Salient Features of the Corridor**

S. No.	Route	Length in Kms	No. of Stations
1	Millennium City Centre to Cyber City	27.20	26
2	Spur from Basai Village to Dwarka Expressway	1.85	1
3	New Spur to Railway Station	1.80	1
<b>Total</b>		<b>30.85</b>	<b>28</b>

#### 3.1.2 Spur Line from Basai Village to Dwarka Expressway (Sector 101)

The purpose of the proposed spur is to connect GMRP with Dwarka Expressway. It begins just after the Basai Village station and terminates at Dwarka Expressway (Sector 101). The spur is fully elevated and has a total length of about 1.85 km.

#### 3.1.3 Stations

The GMRP has been planned to serve major passenger catchment areas/destinations and to enable convenient integration with other modes of transport. Stations vary in complexity along the route and have been located by an interactive process influenced by ridership forecasts, interchange requirements with other modes of transport, station spacing, alignment, utilities, road, pedestrian requirements, etc. There are 28 elevated stations proposed in GMRP. The details of metro stations are provided in **Annexure 3.1**.

The station's design depends on the peak hour traffic load for each station. As per the DPR, the horizon year for the study is taken as 2041, where a maximum Peak Hour Peak Direction Trip (PHPDT) is 34,309. The platform length is planned with a capacity of 6 cars/train. The total evacuation time for the movement of all passengers in an emergency from platform level to the landing at the next level is considered as 5.5 minutes (as per National Building Code (NBC), 2016) considering that the stations are open and the risk is less. Three typical designs of stations (

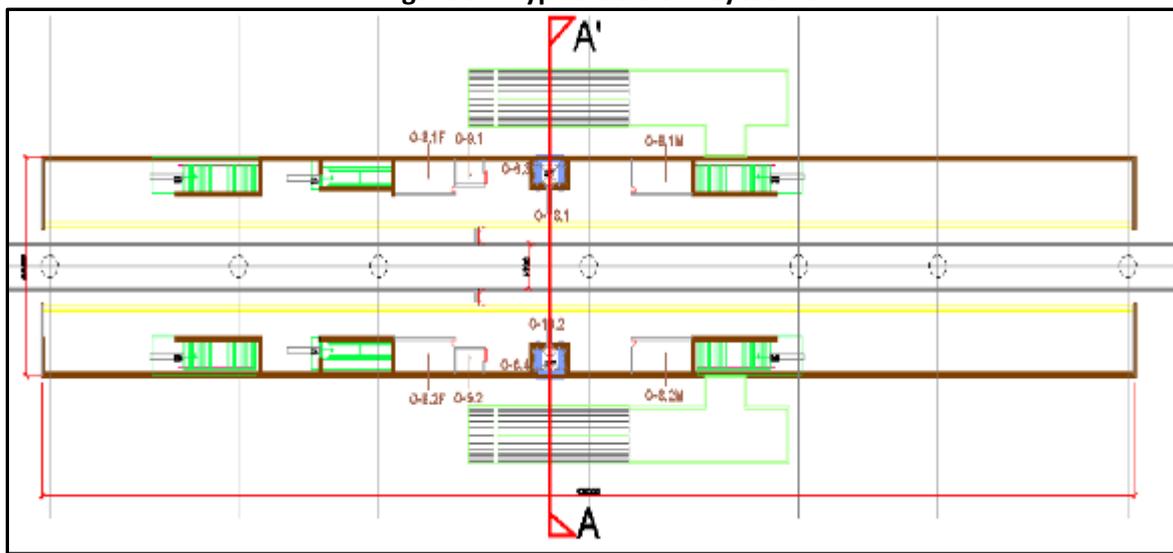
Table 3-2), have been proposed and will serve as the foundation for all station development. Typical stations layout is shown in **Figure 3-1**.

**Table 3-2 Typical Designs**

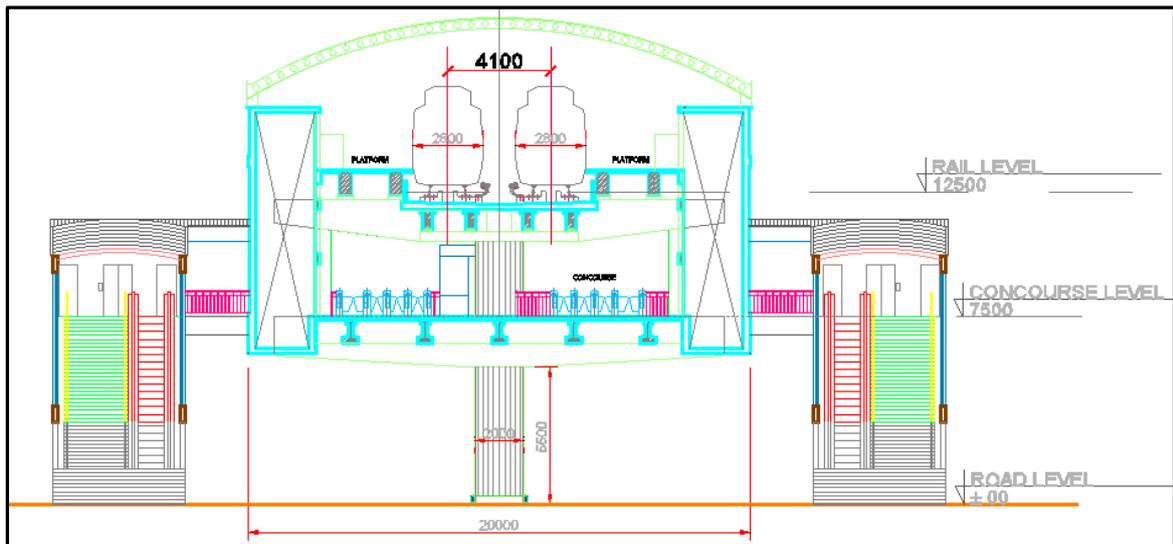
S. No.	Proposed Type	Dimensions
1	Type A (Typical Station)	130m x 20m
2	Type B (Cyber City)	130m x 28m
3	Type C (Millenium City Centre)	130m x 22m

Source: DPR, 2021

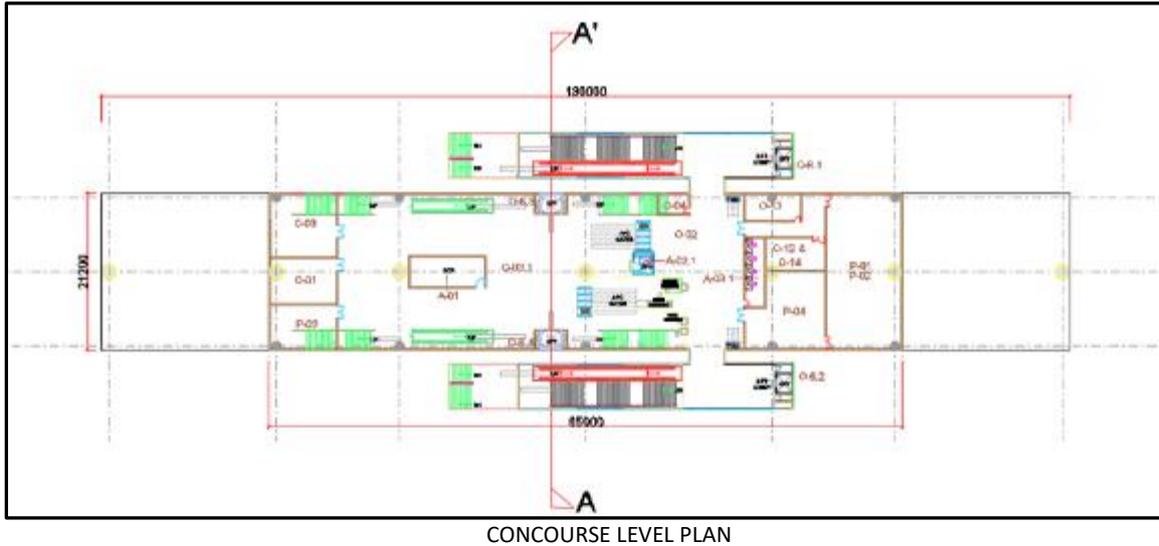
**Figure 3-1 Typical Station Layout Plan**



PLATFORM LEVEL PLAN



CROSS SECTION AA'



Source: DPR, 2021

### 3.1.4 Depot

As per the DPR, a stabling depot was initially planned at Sector 101, which is a part of the KBA/IBA in Sector 101, Basai, a low-lying area frequented by migratory birds. After evaluating all available alternatives, the depot location has been shifted to Sector 33. The proposed depot at Sector 33 will be developed with full/light/heavy repair facilities, stabling and inspection areas and associated support infrastructure. The area of the proposed Depot is 22.37 ha and the layout plan is shown in **Figure 3-2**.

**Figure 3-2 Proposed Depot Site Layout Plan**



Source: GMRL

### 3.1.5 Permanent Way

**Gauge:** GMRP will adopt a standard gauge of 1435 mm which permits sharper curves and is better suited for metro alignment in urban scenarios, resulting in less property demolition and acquisition.

**Formation:** A ballast less track system is proposed for elevated stretches and depot area to optimize maintenance requirements and minimize risks to road traffic. This will help in reducing fugitive dust emissions during operation.

### 3.1.6 Rolling Stock

The proposed rolling stock aims to improve energy efficiency and resource utilization. The broad features of rolling stock are presented in **Table 3-3**.

**Table 3-3 Broad Features of Rolling Stock**

S. No.	Parameters	Rolling Stock
1.	Basic Unit	3 Car basic unit 2 DMC and 1 TC
2.	Coach Dimensions	19.9m x 2.8m
3.	Train Composition	3 Car: DMC+TC+DMC 6 Car: DMC-TC-MC-MC-TC-DMC
4.	Train Capacity	3 car train: 757 @6p/m <sup>2</sup> , 978 @8p/m <sup>2</sup> 6 car train: 1576 @6p/m <sup>2</sup> , 2040 @8 p/m <sup>2</sup>
5.	Coach construction	Aluminium body
6.	Axle load	≤16 T
7.	Braking System	Regenerative Braking
8.	Propulsion system	3 phase drive system with VVVF control
9.	Type of traction supply	750 V DC Third Rail

Source: DPR, 2021

### 3.1.7 Signalling & Train Control System

A Communication Based Train Control (CBTC) system is proposed which is mainly used for MRTS networks. This system works on the moving or virtual block principle to reduce headways, increase transport capacity, provide adequate safety level and reduce demand on passenger evacuation systems.

### 3.1.8 Traction System

A 750 V DC third rail traction system is proposed for the GMRP corridor. Modern rolling stock with a 3-phase VVVF drive system has been proposed, which is the electricity driven MRTS. The metro cars will be equipped with 3 phase AC traction motors with regenerative braking system; by which the trains can 'generate' electricity when brakes are applied. Regenerative braking will be the main brake power of the train and will regain the maximum possible energy and pump it back to the system and thus fully utilize the advantage of 3-phase technology.

### 3.1.9 Power Requirements

The power requirements of a metro system are determined by peak-hour power demand for traction and auxiliary applications. The ultimate (design) power requirement for this corridor has been conceptualized considering various norms, directives, and guidelines. Accordingly, the estimated power demand for the GMRP corridor is provided in **Table 3-4**.

**Table 3-4 Power Demand Estimation (MVA)**

Year	2026	2031	2041
Traction	13.65	25.46	31.42
Auxiliary	8.87	10.27	11.67
<b>Total</b>	<b>22.52</b>	<b>35.73</b>	<b>43.09</b>

Source: DPR, 2021

#### 3.1.10 Substation

Gurugram City has 220kV and 66kV power transmission and distribution network that caters to various types of demand. As part of the GMRP, two Receiving Sub-Stations (RSS) are proposed to supply power for both traction and auxiliary services, These RSS will source power from the existing Grid Sub-Stations (GSS) of Haryana Vidyut Prasaran Nigam Limited (HVPNL). The GSS and RSS details are given in **Table 3-5**.

**Table 3-5 Sources of Power Supply**

Grid Sub-Station	RSS of Metro Authority	Approx. Dist. GSS to RSS
Sector 52 GSS (220/66 kV)	Sector-45 RSS (66/33 kV)	03 km
Daulatabad GSS (440/220/66 kV)	Krishna Chowk RSS (66/33 kV)	07 km

Source: DPR, 2021

#### 3.1.11 Ventilation and Air-Conditioning System

The air conditioning and ventilation requirements at the elevated stations of the GMRP are mainly for ancillary spaces such as staff room, equipment rooms, etc. These systems are essential to ensure a comfortable working environment for operations and maintenance personnel, to prolong the life of equipment through proper control of temperature, pressure and humidity, and to mitigate the possible risk of gas accumulation.

#### 3.1.12 Fare Collection System

An automatic fare collection system has been proposed, which enables ease of use/operation, issue of single/multiple journey tickets, amenability to quick fare changes and requires lesser manpower requirements and significantly improves passenger flow and egress at stations.

#### 3.1.13 Transport Demand Forecast

The projected trips between adjacent stations of the GMRP have been estimated for the years 2026, 2031, 2041 and 2051. The maximum PHPDT for the GMRP are given in

Table 3-6.

**Table 3-6 Maximum Peak Hour Section Loading on Study Corridor**

Corridor Details	Maximum PHPDT			
	2026	2031	2041	2051
Millenium City Centre to Cyber City and Spur	19359	27263	34309	43878

Source: DPR, 2021

**3.1.14 Ridership on Metro Corridor for Years 2026, 2031, 2041 & 2051**

The estimated daily ridership on the study corridor is projected to be 5.34 lakh passenger trips in 2026, 7.26 lakh in 2031, 8.81 lakh in 2041, and 10.70 lakh in 2051. The corresponding daily passenger boardings and trips for these years are presented in **Table 3-7**.

**Table 3-7 No. of Daily Ridership for the Study Corridor**

Corridor Details	Details	Horizons Year			
		2026	2031	2041	2051
Millenium City Centre – Cyber City and Spur	Daily Boarding	563175	772925	940286	1150076
	Daily Trips	534294	726098	881563	1070315

Source: DPR, 2021

**3.1.15 Land Requirement**

Land will be required for various key components of the project, including the viaduct, station buildings along with entry/exit points, traffic integration facilities and depots. Additionally, land shall be needed for receiving and traction substations, as well as for temporary land for construction yards.

GMRP corridor is fully elevated and planned on the median of the existing roads, thereby minimizing the private land requirement. The land requirements detail along with ownership information are described in **Table 3-8**.

**Table 3-8 Land Requirement**

Purpose	Permanent Land (Ha)	Temporary Land (Ha)	Ownership
Station/Viaduct	0.08	-	Central Government
Station/Viaduct	1.71	-	State Government
Maintenance Depot	21.73	-	
Construction Yards	-	5.00	
Station/Viaduct	0.68	-	Private
Maintenance Depot	0.64	0	
<b>Total</b>	<b>24.84</b>	<b>5.00</b>	

Source: GMRL

### 3.1.16 Solar Energy

A grid-connected solar photovoltaic (PV) power plant is proposed for the GMRP, utilizing all feasible areas such as rooftops of stations, sheds, and other buildings. Based on the solar radiation intensity in the city, the peak solar power generation is expected to be about 50 kWp for the elevated stations and about 500 kWp for the stabling depot. The solar energy harnessing system is proposed to be implemented under the Renewable Energy Service Company (RESCO) model, as adopted in various metro projects. A fixed tariff, as per the power purchase agreement shall be applicable for a duration of 20-25 years. This initiative is expected to result in significant energy cost savings and reduction in CO<sub>2</sub> emissions using renewable solar energy.

### 3.1.17 Structural Safety

The structural safety of an elevated metro system is of paramount importance to ensure the safety of passengers, staff and the public. The structural design of the metro system shall be undertaken by the DDC and will incorporate several critical safety considerations. These include vibration control, earthquake resistance, and other essential parameters that must be addressed during the design, construction, and maintenance phases of the elevated metro system.

## 3.2 Resource Requirements

### 3.2.1 Labour

The civil works for the GMRP is expected to be completed in a period of 5 years, during which manpower will be required for various construction related activities. In the post-construction phase, additional personnel will be employed for the operation and maintenance of the metro system, thereby generating substantial direct employment opportunities.

In addition to direct employment, the project is also expected to create significant indirect employment in allied sectors, such as the supply of essential goods, construction materials, metro cars/coaches and rolling stock. The project workforce will comprise direct workers, contracted workers and primary supply workers.

### 3.2.2 Construction Material Requirement

Major construction materials such as reinforcing bars, cement, steel sections, shuttering materials, precast segments, solar panels, etc will be primarily sourced from local suppliers.

### 3.2.3 Source of Construction Material

Construction materials such as aggregate and earth shall be sourced exclusively from licensed quarries, in strict compliance with material sourcing regulations, including those specific to the Aravalli region, to minimize E&S risks and impacts. No mining, quarrying, or excavation activities are permitted in the Aravalli Hill areas notified under the MoEF&CC Notification dated 07.05.1992, unless prior Environmental Clearance (EC) has been obtained from the competent authority.

### 3.2.4 Use of Water

The water required for construction activities will be sourced from treated water. Drinking water and raw water requirements for the elevated stations will be met through municipal sources, in coordination with the relevant local agencies.

### 3.3 Cost Estimate

Cost estimate for GMRP has been prepared in DPR covering civil, electrical, signalling and telecommunications works, rolling stock, etc. The estimated total cost including Taxes & Duties at Sept' 2021 price level is Rs. 5189.21 Cr (Rs. 51892.1 million).

### 3.4 Associated Facilities

Associated facilities refer to those facilities or activities that are not funded as part of the project but, in the judgement of the Bank, meet all of the following criteria:

- a. directly and significantly related to the project; and
- b. carried out, or planned to be carried out, contemporaneously with the project; and
- c. necessary for the project to be viable and would not have been constructed, expanded or conducted if the project did not exist.

Associated facility must meet all three criteria. Common associated facilities for a metro project are given below.

#### 1. Road Expansion Facilities

Any future road expansion by other agency to facilitate the access to metro stations or improving overall transportation connectivity in the project area may also be considered associated facilities.

All such future associated facility activities will be screened, and their E&S risks and impacts will be assessed in accordance with the WB's ESF principles. GMRL will update the ESIA at a later stage to incorporate the findings of these assessments.

## Chapter 4: Analysis of Alternatives

This chapter presents an analysis of alternatives undertaken to identify the most suitable option among various transport modes. The alignment design was developed after evaluating a range of alternatives during the planning phase, with the relative E&S benefits of the selected option assessed based on the following mitigation hierarchy:

- Anticipate and avoid risks and impacts;
- Minimize or reduce risks and impacts to acceptable levels, where avoidance is not possible;
- Once risks and impacts have been minimized or reduced, mitigate; and
- Wherever significant residual impacts remain, compensate or offset them, where technically and financially feasible.

The key aspect which is considered while selecting the metro alignment are optimization of the functionality, minimization of E&S risks & impacts, reduction in construction time, reduction in construction and operational costs and maximization of the overall economic return from the investment.

### 4.1 Assessment of Alternatives

While considering the best alternatives for the GMRP corridor, various parameters were considered, including:

- E&S Impacts due to project
- Cost benefits analysis
- Flexible and economic operation
- Land use and intermodal integration
- Meet the projected traffic demand
- Safe, fast and comfortable travel

#### 4.1.1 Conceptual Transport Alternatives as per Comprehensive Mobility Plan (CMP)

To meet the public transport demand in Gurugram city, both rail-based and road-based mass transit systems have been considered, as detailed in **Table 4-1**.

**Table 4-1 Different Types of Public Transport Modes**

System		Normal Bus System	Bus Rapid Transit (BRT)	Metro-Neo	Metrolite	Medium Metro Rail System	Heavy Metro Rail System
Exterior of Vehicle							
Description		Bus operation characterized by use of shared rights-of-way along the general traffic flows.	Bus operation characterized by use of reserved rights-of-way (bus ways) that permit higher speeds and avoidance of delays from traffic flows.	Electric coaches are driven on electricity provided by overhead wires.	Transport system runs on elevated or at grade track.	Most prevalent worldwide Mass Rail Transit System, runs on elevated/at-grade/underground	Heavy Metro similar to Medium Metro but with higher carrying capacity and thus higher axle load.
Gauge		Not Applicable	Not Applicable	Not Applicable	Standard Gauge (1435mm)	Standard Gauge (1435mm)	Broad Gauge (1676mm)
Superstructure		Roads	Roads	Roads/Concrete Slab	Concrete slab	Concrete slab	Concrete slab
Axle load (max)		6.0 to 10.0T	6.0 to 10.0T	10.0 T	12.0 T	16.0 T	17.0 T
Rolling stock	Length (m)	12m	12m	18 m (Articulated) 25 m (Bi-articulated)	33 m	20.0 – 22.60 m	22.60 – 25.0 m
	Width (m)	2.5m to 2.6m	2.5m to 2.6m	2.5m to 2.6m	2.65 m	2.80 – 2.90 m	3.20 m
	Height (m)	3.25 to 3.5m	3.25 to 3.5m	3.25 to 3.5m	3.90 m	3.90 m	3.90 – 4.20 m
Traction System		None	None	None/ Catenary	Catenary or 3 <sup>rd</sup> Rail	Catenary or 3 <sup>rd</sup> Rail	Catenary or 3 <sup>rd</sup> Rail
Maximum Speed		80 Kmph	80 Kmph	70 Kmph	60 Kmph	90 Kmph	100 Kmph
Average speed		10 - 15 Kmph	20 - 25 Kmph	25 Kmph	30 Kmph	35 Kmph	35 Kmph
Minimum curve radius		12 m	12 m	15 m	25 m	120 m	220 m

System		Normal Bus System	Bus Rapid Transit (BRT)	Metro-Neo	Metrolite	Medium Metro Rail System	Heavy Metro Rail System
Maximum gradient		10%	10%	6%	6%	4%	4%
Capacity		100 per coach	100 per coach	140 for 18 m coach 225 for 25 m coach	300 per coach	250 per coach	350 per coach
Max. PHPDT		Upto 3000	Upto 4000	Upto 8000	Upto 15,000	Upto 60,000	Upto 90,000
Environment Effect		Higher level of pollution compared to other modes	More polluting than rail-based systems	This type of system is more ecofriendly due to the operation of the system on electricity.	This type of system is more ecofriendly due to the operation of the system on electricity.	This type of system is more ecofriendly due to the operation of the system on electricity.	This type of system is more ecofriendly due to the operation of the system on electricity.
Social Effect		Requirement of land is less compared to other systems.	Needs urban spaces for dedicated corridor	Space is required for the dedicated corridor	Land requirement is huge for maintenance depot	Land requirement is huge for maintenance depot	Land acquisition is high for corridor and depot
Surrounding & Harmony		Noise and Pollution Problems	Noise and Pollution Problems	Low noise as compared to rail-based system	Noisy due to steel wheel arrangements.	Noisy due to steel wheel arrangements.	Noisy due to steel wheel arrangements.
Maintainability and cost	Track	Extensive maintenance of roads required.	Extensive maintenance of roads required.	Extensive maintenance of roads required.	less maintenance of track as compared with Metro rail transit system.	Requires extensive track maintenance work due to rail-wheel interaction.	Requires extensive track maintenance work due to rail-wheel interaction.
	Vehicle	Maintenance of engine and rubber tyre is necessary.	Maintenance of engine and rubber tyre is necessary.	Maintenance of engine and rubber tyre and battery charging are necessary.	Maintenance of rotary motors and turning of steel wheels necessary.	Maintenance of rotary motors and turning of steel wheels necessary.	Maintenance of rotary motors and turning of steel wheels necessary.
Capital cost per km (Cr/km)		Rs 10 Cr/km	Rs. 15-20 Cr/Km (At grade) Rs. 50-60 Cr/Km (Elevated)	Rs. 50 Cr/Km (At grade) Rs. 80-100 Cr/Km (Elevated)	Rs. 120 Cr/km (At Grade) Rs. 180 Cr/km (Elevated)	Rs. 200 - 250 Cr/km (Elevated) & Rs. 450 - 500 Cr/km (Underground Section)	Rs. 250 - 300 Cr/km (Elevated) & Rs. 500 - 600 Cr/km (Underground Section)

Source: DPR, 2021

### 4.1.2 Constraints considered during DPR stage

While finalizing the alternatives for the GMRP corridor, the following key requirements and constraints have been kept in view:

- To remain on the centre line of the existing road or within government owned land, while minimizing the impact to the extent feasible.
- To utilize the existing road RoW to the maximum extent to minimise the land acquisition and minimize the length of required diversions.
- To avoid dismantling of existing structures, buildings and other permanent facilities.
- To avoid private built-up areas, villages, habitation zones, and religious structures, etc. to the extent possible.
- To provide adequate clearance from existing railway and highway structures.
- To satisfy the requirements of sound engineering principles and economic feasibility.
- To rationalise the location of proposed stations.

#### 1. Alternatives for Millennium City Centre Station

Details of the alternatives considered for Millennium City Centre Station are given in **Table 4-2** and illustrated in **Figure 4-1**. After evaluating all relevant parameters and associated impacts, Alternative 1 i.e. positioned along the road median between the existing Millennium City Centre Metro Station and Sector 45 has been selected as the proposed station location.

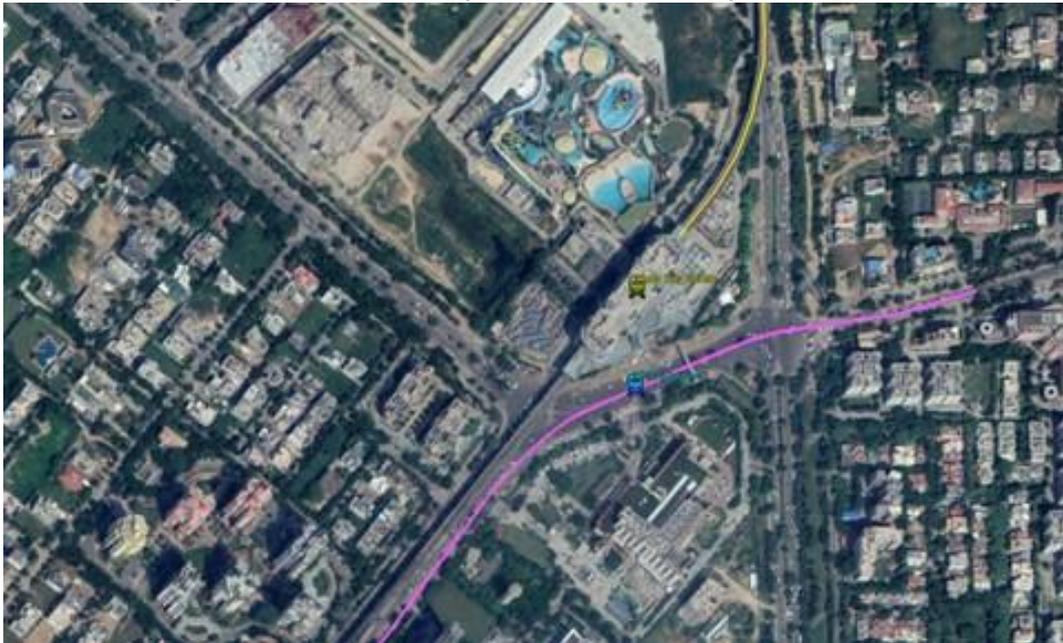
**Table 4-2 Comparison of Alternatives for Millennium City Centre Station**

Planning Parameters	Alternative 1	Alternative 2	Alternative 3
Location	On Dividing Road of Millennium City Centre Metro Station and Sector 45.	On Millennium City Centre's Parking and Sub-station.	On Millennium City Centre's Parking towards underpass.
Connectivity	<ul style="list-style-type: none"> <li>• Better integration with existing Millennium City Centre Metro Station.</li> <li>• Direct connection to the platform of existing Metro station can be planned.</li> <li>• Integration with Rapid Metro is possible.</li> </ul>	<ul style="list-style-type: none"> <li>• Direct connection to platform of existing metro station can be provided.</li> <li>• Construction of station building close to existing metro station would be very difficult.</li> </ul>	The commuters will have to travel longer for interchange with the existing HCC Metro station.
Time	Less time is required for interchange.	Reduced time for interchange for passengers.	Travel time is long for interchange.
Environmental & Social Aspects	<ul style="list-style-type: none"> <li>• No acquisition, as the station is proposed on road.</li> <li>• Sufficient space is available for movement of construction equipment.</li> <li>• 22 trees will be impacted because of the alignment.</li> </ul>	<ul style="list-style-type: none"> <li>• Land acquisition of existing Parking and Sub-station area.</li> <li>• Some portion of viaduct will overhang in private land (Appu Ghar water Park), which may require acquisition of land, and effectively reduces recreation area and creates</li> </ul>	<ul style="list-style-type: none"> <li>• Private Land acquisition for entry/exit of station and for curve portion of the alignment.</li> <li>• 40 trees will be impacted because of the alignment.</li> </ul>

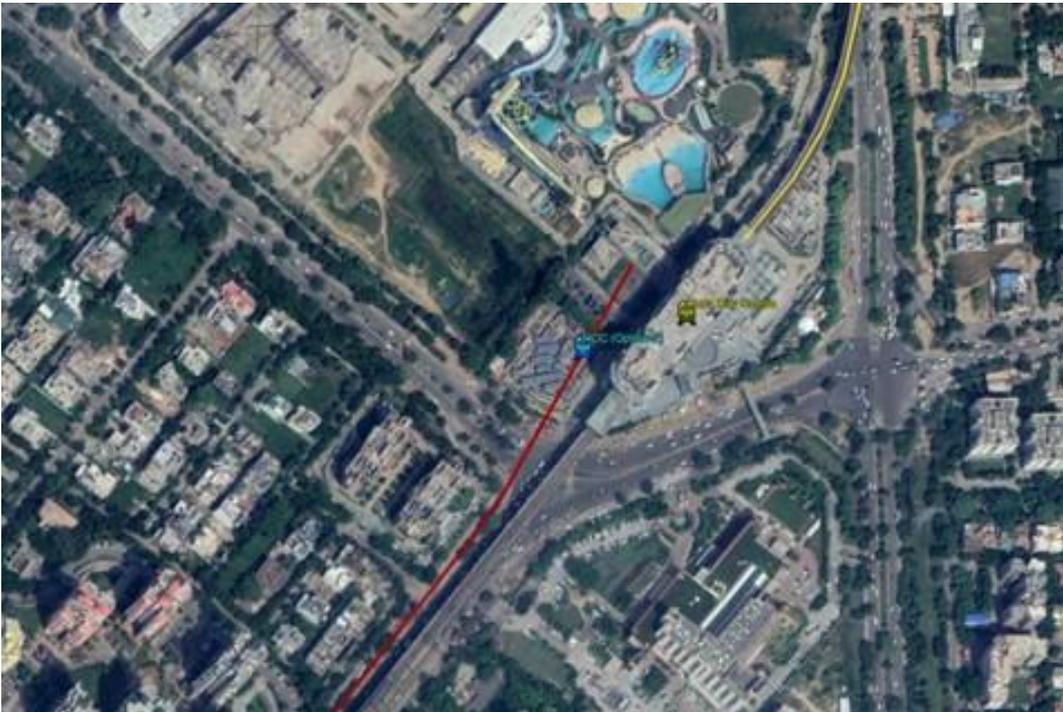
Planning Parameters	Alternative 1	Alternative 2	Alternative 3
		disturbances during construction. • 37 trees will be impacted because of the alignment.	

Source: DPR, 2021

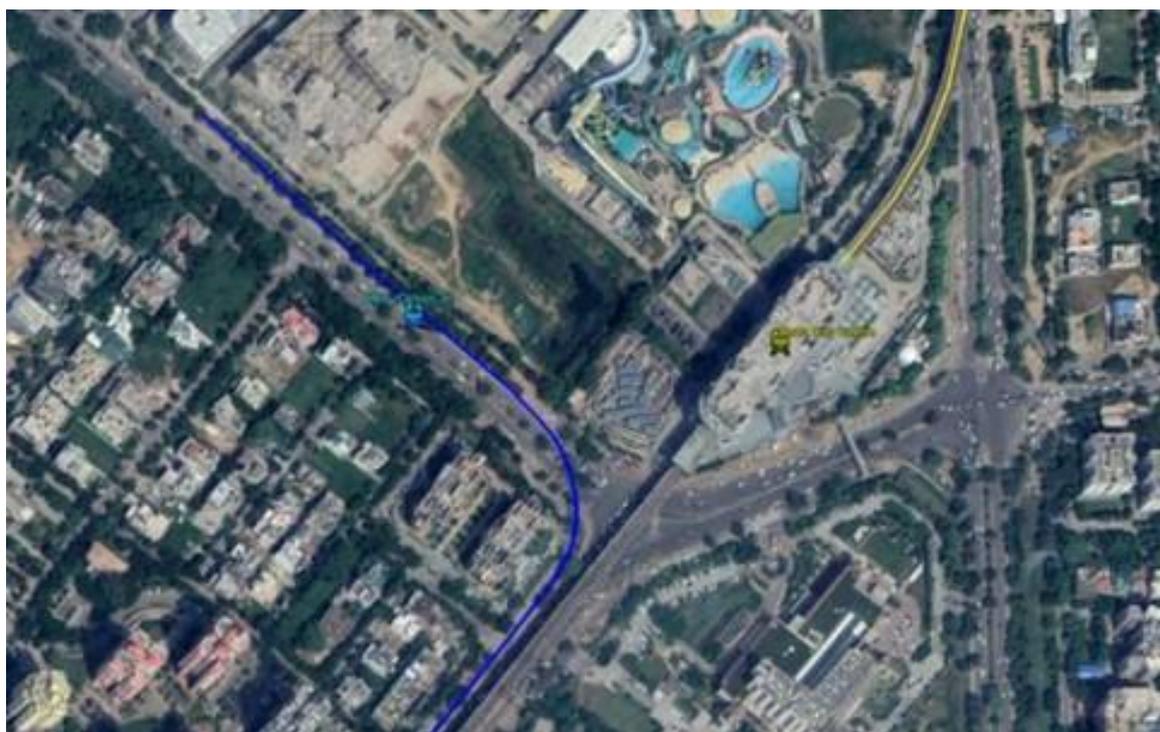
**Figure 4-1 Location of Proposed Millennium City Centre Station**



**Alternative 1**



**Alternative 2**



Alternative 3

Source: DPR, 2021

**2. Alternatives for Corridor from Sector-5 to Sector-3**

Details of the alternatives considered for the corridor from Sector-5 to Sector-3 are provided in **Table 4-3** and illustrated in **Figure 4-2**. Among the three alternatives proposed, Alternative-3 i.e. comprising a fully elevated continuous corridor from MCC to Sector-22 has been finalized.

**Table 4-3 Alternatives for Corridor from Sector-5 to Sector-3**

Planning Parameters	Alternative 1	Alternative 2	Alternative 3
Location	Continuous Corridor from MCC to Cyber City- Completely Elevated	Continuous Corridor from MCC to Cyber City is elevated except Gurugram Railway Station section is Underground.	Continuous Corridor from MCC to Cyber City with a spur to Gurugram Railway station from Sector-5 Metro station - Completely Elevated
Alignment Description & Connectivity	The alignment will pass through the area adjacent to Gurugram Railway station Platform No. 1.	The alignment section at Railway station proposed as underground.	Spur of a length of 1.2 km from Sector-5 considered to connect the Gurugram Railway station. Few trains will directly go to Gurugram Railway station and rest towards Cyber City.
Number of Stations	A greater number of stations can be established, expanding the catchment area, improving accessibility,	-	Additional stations could increase ridership, improve accessibility, and lead to a reduction in the use of private vehicles and

Planning Parameters	Alternative 1	Alternative 2	Alternative 3
	and reducing the reliance on private vehicles and Intermediate Public Transport (IPT).		Intermediate Public Transport (IPT).
Environmental & Social Effect	Acquisition of private properties at junction of Neki Ram Marg and Railway Road, adjacent to Maruti Stock Yard, outdoor recreational space of GEMS International School, near Carter Puri Road.	Acquisition of land for ramps along Neki Ram Marg and Carterpuri Road.  The alignment will have to pass below private properties which may result in vibration impacts.	<ul style="list-style-type: none"> <li>Acquisition of private property at junction of Neki Ram Marg and Railway Road.</li> <li>Minimal property acquisition compared to other alternatives.</li> </ul>
Cost Implication	Cost of project is lesser.	Cost of the entire project would increase by about Rs. 1200 Crore due to underground length of about 4.7 kms and 3 underground stations.	Cost of project will be lesser as compared to other options

Figure 4-2 Alternatives for Corridor from Sector-5 to Sector-3



Alternative 1- Completely Elevated



Alternative 2 – Railway Station as Underground



Alternative 3 – Completely Elevated with a Spur to Railway Station

Source: DPR, 2021

## 4.2 With or Without Project Scenario

The 'Without Project Scenario' represents the current conditions, including existing and committed transport infrastructure developments expected to be implemented in the future.

A comparative analysis of the 'With Project' and 'Without Project' scenarios is provided in **Table 4-4**.

**Table 4-4 With or Without Project Scenario**

Quantitative Evaluation	With Project Scenario	Without Project Scenario
Travel Time	<ul style="list-style-type: none"> <li>Travel Time will be reduced due to higher speed of MRTS project.</li> </ul>	<ul style="list-style-type: none"> <li>With the increase in population, the traffic load would be more that will result in increased travel time.</li> </ul>
	<ul style="list-style-type: none"> <li>Congestion reduction due to modal shift leads to fewer vehicles on roads. This also contributes to time savings of passengers travelling on other modes.</li> </ul>	<ul style="list-style-type: none"> <li>Traffic congestion on road due to inadequate capacity of public transports, increases the traffic time.</li> </ul>
Vehicles Operating Cost	<ul style="list-style-type: none"> <li>Less number of vehicles on road due to modal shift passengers on MRTS.</li> <li>Smoother operations of passenger trips of other mode vehicles owing to reduced congestion on roads.</li> </ul>	<ul style="list-style-type: none"> <li>More number of vehicles will lead to increased operating cost.</li> </ul>
Accident	<ul style="list-style-type: none"> <li>Reduction in accidents due to less no. of vehicles on roads.</li> <li>Savings in damage cost to vehicles involved in accidents.</li> </ul>	<ul style="list-style-type: none"> <li>Accident rate is high due to mismanagement of traffic system.</li> </ul>
Pollution	<ul style="list-style-type: none"> <li>Reduction in vehicular emissions due to modal shift of passengers on MRTS.</li> <li>Less conversion of land as MRTS is elevated over existing road infrastructure</li> <li>Less pollution due to reduced congestion on roads.</li> <li>Less tree felling as the alignment is planned on median,</li> </ul>	<ul style="list-style-type: none"> <li>Emission rates are high due to vehicular pollution.</li> <li>Need to convert more land for future vehicle movement</li> <li>Increased congestion</li> <li>Expanding the road sideways could cause disruptions to local communities.</li> <li>Trees retained on medians, contributing to reducing urban heat island effect</li> </ul>
Connectivity	<ul style="list-style-type: none"> <li>The project connects Millennium City Centre to Cyber City with a spur to Dwaraka Expressway</li> </ul>	<ul style="list-style-type: none"> <li>Without project, vehicles will be high, which lead to traffic jams, increased travel time, increased air pollution etc.</li> </ul>
Road Traffic	<ul style="list-style-type: none"> <li>Reduction in daily vehicle trips due to the project in Year 2051 will be 78,17,591 (Car: 7,20,726; 2W: 32,96,184; Auto: 20,35,290; Bus: 17,65,391)</li> </ul>	<ul style="list-style-type: none"> <li>Vehicle trips (78,17,591 nos) will be increased in Year 2051</li> </ul>
Fuel Consumption	<p>The reduction in fuel consumption in the year 2051 will be as follows:</p> <ul style="list-style-type: none"> <li>Diesel: 1.68 Lakh Liter per year</li> <li>Petrol: 3.97 Lakh Liter per year</li> <li>CNG: 1.79 Lakh Kg per Year</li> </ul>	<ul style="list-style-type: none"> <li>Fuel consumption will be more in Year 2051</li> </ul>

Quantitative Evaluation	With Project Scenario	Without Project Scenario
Impact on Structures	<ul style="list-style-type: none"> <li>The metro project shall impact 210 structures.</li> </ul>	<ul style="list-style-type: none"> <li>These structures will be saved without metro project scenario.</li> </ul>
Maintenance of road infrastructure	<ul style="list-style-type: none"> <li>With less no of vehicles on roads, expenditure on road maintenance is expected to go down.</li> </ul>	<ul style="list-style-type: none"> <li>With a greater number of vehicles on road, the maintenance requirement is high.</li> </ul>

#### 4.2.1 Economic Analysis

The development of the two scenario starts with the estimation of traffic demand and modal share for the proposed metro system. The total estimated travel demand is approximately 33.36 lakh trips per day in the year 2026, which is projected to increase to around 78.17 Lakh by 2051. In 2026, the rail-based transit system is expected to cater to about 3.74 Lakh daily trips, rising to an estimated 8.98 lakh trips per day by 2051. The estimated trips under the 'With Project' and 'Without Project' scenarios are illustrated in **Table 4-5**.

**Table 4-5 Estimated Trips 'With' and 'Without' Scenario**

Mode	Trips without Mass Transport System				Trips with Mass Transport System			
	Year				Year			
	2026	2031	2041	2051	2026	2031	2041	2051
Bus	753287	1238074	1478406	1765391	656639	1061196	1263567	1542474
Car	307532	505447	603564	720726	261223	425980	506994	618511
2 Wheelers	1406472	2311624	2760351	3296184	1257755	2014982	2400260	2931888
Auto	868452	1427355	1704430	2035290	786121	1254245	1494365	1825883
Metro	-	-	-	-	374006	726098	881563	898833
<b>Total</b>	<b>3335744</b>	<b>5482500</b>	<b>6546750</b>	<b>7817590</b>	<b>3335744</b>	<b>5482500</b>	<b>6546750</b>	<b>7817590</b>

Source: DPR 2011

The GMRP is expected to generate both tangible and intangible benefits through a corresponding reduction in road traffic and various socio-economic benefits. The introduction of the MRTS will result in reduction in the number of buses, IPT modes, usage of private vehicles, air pollution and an increase in the average speed of road-based vehicles. These changes will contribute to significant E&S benefits including reduced fuel consumption, vehicular emissions, road accidents, land acquisition and tree cutting for road expansion. Additionally, there will be savings in vehicle operating costs and passenger travel time. The project will also help reduce future road construction, expansion, and maintenance costs, providing long-term benefits to society at large.

#### 4.3 New Link from Millennium City Centre to Rapid Metro Station Sector 42-43

A new link is proposed to connect the Rapid Metro at Sector 42-43 Station to enhance network connectivity and improve the overall passenger experience. The tentative length of this proposed link is about 2.4 km. The alignment design is yet to be finalised. The tentative alignment is shown in **Figure 4-3** and the details of the proposed link are provided in **Table 4-6**.

Figure 4-3 Tentative alignment of New Link



Source: GMRL

Table 4-6 Description of New Link

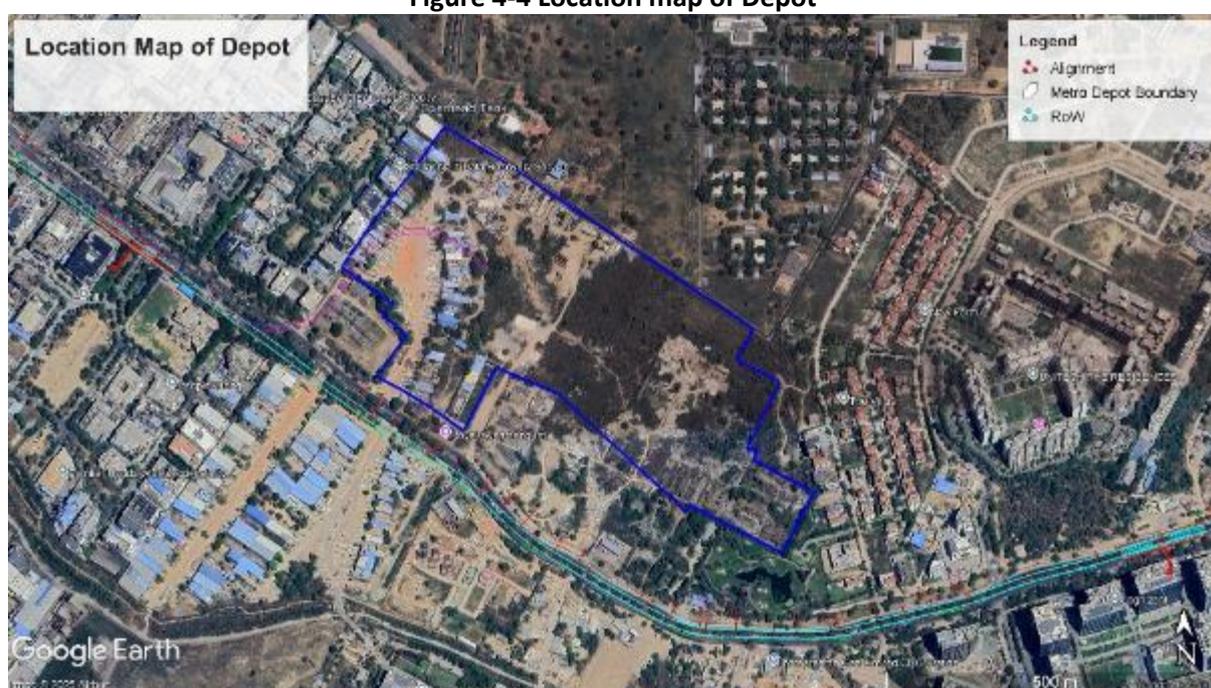
S. No	Parameter	Description
1.	Length of the alignment	2.4 km
2.	Location	From Millenium City Centre to Rapid Metro at Sector 42-43 Station
3.	Surrounding Area	The alignment passes through the service lane on the left side of the existing road from Millennium City Centre to Golf Course Road.  The settlements along the alignment are residential and commercial in nature.
4.	Land use of the Project Site as per Master Plan 2031, Department of Town and Country Planning, Haryana	Adjacent to Residential area Alignment falls within RoW of road
5.	Waterbody	-NIL (however, the alignment is crossing one bundh)
6.	Major Environmental & social Impacts	<ul style="list-style-type: none"> <li>• Noise Pollution and Air Pollution</li> <li>• Trees to be cut: Approx 378</li> <li>• Squatters: Approx 41</li> <li>• Temple: 1</li> </ul> Detailed EIA study will be carried after finalization of new link from Millenium City Centre to Rapid Metro at Sector 42-43.

Source: RITES Study

#### 4.4 Alternative Analysis for Depot

As per the DPR, a stabling depot was initially proposed at Sector 101, Basai. The existing maintenance depot of the Rapid Metro was proposed to its track integration with the Rapid Metro and to utilise existing infrastructure facilities. An area of 5.50 ha was earmarked for the stabling depot at Sector 101, Basai, which is low lying area. However, considering the biodiversity importance of the area known as KBA/IBA in Sector 101, Basai, in line with the ESS6 principles. The Project Proponent has opted to avoid the environmental impacts associated with constructing a depot on this waterbody. Instead, a new depot with all required facilities has been proposed in Sector 33, near the proposed Sector 72A Metro Station, covering an area of 22.37 ha; as illustrated in **Figure 4-4** and details represented in **Table 4-7**.

**Figure 4-4 Location map of Depot**



Source: GMRL

**Table 4-7 Analysis for Depot Locations**

S. No	Parameter	Stabling Depot at Sector 101	Depot at Sector 33
1.	Area of Depot	5.50 ha	22.37 ha
2.	Location	Sector 101	Sector 33
3.	Existing Land use	Proposed at KBA/IBA in Sector 101, Basai and low-lying area	Commercial and Open land
4.	Land use of the Project Site as per Master Plan 2031, Department of Town and Country Planning, Haryana	Sector 101: Public Utilities (Water works, Disposal Works, Grid Substation)	Commercial and Open spaces in Sector 33
5.	Waterbody	KBA/IBA in Sector 101, Basai	A waterbody is located next to proposed depot site, within the golf course area of the Unitech Resort

S. No	Parameter	Stabling Depot at Sector 101	Depot at Sector 33
			Villas complex. The waterbody is located outside the depot boundary; no impact is anticipated.
6.	Major Environmental & Social Impacts	<ul style="list-style-type: none"> <li>• The Basai waterbody is KBA/IBA and the construction and operation of the Depot will impact the Ecosystem.</li> <li>• Impact on Water Quality during construction</li> <li>• Flooding expected at the project site, as KBA/IBA in Sector 101, Basai is low lying area.</li> <li>• Shifting of HTL</li> <li>• Impacts during Construction activities</li> <li>• During operation: Disturbance and Pollution impacts on all parameters, and biodiversity</li> </ul>	<ul style="list-style-type: none"> <li>• R&amp;R issues for relocation of about 61 marble shops at depot location.</li> <li>• Impacts during Construction activities</li> <li>• During operation: Noise Pollution and soil contamination</li> <li>• Trees to be affected: 259</li> <li>• Relocation of Electric Sub-station</li> </ul>

## Chapter 5: Environmental and Social Baseline Condition

### 5.1 Methodology for Environmental Baseline Data Collection

#### 5.1.1 Right of Way (RoW)

The alignment from Millennium City Centre to Cyber City is passing majorly through existing roads, settlements, open land, etc. The RoW requirements are as follows:

- Alignment/Viaduct: 16 m (i.e., 8 m on either side from the centreline of the alignment/viaduct, including 3m for working space).
- Stations: 3m from the outer periphery of the stations.
- Entry/Exit Points: 3m from the outer periphery of the entry/exits .
- Depot: Up to the outer boundary of the depot area.

To comprehensively assess the potential E&S risks and impacts of the GMRP, the following spatial delineations have been adopted for impact assessment, taking into account urban density, existing land use, and expected propagation of impacts:

- **Physical and Social Impacts:** The GMRP viaduct alignment, spanning 16m in width has been considered to assess land acquisition requirements and involuntary resettlement, displacement (if any), and impacts on physical infrastructure and utilities.
- **Noise and Vibration Impacts:** A 100m buffer zone on either side of the alignment has been adopted to identify and assess potential noise and vibration impacts on sensitive receptors such as residential areas, educational institutions, hospitals and heritage structures.
- **Indirect and Cumulative Impacts:** A buffer of 10km either side of GMRP corridor has been considered for identification of NOCs/clearances, Land Use/Land Cover classification, etc.

The area of influence includes project associated facilities, construction camps, labour camps, access roads, material sourcing areas, etc. and considers potential impacts on VEC. The area of influence for the proposed project is shown in **Figure 5-1**.

#### 5.1.2 Baseline Conditions

The baseline study includes the collection and evaluation of both secondary and primary data to establish existing E&S conditions within the study area. Secondary data has been sourced from relevant databases, published reports, and other official records, while primary data has been collected through field surveys covering ambient air quality, noise, vibration, land and soil characteristics, water quality, ecology and biodiversity, and socio-economic aspects.

The E&S baseline provides a comprehensive understanding of existing conditions, forming the foundation for assessing the potential risks & impacts of GMRP. Baseline data has been compiled for the following components:

- Land Environment: Physiography and climate, geology and hydrogeology, soils, minerals, land use and land cover, and seismicity.

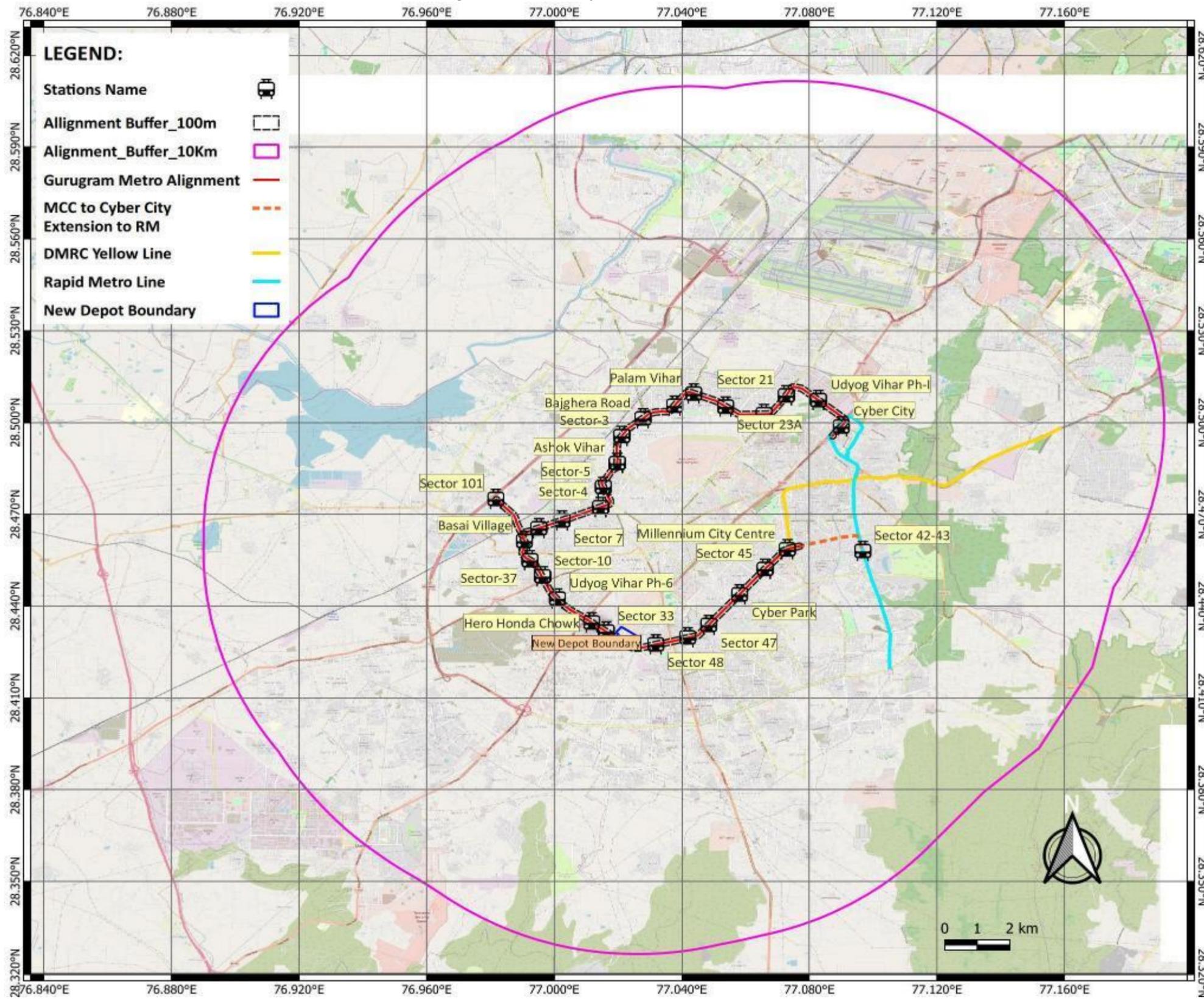
- Water Environment: Water resources, availability, access, quality, drainage patterns and flood risks.
- Air, Noise and Vibration
- Biological Environment: Biodiversity (flora and fauna), habitat studies, forests and protected areas.
- Socio-Economic Environment: Demographic characteristics, socio-economic conditions, cultural heritage, etc.

Data collection for the ESIA study was conducted between November 2023 and October 2024. A scoping matrix along with the frequency adopted for data collection of E&S attributes is summarized in **Table 5-1**.

**Table 5-1 Environmental Attributes and Frequency of Monitoring**

S. No.	Attribute	Parameter	Frequency	Source
<b>LAND ENVIRONMENT</b>				
1.	Physiography	Elevation	-	Secondary Data
2.	Soils	Soil Characteristics	Once	Field studies
3.	Geology and hydrogeology	Geological Status & hydrogeology	-	Secondary Data
4.	Seismology	Seismic Hazard	-	Secondary Data
5.	Minerals	Minerals	-	Secondary Data
6.	Land Use and Land Cover	Land Use	-	Primary and secondary data
<b>WATER ENVIRONMENT</b>				
7.	Ground Water	Physical and Chemical	Once	Field Studies
8.	Surface Water	Physical, Chemical and Biological	Once	Field Studies
9.	Drainage	Drainage	-	Secondary data
10.	Floods	Floods	-	Secondary data
<b>AMBIENT ENVIRONMENT</b>				
11.	Meteorology	Temperature, Relative Humidity, Rainfall, wind direction and speed	Monthly	Secondary data
12.	Ambient Air Quality	PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>2</sub> , NO <sub>2</sub> , and CO	2 working days in a week continuously for 4 weeks	Field Studies
13.	Noise	Noise levels in dB (A)	2 working days in a week	Field Studies
14.	Vibration	Peak Particle Velocity	24 hr continuous Monitoring	Field studies
<b>BIOLOGICAL AND ECOLOGICAL ENVIRONMENT</b>				
15.	Trees	Number/species	Once	Field Studies
<b>SOCIO-ECONOMIC</b>				
16.	Socio-economic aspects	Socio-economic profile	Once	Field Studies and Secondary data

Figure 5-1 Area of Impact and Area of Influence



Source: RITES

## 5.2 Land Environment

### 5.2.1 Physiography

Gurugram district features a diverse topography, comprising hills, depressions and irregular terrain. The Delhi Ridge forms the eastern boundary, while the Firozpur Jhirka–Delhi Ridge marks the western boundary. The district's hills are part of the northern extension of the ancient Aravalli Range. The Aravalli Range contains some of the oldest rocks formations in the country. Sand dunes are present in the north-western region, shaped by south-westerly winds. This combination of Aravalli hills and sand dunes contributes to the district's varied physiographic characteristics.

The metro alignment starts near Millennium City Centre at coordinates 28°27'34.40"N & 77°4'36.86"E and terminates near the entrance of CyberHub at coordinates 28°29'44.30"N 77° 5'14.39"E, with an average elevation of 257m above sea level. A topographical and contour map of the study area is provided in **Annexure 5.1**. As per the contour map, the alignment elevation range varies from 214m to 238m. Since the GMRP alignment is entirely elevated, no significant impact on the topography of the project area is anticipated.

### 5.2.2 Geology and Hydrogeology

Gurugram district is mainly covered by vast alluvial and sandy tracts, which are remnants of the Aravali Mountain chain. The area is geologically classified under the Delhi Supergroup, comprising the Alwar and Ajabgarh formations, with occurrences of various mineral intrusions. Groundwater within the quartzite ridge is primarily found in fractures and joints, while sandy layers at varying depths serve as major water-bearing horizons. Groundwater occurs in unconfined to semiconfined conditions, with the upper saturated zone consisting of fine sand with varying amount of silt. In urban areas, the first aquifer depth ranges from 34m to 43m, with tube well yields varying between 129 to 606 liters per minute.

### 5.2.3 Soils

The soils in Gurugram district are classified into tropical and brown soils, primarily found in the northwestern, northern, and northeastern parts of the district, and waterlogged or salt-affected soils located in the southern regions. The average soil texture across the Gurugram blocks is medium-textured loamy sand.

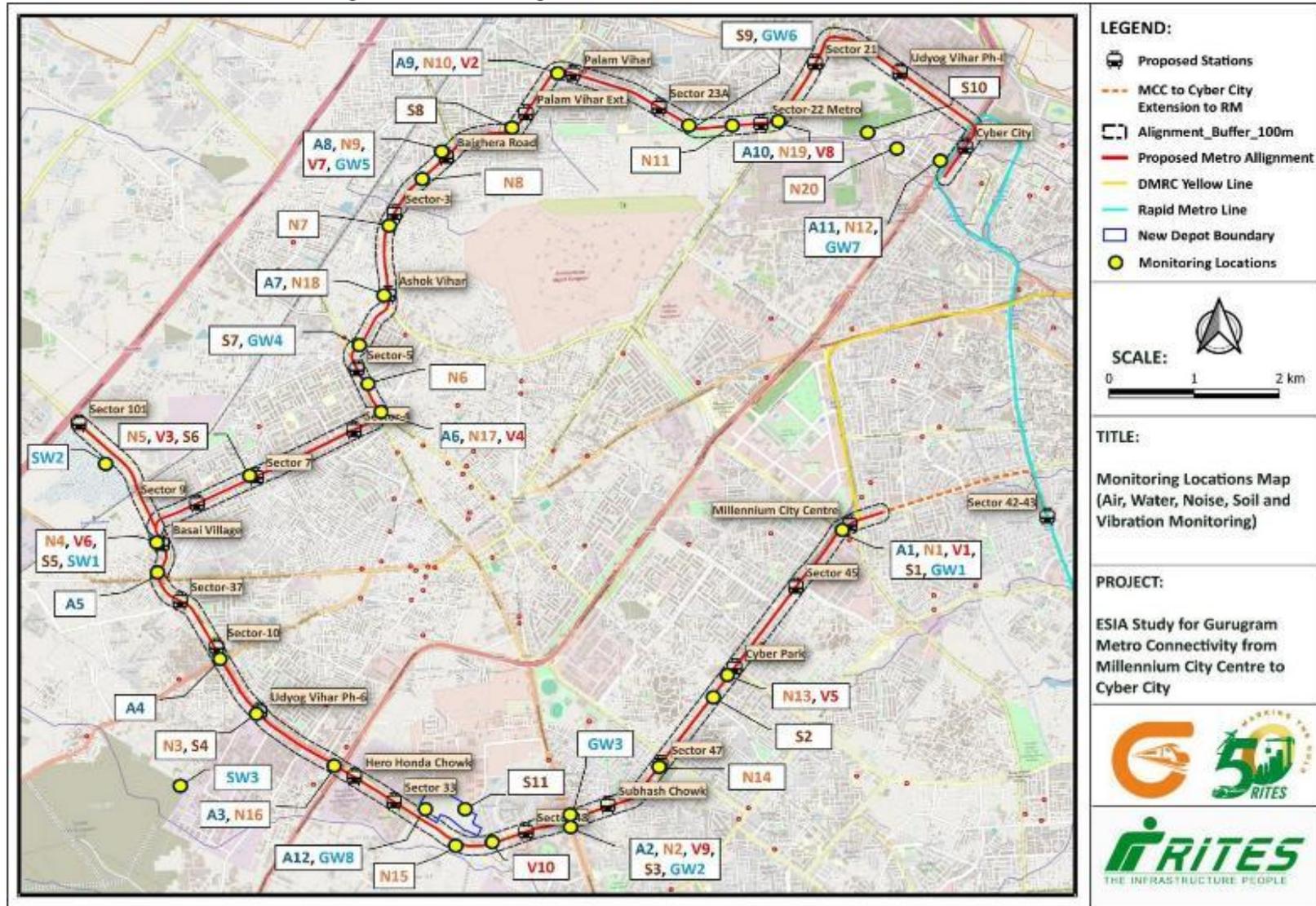
Soil samples were collected from various locations such as open areas and vegetated areas along the GMRP corridor between November 2023 to January 2024. Details of the sampling locations are given in **Table 5-2** and the location map is shown in **Figure 5-2**. The results of the laboratory analysis are summarized in **Table 5-3**. During field investigations, signs of contamination, such as sewage discharge or waste dumping, at the proposed station sites and depot areas was not observed. However, it is acknowledged that during the detailed design and construction phases, changes in station locations or alignment may occur. In such cases, the assessments will be updated accordingly.

**Table 5-2 Soil Sampling Locations**

<b>S. No</b>	<b>Location</b>	<b>Date of monitoring</b>	<b>Latitude</b>	<b>Longitude</b>
S1	Millennium City Centre	30/11/2023	28.457135	77.073188
S2	Cyber Park	22/11/2023	28.440801	77.056182
S3	Subhash Chowk	22/11/2023	28.428008	77.03756
S4	Udyog Vihar	27/11/2023	28.436087	77.009277
S5	Basai Village	22/11/2023	28.46185	76.988835
S6	Sector-7	27/11/2023	28.468735	77.002448
S7	Sector-5	27/11/2023	28.480685	77.0153
S8	Palam Vihar Ext.	27/11/2023	28.503847	77.035454
S9	Sector-23A	27/11/2023	28.502977	77.057893
S10	Udyog Vihar Phase-V	02/12/2023	28.500758	77.079608
S11	Depot	04/01/2024	28.42951	77.02349

Source: RITES Field Study

Figure 5-2 Monitoring Locations – Air, Noise, Vibration, Soil and Water



Source: RITES

**Table 5-3 Soil Quality Monitoring Results**

S. No.	Parameter	Unit	Sampling Locations										Dutch Intervention Level (mg/kg)	
			S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	
1.	pH	-	8.05	7.88	7.96	7.66	7.82	7.42	7.26	7.90	8.12	7.68	7.52	-
2.	Electrical Conductivity (10% Solution)	µs/cm	428	488	338	563	510	620	429	642	415	436	454	-
3.	Organic matter	%	1.54	1.28	0.91	1.34	1.29	1.65	1.56	1.76	1.18	1.18	1.05	-
4.	Total Nitrogen (as N)	mg/Kg	240.3	172.0	92.8	232.3	98.9	205.3	200.0	249.8	220.5	192.0	188	-
5.	Total Phosphates (as PO <sub>4</sub> )	mg/Kg	32.7	28.9	14.3	29.2	26.5	38.7	32.4	39.2	21.5	28.3	24.2	-
6.	Potassium as K	mg/kg	422.0	503.5	232.0	463.0	356.7	442.0	423.7	527.0	410.0	415.0	388	-
7.	Available Calcium as Ca	mg/Kg	2815	2985	2765	3218	3008	3508	3185	3418	3008	2415	2269	-
8.	Zinc	mg/Kg	73.5	97.8	41.9	75.3	42.7	66.2	78.1	57.3	62.3	98.4	90.1	720
9.	Boron	mg/Kg	20.2	19.4	10.2	26.3	30.1	29.5	20.9	29.2	27.1	22.5	26.2	-
10.	Magnesium	mg/Kg	835.0	182.6	281.3	825.0	510.3	1008.0	355.0	1018.0	819.0	652.0	690	-
11.	Iron	mg/Kg	94.5	97.3	64.9	108.3	91.4	114.9	97.2	106.5	105.2	91.4	82.2	-
12.	Texture													
I.	Silty	%	13	14	16	13	21	12	11	11	12	14	17	-
II.	Sandy	%	56	54	54	52	48	63	54	53	56	58	56	-
III.	Clay	%	31	36	30	35	31	25	34	31	32	28	27	-
13.	Sodium (as Na)	mg/Kg	154	435.2	618.5	338	420.8	305	198	302	169	178	196	-
14.	Chloride (as Cl)	%	0.20	0.22	0.25	0.18	0.28	0.15	0.21	0.14	0.20	0.22	0.18	-
15.	Bicarbonates	%	13.5	8.5	11.8	9.2	9.1	12.8	13.9	17.2	13.8	18.2	22.4	-
16.	Sulphates	mg/kg	6.3	14.6	9.3	7.9	10.9	4.8	6.8	4.6	4.9	9.3	11.6	-
17.	Organic Carbon	%	0.86	0.94	0.56	0.90	0.84	0.96	0.82	0.82	0.75	0.78	0.84	-
18.	Organic Matter	%	1.54	1.28	0.91	1.34	1.29	1.65	1.56	1.76	1.18	1.18	1.05	-
19.	Carbonates	%	10.3	8.2	13.1	10.2	12.1	10.8	10.1	10.4	10.2	12.4	10.1	-
20.	Sulphur	mg/kg	22.4	31.6	12.4	19.4	16.7	21.7	23.4	21.6	13.5	26.3	29.4	-
21.	Total Cadmium (as Cd)	mg/kg	1.79	2.26	0.81	1.97	2.24	2.24	1.73	2.19	1.15	1.43	1.16	13
22.	Total Copper (as Cu)	mg/kg	31.2	32.7	21.6	29.5	24.8	33.5	30.4	33.2	33.9	33.8	46.8	190
23.	Total Lead (as Pb)	mg/kg	10.1	12.8	8.6	11.2	10.9	10.8	9.4	10.2	10.6	9.3	8.6	530
24.	Nickel as Ni	mg/kg	4.6	6.8	7.2	6.8	13.8	5.6	4.5	5.5	5.4	8.3	6.8	100
25.	Permeability	cm/hour	3.1	1.85	1.81	2.9	2.7	2.7	1.80	2.7	2.7	1.4	1.9	-
26.	Water Holding Capacity	%	26.5	23.7	27.2	25.3	22.9	29.5	26.5	25.1	29.2	29.3	29.8	-
27.	Porosity	%	27.3	27.5	36.6	29.8	39.5	25.1	23.2	26.2	26.2	22.4	25.9	-

Source: RITES Field Study

Based on the soil analysis results, the following observations were made:

- At all sampling locations, the percentage of silt, sand and clay ranged from 11-21%, 48-63% and 25-36%, respectively. Accordingly, the soil in the project area is classified as sandy clay loam.
- Sandy clay loam soil exhibits a balanced composition of sand, silt, and clay. It offers good drainage due to its sandy component, moderate fertility and reasonable water retention capacity.
- Arsenic (As), Mercury (Hg) and Molybdenum (Mo) were not detected in any of the soil samples, indicating no significant contamination risks from these elements.
- The concentrations of heavy metals were as follows: Zinc (Zn) ranged from 41.9 to 98.4 mg/kg, Cadmium (Cd) from 8.1 to 22.6 mg/kg, Copper (Cu) from 21.6 to 46.8 mg/kg, Lead (Pb) from 8.6 to 12.8 mg/kg, and Nickel (Ni) from 4.6 to 13.8 mg/kg across various sampling locations, reflecting variable levels of these elements in the soil.
- The soil quality data from locations S1–S11 were compared with the Dutch Intervention Levels as per the MoEF&CC Guidelines for Contaminated Sites (Volume II). Heavy metals concentrations including Copper, Lead, Zinc, Cadmium, and Nickel, were found to be well within acceptable limits.
- Electrical conductivity across the study area ranged from 338 to 642  $\mu\text{S}/\text{cm}$ , classifying the soils as non-saline (normal).
- Calcium concentrations were found in the range of 2415 to 3508 mg/kg, indicating a moderate to high presence of calcium. Its influence on overall soil characteristics depends on intended use of the soil.
- Total Nitrogen (as N) ranged from 172 to 249 mg/kg, Total Phosphates (as  $\text{P}_2\text{O}_5$ ) from 22 to 39 mg/kg, and Potassium (as K) from 410 to 527 mg/kg, indicating high soil fertility (excluding S3 and S5) and suitability for plant growth with improved resistance to environmental stressors.
- At sampling locations S3 and S5, nutrient levels were slightly lower but still indicative of good fertility: Total Nitrogen ranged from 92.8 to 98.9 mg/kg, Phosphates from 14.3 to 26.5 mg/kg, and Potassium from 232 to 356 mg/kg. These values signify adequate to high nutrient availability, providing favourable conditions for vegetation growth and development.

#### 5.2.4 Land Use and Land Cover

Land use patterns are important component of the ESIA as they help to identify various land utilization types such as agriculture, settlements, forests, vegetation, etc. For the GMRP, the Land Use/Land Cover classification includes built-up land, agricultural land, forest, barren land, water bodies, roads, and other categories has been derived using latest satellite imagery for the study area extending 10 km on either side of the proposed corridor centreline.

**Satellite Imagery:** High-resolution imagery (less than 1 meter) of the Indian Remote Sensing (IRS) Cartosat satellite was obtained from the National Remote Sensing Centre (NRSC). The data is referenced using the Universal Transverse Mercator (UTM) projection system with WGS84 datum, Zone 43.

**Land use Map:** The land use map was developed through on-screen visual interpretation using ERDAS Imagine and ArcGIS software. The identified land use classes include built-up area, agricultural land, water bodies, grassland, barren/waste land, and forest. The

classification covers a buffer zone of 10 km on either side of the proposed GMRP corridor centerline. The land use classification data is presented in **Table 5-4**, and corresponding land use map is shown in **Figure 5-3**.

**Table 5-4 Land use Classification of Metro Corridor (10 km on either side of corridor)**

S. No.	Classes		Area in Ha.		%
1	Built Up	Urban	26364	31389	44.37
		Rural	2175		
		Airport	2072		
		Parks	740		
		Mining	38		
2	Agriculture	Crop	11452	21552	30.47
		Fallow	9920		
		Plantation	180		
3	Water Bodies	Ponds	1420	1710	2.42
		Reservoir/tanks and Najafgarh Drain	290		
4	Grass	Grass	4140	4140	5.85
5	Barren/ Waste Land	Barren	2620	11853	16.76
		Scrub	9233		
6	Forest	Forest	99	99	0.14
			<b>Total</b>	<b>70743</b>	<b>100</b>

- Agricultural land: Crop, fallow and plantations land together contribute to about 30.47% of the study area.
- Built-up Area: Including urban, rural, airport, parks and mining covers about 44.37% of the study area. The surrounding villages around the project site are well developed with road, electricity and water connectivity.
- Grass land covers about 5.85% of the study area.
- Out of the total study area, 16.75% is barren land.
- Forest area covers about 0.14% of total study area.
- The water bodies contribute about 2.42% of the total study area.
- Proposed GMRP alignment covers 0.18% of urban area and covers 0.07% of total area.

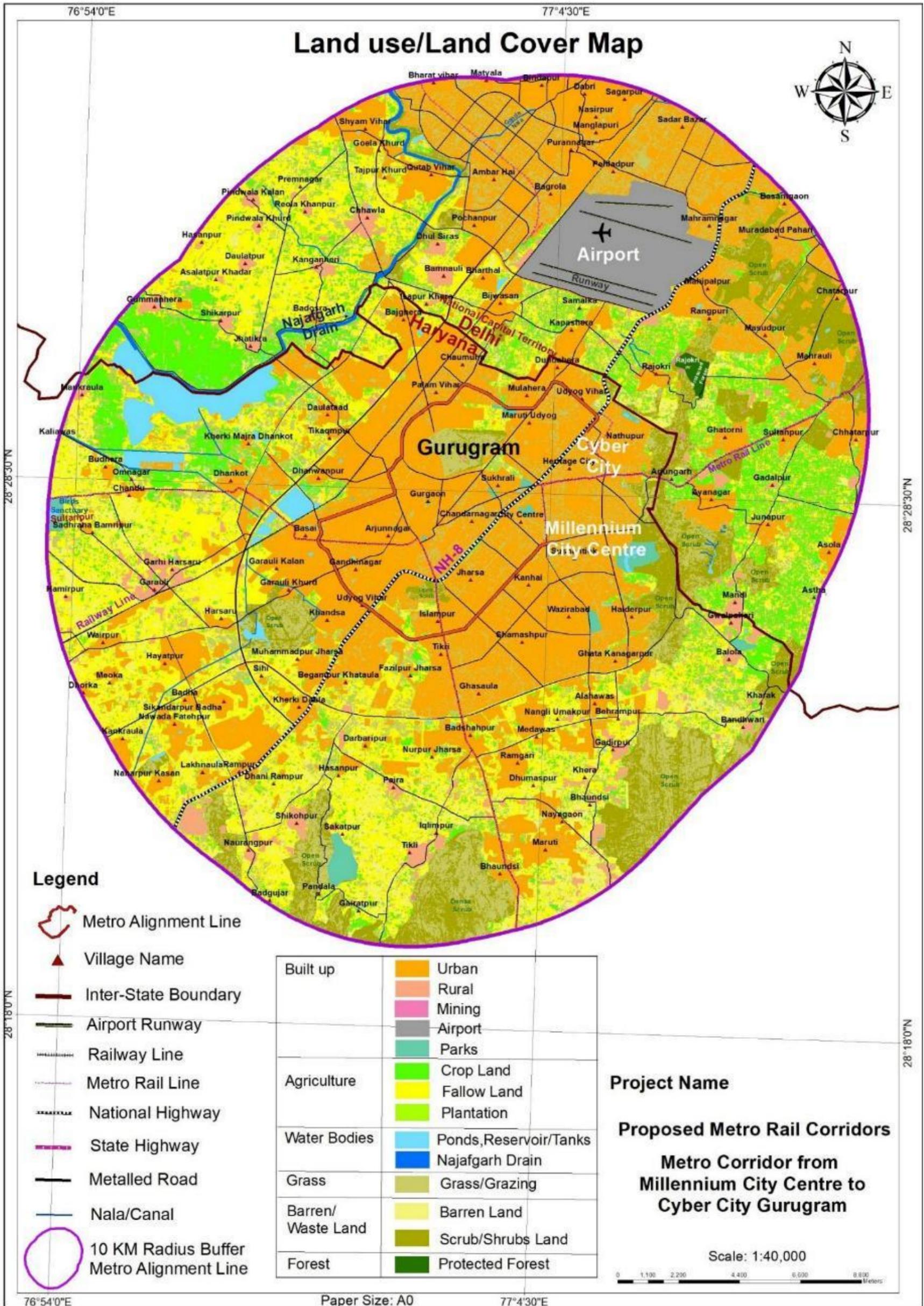
### 5.2.5 Minerals

The principal minerals available in Gurugram district include China clay, quartz/silica sand, quartzite and slate. However, the GMRP alignment passes through urban areas and does not pass through any designated mineral bearing zones.

### 5.2.6 Seismicity

As per the revised seismic zoning map of India, different parts of Haryana fall under Low Damage Risk Zone (Zone II), Moderate Damage Risk Zone (Zone III) and High Damage Risk Zone (Zone IV). As per IS 1893 standards, the GMRP corridor in Gurugram City falls in Seismic Zone IV, indicating a high damage risk.

Figure 5-3 Land Use Classification – Buffer of 10 km on either side of GMRP



Source: RITES

## 5.3 Water Environment

The water environment consists of both the availability and quality of water resources. Its study is important to assess the sufficiency of water resources to meet the project's requirements at various stages and to assess the potential impact of the project on local water resources.

### 5.3.1 Water Resources of the District

Water resources data is crucial for the GMRP, as it informs water availability, seasonal variations and groundwater management requirements. A comprehensive assessment and strategic planning are essential to ensure smooth project implementation and operation, while mitigating environmental and construction related issues. Gurugram's water demand is primarily met through surface water, with a smaller share contributed by groundwater and a minor portion from rainwater. Efforts are being made to diversify and optimize the use of available water sources for distribution.

**Surface Water:** Gurugram features the Najafgarh Jheel, an important component that supports both water storage and groundwater recharge. However, the lake is facing pollution and shrinkage due to waste and wastewater discharge. Additionally, many seasonal streams and ponds in the region have dried up as a result of rapid urbanization and lack of maintenance. The city primarily relies on surface water drawn from the Yamuna River, supplied through the Gurugram Water Supply (GWS) system and National Capital Region (NCR) channels.

**Ground Water:** Groundwater serves as a significant water source in Gurugram, largely extracted by private users including housing societies and individual households. It occurs under unconfined and semi-confined conditions, with tube wells generally installed at depths ranging from 45m to 90m, yielding between 129 to 606 L/min. The pre-monsoon groundwater level averages 39.89m below ground level (mbgl), while post-monsoon levels range from 37.37 to 38.12 mbgl. Despite moderate monsoon recharge effects, groundwater development across the district is categorized as "Over Exploited", mainly due to excessive extraction for irrigation purposes.

As per the Haryana Water Resources Authority (HWRA) notification dated 23.12.2020; groundwater extraction for construction is prohibited in over-exploited zones unless treated sewage water is unavailable within a 10 km radius. For the GMRP corridor, treated sewage water is available within the specified distance; hence, groundwater extraction for the project is not permitted.

### 5.3.2 Water Quality of the Project Area

#### 5.3.2.1 Surface Water Quality

Three surface water samples were collected along the GMRP corridor and its vicinity to assess the baseline surface water quality. The sample locations are shown in **Figure 5-2** and the details of the surface water quality monitoring locations are provided in **Table 5-5**.

**Table 5-5 Location of Surface Water Samples**

Location No	Particulars	Latitude	Longitude	Source
SW1	Basai Village	28.46185	76.988835	Pond
SW2	Sector-101	28.471235	76.98526	Pond
SW3	Sector-37	28.435008	76.99162	Drainage

The samples were analyzed for various physical and chemical parameters and compared against the permissible limits for inland surface waters as specified in IS: 2296 – 1982. The analysis results are presented in **Table 5-6**.

**Table 5-6: Analysis of Surface Water Samples in Project Area**

S. No.	Parameter	Unit	SW1	SW2	SW3	Permissible unit		
						Class C	Class D	Class E
1.	Temperature	°C	18.4	16.2	16.6	-	-	-
2.	pH Value	-	7.28	7.35	7.31	6.0-9.0	6.5-8.5	6.0-8.5
3.	Salinity	PPT	<1	<1	<1	-	-	-
4.	Electrical Conductivity at 25 °C	µmhos/cm	615	852	882	-	1000	2250
5.	Dissolved Oxygen (DO)	mg/l	3.7	3.9	3.9	4	4	-
6.	BOD at 5 days at 20 °C	mg/l	13	15.6	17	3	-	-
7.	COD	mg/l	66	77	83	-	-	-
8.	Nitrate	mg/l	7.3	8.4	9.5	50	-	-
9.	Nitrite Nitrogen	mg/l	<0.1	<0.1	<0.1	-	-	-
10.	Turbidity	NTU	17.5	25.5	20	-	-	-
11.	Total Alkalinity (as CaCO <sub>3</sub> )	mg/l	116	155	187	-	-	-
12.	Chloride	mg/l	58	96	112	600	-	600
13.	Total Kjeldahl Nitrogen (as N)	mg/l	12	18	14.4	-	-	-
14.	Total Phosphorous (as P)	mg/l	0.66	0.57	0.63	-	-	-
15.	Ammonical Nitrogen (as N)	mg/l	8.3	12.4	9.6	-	1.2	-
16.	Total Hardness (as CaCO <sub>3</sub> )	mg/l	162	179	195	-	-	-
17.	Calcium (as Ca)	mg/l	28	40	48	-	-	-
18.	Sulphate as SO <sub>4</sub>	mg/l	38	54	63	400	-	1000
19.	Sodium (as Na)	mg/l	44	78	84	-	-	-
20.	TDS	mg/l	332	460	511	1500	-	2100
21.	Total Suspended Solids	mg/l	23	36	29	-	-	-
22.	Total Phosphate (as PO <sub>4</sub> )	mg/l	1.36	1.76	1.94	-	-	-
23.	Boron (as B)	mg/l	ND	ND	ND	-	-	2
24.	Magnesium (as Mg)	mg/l	22	19.1	18	-	-	-
25.	Potassium (as K)	mg/l	4.7	5.76	7.32	-	-	-
26.	Fluoride (as F)	mg/l	0.78	1.36	1.12	1.5	-	-
27.	Cadmium (as Cd)	mg/l	ND	ND	ND	0.01	-	-
28.	Total Arsenic (as As)	mg/l	ND	ND	ND	0.2	-	-
29.	Lead (as Pb)	mg/l	ND	ND	ND	0.1	-	-

S. No.	Parameter	Unit	SW1	SW2	SW3	Permissible unit		
						Class C	Class D	Class E
30.	Hexavalent Chromium (as Cr <sup>+6</sup> )	mg/l	ND	ND	ND	0.05	-	-
31.	Nickel (as Ni)	mg/l	ND	ND	ND	-	-	-
32.	Mercury (as Hg)	mg/l	ND	ND	ND	-	-	-
33.	Iron (as Fe)	mg/l	0.26	0.32	0.21	-	-	-
34.	Aluminium (as Al)	mg/l	ND	ND	ND	-	-	-
35.	Barium (as Ba)	mg/l	ND	ND	ND	-	-	-
36.	Copper (as Cu)	mg/l	ND	ND	ND	-	-	-
37.	Residual Free Chlorine	mg/l	ND	ND	ND	-	-	-
38.	Manganese (as Mn)	mg/l	ND	ND	ND	-	-	-
39.	Phenolic Compound (as C <sub>6</sub> H <sub>5</sub> O <sub>6</sub> )	mg/l	ND	ND	ND	-	-	-
40.	Selenium (as Se)	mg/l	ND	ND	ND	-	-	-
41.	Silver (as Ag)	mg/l	ND	ND	ND	-	-	-
42.	Sulphide (as H <sub>2</sub> S)	mg/l	ND	ND	ND	-	-	-
43.	Zinc (as Zn)	mg/l	0.14	0.15	0.08	-	-	-
44.	Cyanide (as CN)	mg/l	ND	ND	ND	-	-	-
45.	Total Chromium (as Cr)	mg/l	ND	ND	ND	-	-	-
46.	Vanadium (as V)	mg/l	ND	ND	ND	-	-	-
48.	Oil & Grease	mg/l	<0.1	<0.1	<0.1	-	-	-
49.	Total Nitrogen (as N)	mg/l	19.3	26.4	23.9	-	-	-
50.	Total Coliform	MPN/100ml	70	90	110	-	-	-

Source: RITES Field Study

The analysis of various parameters revealed the following findings:

- The parameters such as pH, Nitrate, Chlorides (as Cl) and Sulphate (as SO<sub>4</sub>) at all three locations were found within the prescribed limits.
- Parameters related to toxic substances including Boron, Cadmium, Arsenic, Lead, Chromium, nickel, mercury, aluminium, barium, copper, phenolic compound, selenium, silver, and zinc were not detected in any of the samples across the three locations.
- Fluoride concentrations in the surface water samples were within the permissible limit of 1.5 mg/L for Class C as per 2296 – 1982 for Inland Surface Waters subject to pollution. However, as the water is not proposed for drinking source, no fluoride treatment is required, and no significant impact is anticipated on either metro operations or local fluoride levels.
- DO levels ranged from 3.7 to 3.9 mg/L, which is slightly lower than optimal levels for sustaining fish health.
- BOD values were observed in the range of 13 to 17 mg/L, which exceeds acceptable limits, indicating moderate organic pollution. This suggests a considerable presence of organic matter in the water, resulting in elevated microbial activity and oxygen consumption.
- Total coliform concentrations ranged from 70 to 110 mg/l at all three locations, suggesting the presence of microbial contamination.

### 5.3.2.2 Ground Water Quality

As per CGWB data, ground water in the district is alkaline in nature and ranges from moderately to highly saline. Analysing ground water is essential to assess whether the construction and operation of the GMRP could potentially introduce contaminants or pollutants into the subsurface, thereby impacting ground water quality through leaching process.

To establish the baseline ground water quality, eight samples were collected along the GMRP alignment or its vicinity. The sampling locations are shown in **Figure 5-2** and the descriptions of ground water quality monitoring locations are provided in **Table 5-7**.

**Table 5-7 Location of Ground Water Samples**

Location No	Particulars	Latitude	Longitude	Source
GW1	Millennium City Centre	28.45739	77.07347	Bore Well
GW2	Sector-10	28.447465	76.997526	Bore Well
GW3	Subhash Chowk	28.428566	77.058486	Bore Well
GW4	Sector-4	28.472975	77.017484	Bore Well
GW5	Bajghera Road	28.502247	77.028314	Bore Well
GW6	Sector-22	28.500839	77.059598	Bore Well
GW7	Rao Gajraj Singh Marg	28.300335	77.042368	Bore Well
GW8	Depot	28.43006	77.0211	Bore Well

Source: RITES Field Study

The ground water samples were analyzed for various physical and chemical constituents to assess their suitability for domestic and irrigation use. The results of the water quality analysis were compared with the drinking water standards as specified in IS 10500:2012. The detailed results are presented in **Table 5-8**.

- The analysis indicates that parameters such as pH, Turbidity, Sulphate, Fluoride, Iron and Magnesium were within acceptable limits across all samples.
- Calcium, Alkalinity, Chloride, Total Hardness and Total Dissolved Solids exceeded the acceptable limits but remained within the permissible limits for drinking water standards.
- Chloride levels exceeded the acceptable limits in all samples but remained within permissible limits, except at Subhash Chowk (GW3), where the Chloride content was found within acceptable limits.
- Toxic substance including Total Arsenic (As), Lead (Pb), Hexavalent Chromium (Cr+6), Nickel (Ni), Mercury (Hg), Barium (Ba), Copper (Cu), Vanadium (V), and Phenolic Compound (C6H5OH) were not detected in any of the samples.
- Total Coliform and Faecal Coliform were also not detected in any of the ground water samples, indicating no microbiological contamination and serving as a positive indicator of good water quality in terms of microbiological safety.

**Table 5-8 Analysis of Ground Water Samples**

S. No.	Parameter	Unit	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	Acceptable Limit	Permissible Limit
1.	Temperature, °C		18.3	18.4	17.3	18.1	17.2	17.5	16.6	15.44	-	-
2.	pH Value	-	7.4	7.44	7.36	7.48	7.52	7.4	7.38	7.44	6.5-8.5	No relaxation
3.	Salinity	PPT	<1	<1	<1	<1	<1	<1	<1	<1	-	-
4.	Electrical Conductivity at 25 °C	µmhos/cm	1619	1762	1312	1402	1810	2016	2614	2511	-	-
5.	BOD at 5 days at 20 °C	mg/l	<2	<2	<2	<2	<2	<2	<2	<2	-	-
6.	COD	mg/l	7.4	8	<4	6.5	8.4	9.4	10.6	8	-	-
7.	Nitrate	mg/l	5.2	5.6	3.4	4.7	4.1	4.5	5.7	6.3	-	-
8.	Nitrite Nitrogen	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
9.	Turbidity	NTU	<1	<1	<1	<1	<1	<1	<1	<1	1 Max.	5 Max.
10.	Total Alkalinity (as CaCO3)	mg/l	319	354	284	331	318	372	562	532	200 Max.	600 Max.
11.	Chloride	mg/l	286	312	244	295	295	344	438	472	250 Max.	1000 Max.
12.	Total Kjeldahl Nitrogen (as N)	mg/l	<1	<1	<1	<1	<1	<1	<1	<1	-	-
13.	Total Phosphorous (as P)	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
14.	Ammonical Nitrogen (as N)	mg/l	<1	<1	<1	<1	<1	<1	<1	<1	-	-
15.	Total Hardness (as CaCO3)	mg/l	462	478	390	422	451	489	572	543	200 Max.	600 Max.
16.	Calcium (as Ca)	mg/l	105	112	88	95	104	120	136	128	75 Max.	200 Max.
17.	Sulphate as SO4	mg/l	109	117	90.6	98.5	98	128	192	180	200 Max.	400 Max.
18.	Sodium (as Na)	mg/l	79.6	86.4	54	66.5	79.8	95.6	98.7	92.6	-	-
19.	TDS	mg/l	917	952	766	852	977	1170	1411	1372	500 Max.	2000 Max.
20.	Total Suspendend Solids	mg/l	<1	<1	<1	<1	<1	<1	<1	<1	-	-
21.	Total Phosphote (as PO4)	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
22.	Boron (as B)	mg/l	ND	0.5 Max.	2.4 Max.							
23.	Magnesium (as Mg)	mg/l	48	48	41	44.6	46.2	45.7	56	52	-	-
24.	Potassium (as K)	mg/l	1.36	1.82	1.92	2.17	1.58	1.94	1.62	1.34	-	-
25.	Fluoride (as F)	mg/l	0.35	0.48	0.39	0.42	0.44	0.52	0.4	0.38	1 Max.	1.5 Max.
26.	Cadmium (as Cd)	mg/l	ND	0.003 Max.	No relaxation							
27.	Total Arsenic (as As)	mg/l	ND	0.01 Max.	No relaxation							
28.	Lead (as Pb)	mg/l	ND	0.01 Max.	No relaxation							
29.	Hexavalent Chromium (as Cr+6)	mg/l	ND	-	-							
30.	Nickel (as Ni)	mg/l	ND	0.02 Max.	No relaxation							
31.	Mercury (as Hg)	mg/l	ND	0.001 Max.	No relaxation							
32.	Iron (as Fe)	mg/l	0.24	0.2	0.18	0.13	0.28	0.22	0.29	0.31	1 Max.	No relaxation

S. No.	Parameter	Unit	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	Acceptable Limit	Permissible Limit
33.	Aluminium (as Al)	mg/l	ND	0.03 Max.	0.2 Max.							
34.	Barium (as Ba)	mg/l	ND	0.7 Max.	No relaxation							
35.	Copper (as Cu)	mg/l	ND	0.05 Max.	1.5 Max.							
36.	Residual Free Chlorine	mg/l	ND	0.2 Min.	1 Min.							
37.	Manganese (as Mn)	mg/l	ND	0.1 Max.	0.3 Max.							
38.	Phenolic Compound (as C6H5O6)	mg/l	ND	0.001 Max.	0.002 Max.							
39.	Selenium (as Se)	mg/l	ND	0.01 Max.	No relaxation							
40.	Silver (as Ag)	mg/l	ND	0.1 Max.	No relaxation							
41.	Sulphide (as H2S)	mg/l	ND	0.05 Max.	No relaxation							
42.	Zinc (as Zn)	mg/l	ND	5 Max.	15 Max.							
43.	Cyanide (as CN)	mg/l	ND	0.05 Max.	No relaxation							
44.	Total Chromium (as Cr)	mg/l	ND	0.05 Max.	No relaxation							
45.	Vanadium (as V)	mg/l	ND	-	-							
46.	Oil & Grease	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
48.	Total Nitrogen (as N)	mg/l	5.2	5.6	3.4	4.7	4.1	4.5	5.7	6.3	-	-
49.	Total Coliform	MPN/100ml	Absent	-	-							
50.	Faecal Coliform	MPN/100ml	Absent	-	-							

Source: RITES Field Study

### 5.3.3 Drainage

The drainage system in the project area falls within the Yamuna Sub-Basin. The district is traversed by two seasonal rivers Sahibi and Indrani and comprises of large depressions and natural streams. The depressions in the district are Khalipur, Chandaini, Sangel-Ujjina, Kotla Dahar Jheels and Najafgarh Lake.

The drainage pattern within a 10 km radius of the project area is shown in **Figure 5-4**. The GMRP alignment primarily passes through the urban areas of Gurugram City and crossing small streams/nalas, the details of which are given in **Table 5-9**.

**Table 5-9 Stream/Nala Crossings**

S. No.	Section		Nearest Chainage	Nearest Metro Station
	From	Towards		
1.	Ashok Vihar	Sector-3	16859	Ashok Vihar
2.	Cyber city /Udyog Vihar Phase 1	Cyber city	25670	Cyber city

### 5.4 Floods

The main cause of flooding in the district are the heterogeneous topography like hillocks and undulating terrain and rapid urbanisation, which has placed significant pressure on the natural drainage systems, leading to instances of urban flooding. Flood-prone villages in Gurugram Tehsil that are Bajghera, Chandu, Budhera, and Daultabad.

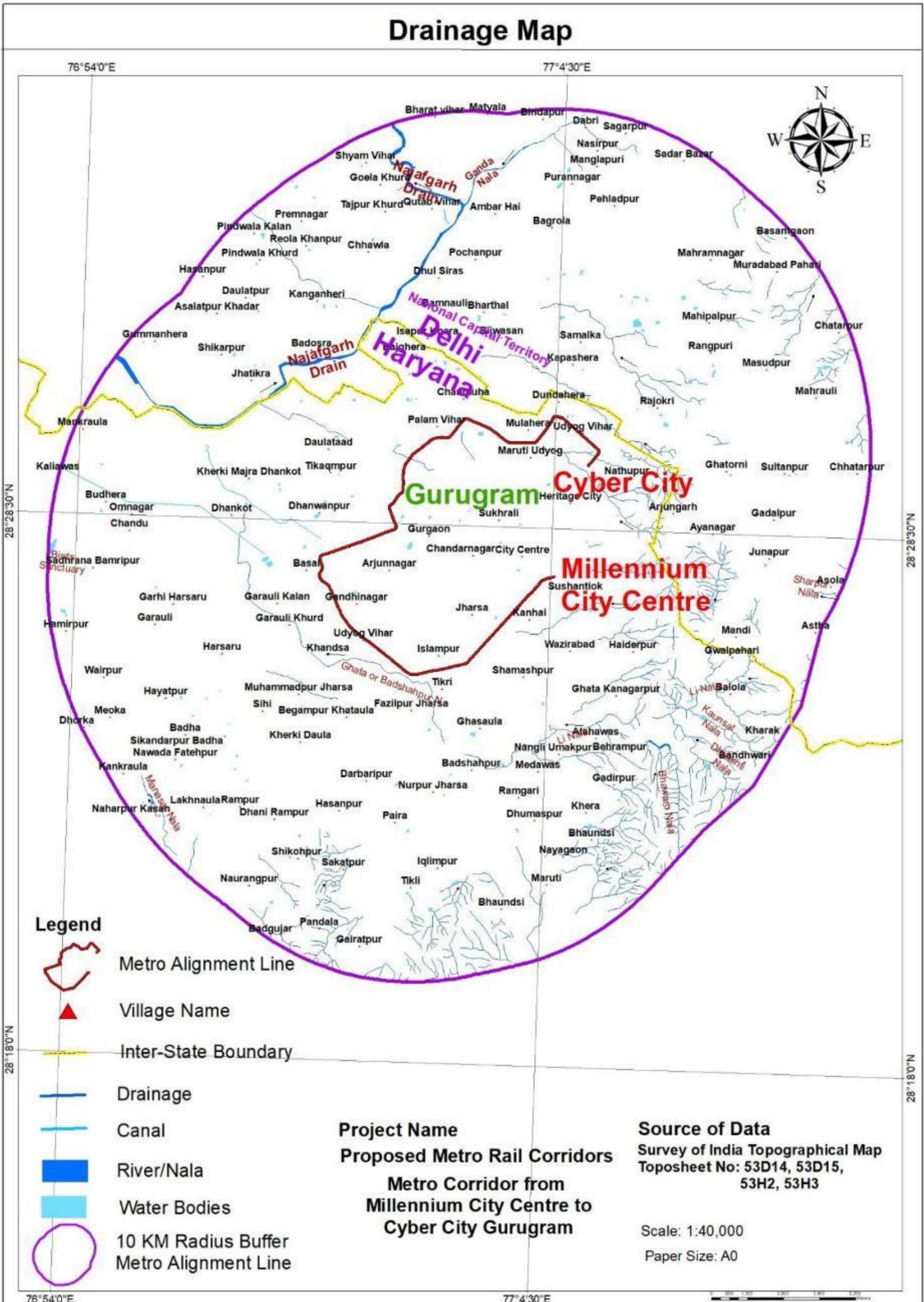
Critical areas prone to storm water stagnation near the GMRP alignment are given in **Table 5-10**.

**Table 5-10 Critical Areas prone to Storm Water Stagnation near to the alignment**

S. No.	Water Logging Points/Location
1.	Hero Honda Chowk & Opposite TPS-1
2.	Subhash Chowk
3.	Bakhtawar Chowk
4.	Umang Bharadwaj Chowk to Himgiri Chowk
5.	Khandsa Chowk
6.	Basai Chowk and Flyover
7.	Near ESI Hospital towards Sector 9A
8.	Sector-4/7 Chowk
9.	Presidium School Flyover Sector 2/3 & Krishna Chowk Palam Vihar

Source: Gurugram flood control order year 2023-24, Department of Revenue and Disaster Management, Government of Haryana

Figure 5-4 Drainage Map of the Project Area



Source: RITES

## 5.5 Meteorology

Air pollutant dispersion and concentration from both point and non-point sources are significantly influenced by meteorological and topographical conditions. Meteorological parameters such as temperature, wind speed and direction, humidity, and rainfall play a crucial role in regulating the transport and diffusion of pollutants in the atmosphere. Gurugram's climate is characterized by generally dry air (except during the monsoon season), hot summers, and cold winters. The region experiences four distinct seasons (i) Summer: March to end of June; (ii) Monsoon: July to mid-September (Southwest monsoon); (iii) Post Monsoon: Mid-September to end of November; (iv) Winter: December to early March.

**Temperature:** The district experiences considerable seasonal variation in temperature. January is the coldest month, with an average maximum temperature of 22.2°C and a minimum of 6.9°C. May and June are the hottest months, with June reaching an average daily maximum temperature of 40.8°C and occasionally exceeding 45°C.

**Rainfall:** Approximately 72% of the district's annual rainfall occurs between July and September, with July and September being the rainiest months. The average annual rainfall is approximately 505.4 mm.

**Humidity:** The air remains generally dry throughout the year, except during the monsoon. April and May are the driest months, with morning relative humidity around 30% and dropping below 20% in the afternoons. Humidity is highest during the southwest monsoon season.

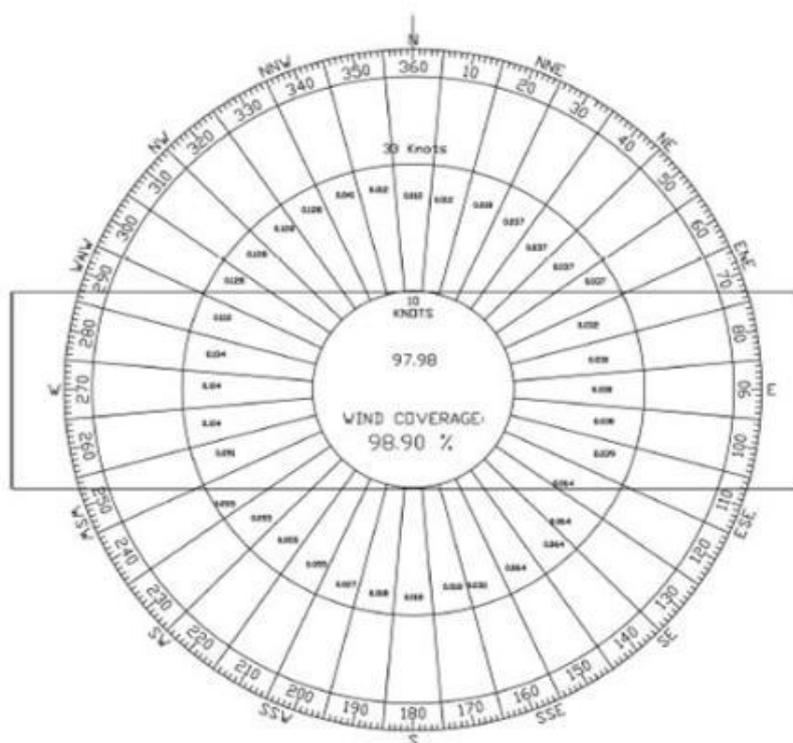
**Cloudiness:** Overcast or heavily clouded skies are typically observed during the monsoon and occasionally for short spells in winter. For the remainder of the year, skies remain mostly clear or lightly clouded.

**Winds:** Winds are generally light throughout the year but gain momentum during the summer and monsoon seasons. During the monsoon, winds mainly blow from the east or southeast, whereas during the rest of the year, they predominantly blow from the west or northwest, shifting to a northerly direction in the afternoon.

**Special weather phenomena:** Between April to June, the region experiences the highest frequency of dust-storms and thunderstorms, some of these can be intense. While some thunderstorms are dry, others are accompanied by heavy showers and occasional hail. Thunderstorms may also occur in winter, associated with Western disturbances.

**Wind Rose:** The wind rose diagram for Gurugram is shown in **Figure 5-5**, indicates that winds predominantly blow from the west 17%, northwest 21%, with calm conditions recorded 26.5 % of the time. Combined, the east west direction accounts for 22% of wind flow, while the northwest southeast axis accounts for 31.5%. The wind rose also shows that 98.9% of the wind speeds fall below 10 knots in the east–west direction

Figure 5-5 Wind Rose Diagram for Gurugram



Source: IMD

## 5.6 Air Environment

The pollution levels in Gurugram city are determined by the existing Ambient Air Quality Index (AQI), which classifies air quality into six categories: Good, Satisfactory, moderate, Poor, Very Poor and Severe. As per CPCB data, the ambient air quality in district varies from moderate to very poor for most parts of the year.

The baseline air quality survey was undertaken to evaluate compliance with national air quality standards. Monitoring was carried out at 12 locations near the GMRP alignment and depot for four weeks from November 2023 to January 2024. Monitoring sites were strategically selected to represent areas at major road intersections, commercial areas and places with high population density or sensitive populations. The air quality monitoring locations are listed in **Table 5-11** and shown in **Figure 5-2**. The results of the air quality analysis are summarized **Table 5-12**.

Table 5-11 Description of Air Quality Monitoring Locations

Station. Id	Location /Metro Station	Distance from Alignment (m)	Latitude	Longitude
A1.	Millennium City Center	150	28°27'26.02"N	77° 4'24.61"E
A2.	Subash Chowk	20	28°25'42.33"N	77° 2'18.07"E
A3.	Hero Honda Chowk	32	28°26'9.82"N	77° 0'33.88"E
A4.	Umang Baradwaj Chowk	10	28°26'49.86"N	76°59'52.09"E
A5.	Basai Chowk	5	28°27'30.12"N	76°59'24.91"E
A6.	Sector 4-7 Chowk	46	28°28'23.77"N	77° 1'4.31"E
A7.	Ashok Vihar	20	28°29'9.89"N	77° 1'11.75"E
A8.	Near Bajghera Road Station	36	28°30'7.96"N	77° 1'42.74"E

Station Id	Location /Metro Station	Distance from Alignment (m)	Latitude	Longitude
A9.	Rejang La Chowk	56	28°30'31.57"N	77° 2'38.83"E
A10.	Palam Mod	40	28°30'9.52"N	77° 4'4.43"E
A11.	Cyber City	20	28°29'50.50"N	77° 5'13.82"E
A12.	Depot	95	28°25'47.208"N	77°1'15.672"E

Source: RITES Field Study

Table 5-12 Analysis of Ambient Air Samples in Project Area

Station Id	Location	Day	PM <sub>2.5</sub>	PM <sub>10</sub>	SO <sub>2</sub>	NO <sub>2</sub>	CO	O <sub>3</sub>	HC
<b>Permissible Limit as per (NAAQS)</b>			<b>60*</b>	<b>100*</b>	<b>80*</b>	<b>80*</b>	<b>2**</b>	<b>100**</b>	<b>NS</b>
<b>Unit</b>			<b>µg/m<sup>3</sup></b>	<b>µg/m<sup>3</sup></b>	<b>µg/m<sup>3</sup></b>	<b>µg/m<sup>3</sup></b>	<b>mg/m<sup>3</sup></b>	<b>µg/m<sup>3</sup></b>	<b>µg/m<sup>3</sup></b>
A1	Millennium City Center	1	112.8	220.5	10.5	24.8	0.9	26.1	ND
		2	119.4	239.1	12.7	26.1	0.9	27.2	ND
A2	Subash Chowk	1	119.5	232.4	11.3	19.7	1.2	24.5	ND
		2	140.2	256.8	13.5	18.5	1.2	25.8	ND
A3	Hero Honda Chowk	1	149.5	259.3	12.7	24.5	1.1	34.5	ND
		2	137.6	242.1	12.2	26.9	1.2	28.9	ND
A4	Umang Baradwaj Chowk	1	113.8	205.9	10.4	18.7	1	ND	ND
		2	92.7	189.3	12.3	19.2	0.9	ND	ND
A5	Basai Chowk	1	138.5	246.2	12.3	20.6	0.8	37.4	ND
		2	131.8	239.7	13.5	27.7	0.9	29.4	ND
A6	Sector 4-7 Chowk	1	118.9	242.5	10.5	19.8	1.1	24.2	ND
		2	114.3	236.9	12.7	20.5	0.9	29.3	ND
A7	Ashok Vihar	1	89.6	205.3	12.4	22.1	0.9	29.2	ND
		2	102.5	219.6	13.8	24.3	0.8	27.4	ND
A8	Near Bajghera Road Station	1	112.5	209.8	13.5	24.2	1	26.9	ND
		2	126.4	235.9	14.1	23.5	1	28.2	ND
A9	Rejang La Chowk	1	123.6	249.6	19.3	27.5	0.9	30.5	ND
		2	118.1	252.5	20.5	28.4	1.1	28.2	ND
A10	Palam Mod	1	110.8	245.2	17.5	24.5	0.9	26.8	ND
		2	119.5	240.8	16.1	23.8	0.9	25.3	ND
A11	Cyber City	1	114.5	243.8	18.3	37.4	1	32.2	ND
		2	116.9	237.5	18.9	38.9	1	29.5	ND
A12	Depot	1	121.7	228.9	13.5	24.2	1	ND	ND
		2	105.9	198.4	15.3	25.4	1.1	ND	ND

Source: RITES Field Study

Remarks: (\*) 24 Hour Average; (\*\*) Annual Average; ND=Not Detected

The findings of air quality monitoring are as follows:

- PM<sub>10</sub> & PM<sub>2.5</sub> concentrations exceeded the permissible limits for residential, industrial and sensitive areas at all locations.
- SO<sub>x</sub>, NO<sub>x</sub> and CO levels were within the permissible limits for all land use categories across all monitoring locations.
- Ozone was detected at all locations except at A4, and the concentrations level at all locations were within permissible limits.
- Hydrocarbons were not detected at any of the monitoring locations.

- Based on the monitoring results, the AQI in the project area ranged from 199 to 322, categorizing the air quality as moderate to very poor.

## 5.7 Noise

The construction and operation of a GMRP corridor generates noise, which may impact adjoining areas. Noise monitoring is essential to assess baseline conditions and implement appropriate mitigation measures.

To evaluate existing noise levels and anticipate potential project-related impacts, monitoring was conducted at 20 locations along the alignment and within the project area. Noise levels were recorded hourly over two consecutive days to evaluate both daytime and night-time noise intensity

The noise monitoring locations are given in **Table 5-13** and shown in **Figure 5-2** and while the recorded noise levels are summarized in **Table 5-14**.

**Table 5-13 Description of Noise Monitoring Locations**

Station Id	Location	Distance from Alignment (m)	Latitude	Longitude	Category of Area/Zone
N1.	Fortis Hospital, near Millennium City Center	150	28°27'26.02"N	77° 4'24.61"E	Silence
N2.	Subash Chowk	20	28°25'42.33"N	77° 2'18.07"E	Residential
N3.	Udyog Vihar Phase 6 Metro station	70	28°26'35.19"N	76°59'57.90"E	Silence
N4.	Near Greenwood Public school (Basai Pond)	10	28°27'42.84"N	76°59'24.59"E	Silence
N5.	ESIC Hospital	22	28°28'3.40"N	77° 0'3.09"E	Silence
N6.	Near Jain Sant Phool Chand Ji Charitable Hospital	60	28°28'40.46"N	77° 0'59.35"E	Silence
N7.	Block C2, Near Blossoms Primary School, Sector 3	25	28°29'36.86"N	77° 1'11.04"E	Residential
N8.	Infront of G A V International School	25	28°29'55.02"N	77° 1'25.12"E	Residential
N9.	Near Krishna Chowk, Presidium School, Palam Vihar	36	28°30'7.96"N	77° 1'42.74"E	Commercial
N10.	Manipal Hospital, Palam Vihar	56	28°30'31.57"N	77° 2'38.83"E	Silence
N11.	Near Rotary Public School	20	28°30'8.89"N	77° 3'52.58"E	Silence
N12.	Cyber City	20	28°29'50.50"N	77° 5'13.82"E	Commercial
N13.	Near Unitech Cyber Park	20	28°26'32.72"N	77° 3'25.61"E	Commercial
N14.	Sector 47 Metro station	5	28°26'5.24"N	77° 2'57.84"E	Commercial

Station Id	Location	Distance from Alignment (m)	Latitude	Longitude	Category of Area/Zone
N15.	Sector 72/A Metro station	20	28°25'35.32"N	77° 1'28.75"E	Commercial
N16.	HeroHonda Chowk	15	28°26'9.43"N	28°26'9.43"N	Commercial
N17.	Sector 4-7 Chowk	10	28°28'23.77"N	77° 1'4.31"E	Commercial
N18.	Sector 5 gol chakkar	32	28°29'9.98"N	77° 1'12.23"E	Commercial
N19.	Sector 22 Metro station	40	28°30'9.52"N	77° 4'4.43"E	Commercial
N20.	Udyog Vihar Phase V Metro station	20	28°30'0.69"N	77° 4'49.60"E	Commercial

Source: RITES Field Study

Table 5-14 Noise Levels (in dB) in the Project Area

Station Id	Day	Lmin	L <sub>10</sub>	L <sub>50</sub>	L <sub>90</sub>	Leq	Lmax	Leq-day	Leq-night
N1.	1	41.8	64.0	57.5	47.4	62.5	72.5	63.9	48.5
	2	43.9	64.9	59.8	48.5	62.4	69.3	63.9	49.9
N2.	1	43.7	63.1	56.6	52.3	61.0	71.2	62.4	52.2
	2	42.5	64.5	58.2	50.9	62.9	71.9	64.4	51.8
N3.	1	36.4	52.5	47.6	43.3	52.4	62.3	53.9	44.1
	2	37.2	52.6	46.6	41.5	52.6	64.1	54.1	44.6
N4.	1	36.8	53.0	46.6	41.5	52.8	64.3	54.3	44.2
	2	37.3	53.3	46.9	41.7	53.4	65.3	54.9	44.8
N5.	1	37.9	67.0	50.9	42.8	52.8	68.1	53.7	44.8
	2	38.8	66.1	50.4	42.8	52.1	67.3	54.5	43.5
N6.	1	39.6	54.5	43.8	40.0	51.7	62.8	53.2	43.6
	2	38.6	54.8	44.7	40.5	52.5	63.9	54.0	43.7
N7.	1	42.3	67.3	56.8	44.0	53.1	70.8	53.8	44.5
	2	43.5	68.0	57.6	45.1	53.4	72.1	54.3	44.1
N8.	1	41.6	66.6	59.3	48.2	62.4	68.9	63.9	44.6
	2	40.8	67.7	59.8	43.2	63.1	68.1	64.7	45.7
N9.	1	38.7	64.4	60.2	47.5	61.2	66.8	62.6	48.3
	2	37.5	63.6	59.3	47.0	60.4	65.3	61.7	47.7
N10.	1	39.2	62.4	59.3	45.7	52.4	67.3	53.7	43.9
	2	40.9	64.4	59.5	47.4	52.9	66.2	54.1	44.4
N11.	1	38.4	50.0	43.6	40.4	53.3	66.3	54.8	44.4
	2	39.5	49.4	43.6	40.6	52.0	64.8	53.5	44.7
N12.	1	38.1	63.4	57.3	49.6	59.7	67.5	61.2	50.1
	2	37.3	63.8	55.8	48.5	59.1	66.3	60.5	49.4
N13.	1	42.9	66.4	60.6	43.9	63.2	68.5	64.5	49.7
	2	41.2	64.8	60.1	44.9	62.5	70.1	63.7	50.5
N14.	1	35.4	55.2	46.0	41.1	52.9	63.9	54.5	44.4
	2	36.6	55.4	46.3	40.1	52.4	62.8	53.9	43.8
N15.	1	40.7	56.0	45.2	41.8	53.3	65.9	54.8	44.9
	2	38.1	53.9	45.9	41.1	51.8	62.3	53.3	43.8
N16.	1	41.9	65.9	53.6	51.6	62.7	72.5	64.3	52.1
	2	42.8	66.6	55.3	51.8	64.3	73.1	66.0	52.9
N17.	1	37.5	65.5	60.2	49.4	52.3	65.3	53.9	44.1
	2	40.1	65.7	60.4	47.1	52.6	66.2	54.3	43.9
N18.	1	39.2	54.9	45.4	41.4	52.7	64.1	54.3	43.4

Station Id	Day	Lmin	L <sub>10</sub>	L <sub>50</sub>	L <sub>90</sub>	Leq	Lmax	Leq-day	Leq-night
N19.	2	38.6	54.6	45.3	40.0	53.3	65.3	54.8	44.2
	1	38.5	68.3	58.0	42.8	63.3	69.7	64.8	47.4
	2	37.9	67.9	59.1	42.4	63.1	68.9	64.6	47.3
N20.	1	41.9	65.2	57.6	44.6	52.8	67.3	53.7	44.6
	2	42.3	63.4	57.5	43.6	53.1	66.5	54.5	44.2

Source: RITES Field Study

The analysis of noise level monitoring reveals the following observations:

- Day time and night-time noise levels at locations N1, N3, N4, N5, N6, N10 and N11 exceeded the permissible limits for silence zones.
- At location N7, noise levels during both day-time and night-time were within the permissible limits for a residential zone. However, at location N2, both daytime and nighttime noise levels exceeded the permissible limits for residential areas. At location N8, noise levels exceeded the permissible limits during daytime on both sampling days and nighttime on one of the sampling days.
- Daytime and nighttime noise levels at locations N9, N12, N13, N14, N15, N17, N18, N19 and N20 were within the permissible limits for commercial zone. However, at N16 location, noise levels exceeded the daytime limit for a commercial zone on one sampling day.
- Noise levels at locations N2, N6, N12, N13, N14, N15, N16, N17, N18 and N20 were found within the permissible limits for residential and commercial zones.
- Fortis Hospital near Millennium City Centre and the area around GAV International School both classified as sensitive zones were observed to have elevated noise levels.

## 5.8 Vibration

Human response to vibration is subjective and can vary significantly among individuals. When vibrations transmitted through floors and walls, they may become perceptible depending on their amplitude and frequency. Such vibrations can cause the rattling of windows, dishes and other objects, resulting in audible disturbances known as ground-borne noise. Ground-borne vibration, often caused by trains, buses on rough roads, construction activities such as pile-driving or the use of heavy equipment's, etc. can be a significant concern for residents living near transit routes. Blasting activities are not required for GMRP.

To assess baseline vibration conditions, 24 hours vibration monitoring was carried out at 10 locations, as listed in **Table 5-15** shown in **Figure 5-2** using vibration level meter. The vibration meter recorded vertical vibrations in VdB, and the summary of results are presented in **Table 5-16**.

**Table 5-15 Description of Vibration monitoring locations**

Station. Id	Location	Distance from Alignment (m)	Latitude	Longitude	Environmental Setting
V1.	Fortis Hospital	15	28°28'24"N	77°04'22"E	Sensitive
V2.	Manipal Hospital	70	28°30'33"N	77°02'28"E	Sensitive
V3.	ESIC	50	28°28'03"N	77°00'03"E	Sensitive
V4.	INOX Mall	45	28°28'24"N	77°01'02"E	Commercial
V5.	Unitech Cyber Park	52	28°26'35"N	77°03'25"E	Commercial
V6.	Greenwood School	50	28°27'44"N	76°59'26"E	Sensitive

Station. Id	Location	Distance from Alignment (m)	Latitude	Longitude	Environmental Setting
V7.	Presidium School	10	28°30'10"N	77°01'46"E	Sensitive
V8.	Sector-22 Palam Vihar	60	28°30'10"N	77°03'59"E	Residential
V9.	Apartment Near Subhash Chowk	150	28°25'42"N	77°02'17"E	Residential
V10.	Infosys Ltd.	100	28°25'35"N	77°01'40"E	Commercial

Source: RITES Field Study

**Table 5-16 Vibration Monitoring Results**

S. No.	Location Name	Ambient Vibration at monitored location (Vdb)	Ambient Vibration at Receptor Location (Vdb)
V1	Fortis Hospital	69	51.5
V2	Manipal Hospital	56	56.0
V3	ESIC	61.8	47.8
V4	INOX Mall	60.1	36.6
V5	Unitech Cyber Park	66.2	53.8
V6	Greenwood School	79.9	69.4
V7	Presidium School	54	40.0
V8	Sector -22, Palam Vihar	66.8	51.2
V9	Apartment near Subash Chowk	69.9	46.4
V10	Infosys	63.5	47.0

Source: RITES Field Study

As indicated in the table above, the predicted vibration level at the Greenwood School (V6 location) exceeds the ground vibration limits outlined in the RDSO guidelines. However, the actual vibration level experience at the building structure is expected to be lower due to the attenuation of vibrations with distance.

## 5.9 Biological Environment

This section presents the baseline status of the biological environment within the project area, based on primary data collected through field surveys and secondary data collated from relevant literature. The scope of the biological baseline includes assessments of flora, fauna, habitats and overall biodiversity in the region. The project area falls within the Semi-Arid biogeographical zone.

Tree Inventorisation was carried out by identifying tree species with a girth greater than 30 cm at chest height. Species identification was conducted using taxonomic manuals, published literature, and verified sources such as the Botanical Survey of India (BSI) and the State/District Forest Department. Faunal species were documented through primary surveys and validated secondary sources. All identified faunal species were screened against the Schedules of the Wildlife (Protection) Act, 1972, and cross-verified with the International Union for Conservation of Nature (IUCN) Red List to determine their conservation status.

### 5.9.1 Forest Area

Haryana's landscape is primarily agricultural, with approximately 80% of its area under cultivation. Forestry activities are primarily concentrated in the rugged Shivalik Hills in the

north and the Aravalli Hills in the south. Forests in Haryana are classified as Reserved, Protected and Unclassified under the Indian Forest Act, 1927 and the Punjab Land Preservation Act, 1900. The state's forest cover constitutes around 3.63% of its total geographical area. The area wise distribution of forests by category is provided in **Table 5-17**.

**Table 5-17 Categories of Forests in Gurugram District**

S. No.	Type of forest	Area (in hectares)
1.	Reserved Forest/ Block Forest	214.89
2.	Protected Forest	144.68
3.	Unclassified Forest	22.66
4.	Areas closed under section 4/5 of PLPA 1900	6824.85
5.	Strip forests (Protected)	1443.59
6.	Areas closed under Section 38	247.37
<b>Total</b>		<b>8898.04</b>

Source: Divisional Forest Office, Gurugram

An unclassified forest area of 1.725 ha (4.26 acres) is located near the Sector 10 Metro Station and is classified as a terrestrial modified habitat. The entry/exit of the Sector 10 Metro Station falls within the unclassified forest, which predominantly occupied by Vilayati Kikar (*Prosopis juliflora*), an invasive species commonly found along roadsides in India. This species is known for its rapid growth and aggressive spread, often displacing growth of native vegetation. Approximately 3,598 sqm (equivalent to 0.3598 ha i.e. 21% of the total forest area) will be required for the construction of the metro alignment and station infrastructure. The entire forest-designated area will not be impacted, only a limited portion is proposed to be utilized. The location of forest area is depicted in **Figure 5-6**.

**Figure 5-6 Location of Forest Area at Entry/Exit of Sector-10 Metro Station**



## 5.9.2 Flora

The common tree species identified along the GMRP corridor during field study are provided in **Table 5-18**.

**Table 5-18 Tree Species Found along the GMRP Corridor**

S. No.	Scientific Name	Common name	Native/Exotic/Invasive
1.	<i>Ailanthus excelsa</i>	Ullo Neem	Native
2.	<i>Albizia lebbek</i>	Siris	Native
3.	<i>Alstonia scholaris</i>	Saptaparni	Native
4.	<i>Azadirachta indica</i>	Neem	Native
5.	<i>Senegalia senegal</i>	Khairi	Native
6.	<i>Broussonetia papyrifera</i>	Paper mulberry	Native
7.	<i>Cassia fistula</i>	Amaltas	Native
8.	<i>Dalbergia sissoo</i>	Shisham	Native
9.	<i>Delonix regia</i>	Gulmohar	Exotic
10.	<i>Eucalyptus cameldulensis</i>	Safeda	Invasive
11.	<i>Ficus benghalensis</i>	Bargad	Native
12.	<i>Ficus religiosa</i>	Peepal	Native
13.	<i>Ficus glomerata</i>	Gular	Native
14.	<i>Leucaena leucocephala</i>	Subabul	Invasive
15.	<i>Melia azedarach</i>	Bakain	Native
16.	<i>Putranjiva roxburghii</i>	Putranjiva	Native
17.	<i>Polyalthia longifolia</i>	Ashok	Native
18.	<i>Pongamia pinnata</i>	Karanja	Native
19.	<i>Prosopis juliflora</i>	Vilayati Kikar	Invasive
20.	<i>Senegalia catechu</i>	Khair	Native
21.	<i>Terminalia arjuna</i>	Arjun	Native
22.	<i>Vachellia nilotica</i>	Babool	Native

Source: RITES Field Study

## 5.9.3 Fauna

Wildlife species found in Gurugram district include Common langur, Golden Jackal, Leopard, Jungle Cat, Indian Grey Mongoose, Nilgai, Monkey, Sambar, etc. Small mammals such as squirrels and mouse are also present along with reptiles like the Common Garden Lizard and Rat Snake. The list of bird and animal species observed in the district, along with their IUCN conservation status and classification under the WPA, 1972, is provided in **Annexure 5.2**.

## 5.9.4 Habitat and Biodiversity in the region

For the ecological study, a buffer distance of 10 km on either side of the GMRP alignment has considered. Sultanpur National Park (a designated Ramsar Site), KBA/IBA in Sector 101, Basai and Najafgarh Jheel are located within this 10 km radius from the GMRP alignment.

### 5.9.4.1 Sultanpur National Park

Sultanpur National Park is an intermittent freshwater wetland and has been designated as a Wetland of International Importance (Ramsar site) under the Ramsar Convention. The mosaic of habitats within the park supports a spectacular diversity of species.

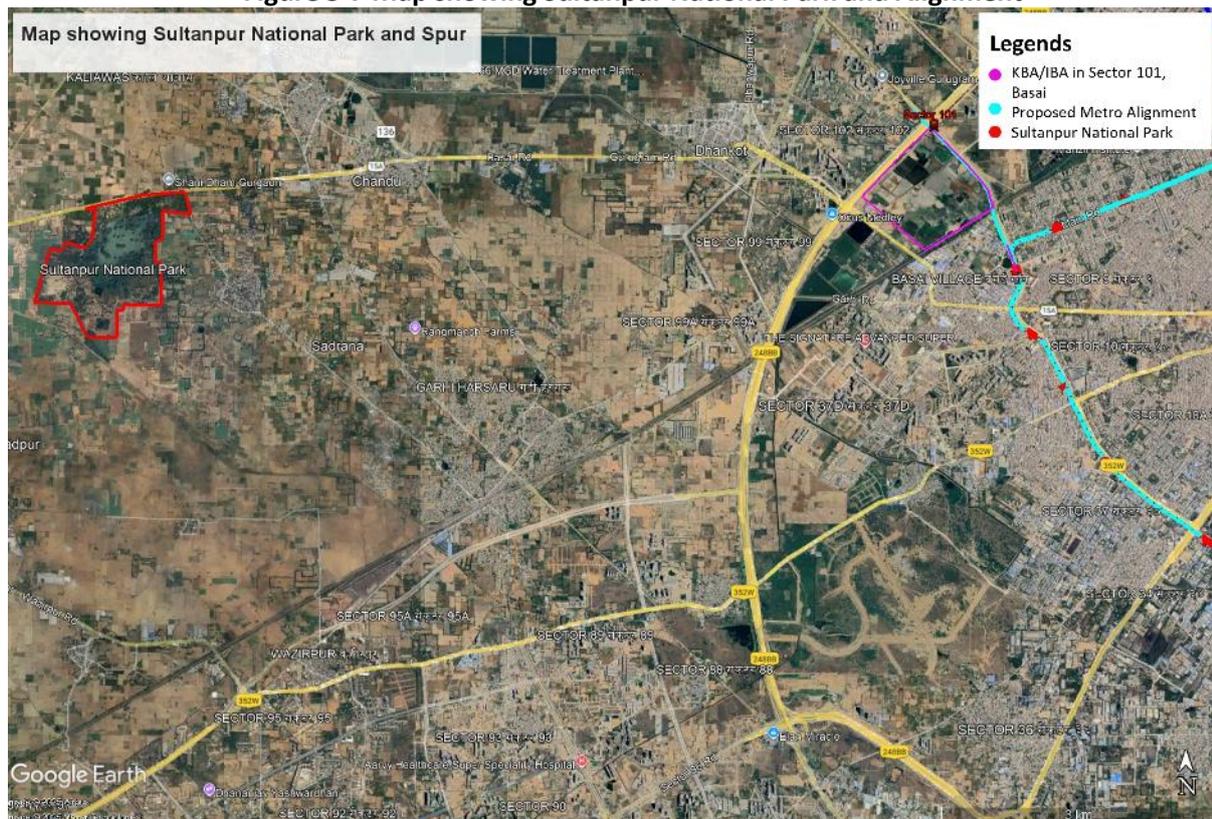
It is located about 8.2 km from the nearest point of the proposed spur from Basai Village to Dwarka Expressway. The National Park covers an area of 143 ha. The location map of the park is represented in **Figure 5-7**.

According to Rodgers and Panwar’s (1987) classification, this Ramsar wetland falls within the semi-arid biogeographic zone and features habitats such as grasslands and marshes. Sultanpur National Park has been assigned IBA Site Code IN-HR-04. It was declared a National Park in July 1991 and recognized as a Ramsar site in 2021.

As per the MoEF&CC Notification dated 27.01.2010, a 5 km radius from the park boundary has been declared an Eco Sensitive Zone (ESZ). The end point of spur is 3.2 km from the boundary of ESZ. The wetland forms the core area of the National Park, is primarily fed by overflow from nearby canals and agricultural fields and is also replenished by saline groundwater.

**Flora:** The vegetation of this park is tropical and dry deciduous, and the flora include grasses, Khair (*Senegalia catechu*), Karanja (*Pongamia Pinnata*), Arjun (*Terminalia arjuna*), Bargad (*Ficus benghalensis*), Neem (*Azadirichta indica*), Babool (*Acacia nilotica*) and Israeli Babool (*Acacia tortilis*) etc.

**Figure 5-7 Map showing Sultanpur National Park and Alignment**



Source: RITES

**Fauna:** The terrestrial fauna of Sultanpur National Park includes species such as the Nilgai (*Boselaphus tragocamelus*) Indian Hare (*Lepus nigricollis*), Golden Jackal (*Canis aureus indicus*), Indian Grey Mongoose (*Herpestes edwardsii*), Rhesus Macaque (*Macaca mulatta*) etc.

**Avifauna:** The wetland supports a rich diversity of avifauna, with over 250 species of resident, winter migratory and local migratory waterbirds recorded at various critical stages of their life cycles. The site hosts several globally threatened species, including the Critically Endangered Sociable Lapwing (*Vanellus gregarius*), and the endangered Egyptian vulture (*Neophron percnopterus*), Saker falcon (*Falco cherrug*), Pallas's fish eagle (*Haliaeetus leucoryphus*) and Black-bellied tern (*Sterna acuticauda*). The site regularly supports over 7% of the biogeographic population of the Bar-headed goose (*Anser indicus*) and more than 8% of the Greylag goose (*Anser anser*) populations, underscoring its international ecological significance. Other notable bird species observed in the park include

**Raptors:** Crested sparrowhawk (*Accipiter trivirgatus*), Besra (*Accipiter virgatus*), Shikra (*Accipiter badius*), Eurasian sparrowhawk (*Accipiter nisus*),

**Mynas:** Common myna (*Acridotheres tristis*), Jungle myna (*Acridotheres fusca*), Bank myna (*Acridotheres ginginianus*),

**Others:** Indian great reed warbler (*Acrocephalus stentorus*), Common sandpiper (*Actitis hypoleucos*), Oriental skylark (*Alauda gulgula*), Common kingfisher (*Alcedo atthis*) are also found in the park.

#### 5.9.4.2 KBA/IBA in Sector 101, Basai

KBA/IBA in Sector 101, Basai was historically characterized as a low-lying area, holds considerable ecological significance, particularly for its avian biodiversity. It was recognised by KBA as an IBA under site code IN-HR-01 and is also listed as a KBA due to its role in supporting a wide variety of migratory and resident bird species recoded over the years. The IBA assessment conducted in 2004 established that the site in Sector 101, Basai met multiple IBA criteria, including: A1 - Presence of globally threatened species, A4i - Supporting at least 1% of the biogeographic population of certain bird species and A4iii - Hosting large congregations of birds.

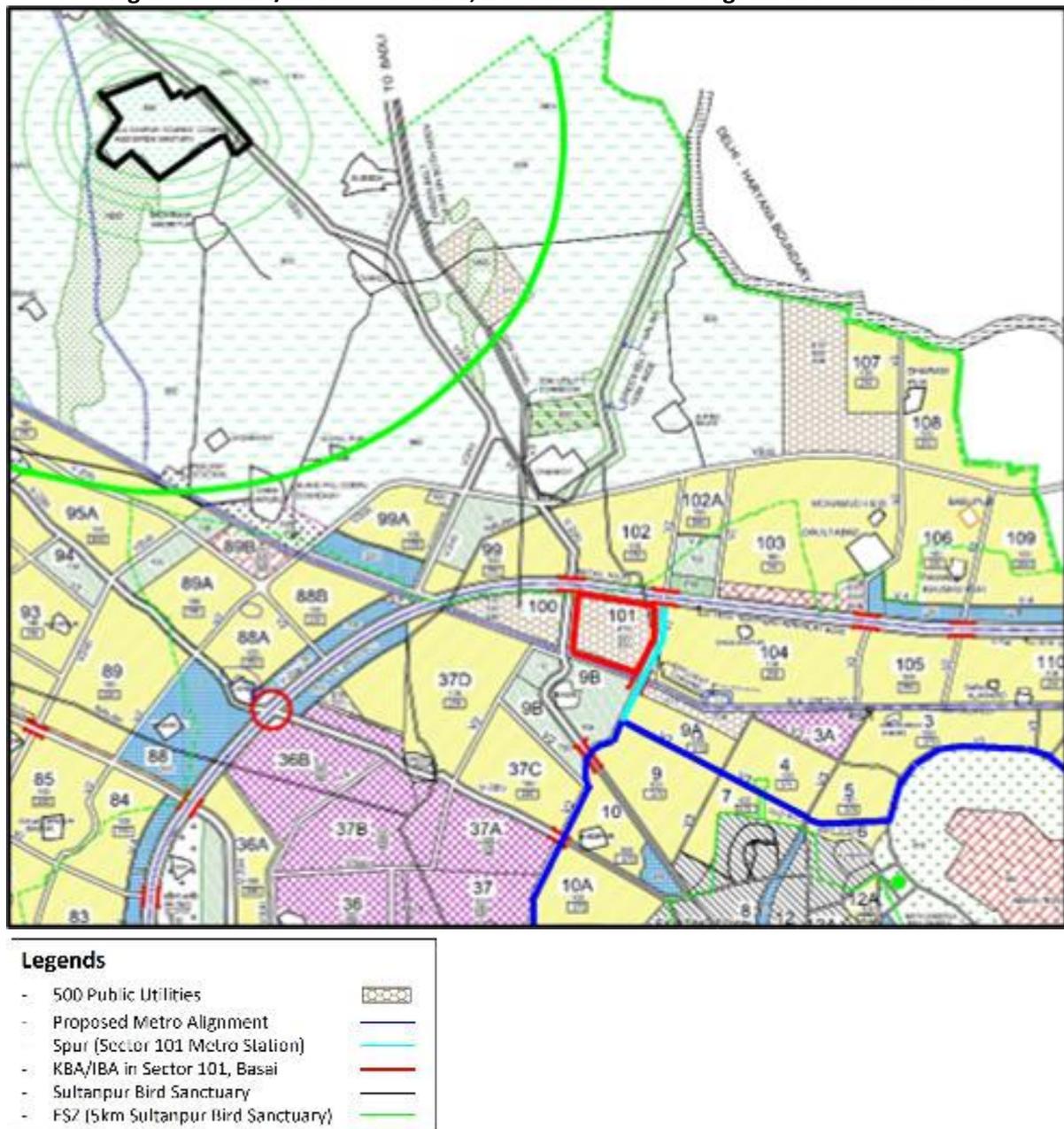
KBA/IBA in Sector 101, Basai is not notified as a wetland by Gol and GoH and it is not listed in the Indian National Wetland Inventory. As per the Gurugram Master Plan 2031, Sector 101 is categorized as "Public Utilities" such Water Works, Disposal Works and Grid Sub Station. The silent feature of the area is provided in **Table 5-19** and **Figure 5-8** illustrates the location of the KBA/IBA in Sector 101, Basai, as marked on the Gurugram Master Plan 2031.

**Table 5-19 Silent Feature of KBA/IBA in Sector 101, Basai**

S. No.	Parameters	Description
1.	Name	Basai Wetland as per IBA, 2004
2.	Location	Sector 101, Basai
3.	Coordinates	28.47° N, 76.98°E
4.	Biogeographic Zone	Semi-Arid
5.	Area	Approx. 250 Acres
6.	Source of Water	The main source of water is from overflow water from the broken drain, which carries Effluent from nearby STP.
7.	Notification if any	Not notified as Wetland by State and Central Government

S. No.	Parameters	Description
8.	Land use as per Master Plan, 2031 of Gurugram	Sector 101 is categorized as “Public Utilities” for Water Works, Disposal Works, and Grid Sub Station.
9.	Whether a Ramsar site?	No
10.	Whether a protected site?	No
11.	Listed in Important Bird Area (IBA)	Yes, as per IBA assessment in the year 2004
12.	IBA Site Code	IN-HR-01
13.	IBA Criteria in the year 2004	A1: Threatened Species, A4i: (>=1% of biogeographical population) and A4iii: (Congregatory species).

Figure 5-8: KBA/IBA in Sector 101, Basai marked on Gurugram Master Plan 2031



Source: Master Plan 2031, Gurugram

The GMRP spur alignment passes along the edge of this area, making it as an environmentally sensitive zone adjacent to the GMRP. A map showing KBA/IBA in Sector 101, Basai and the GMRP alignment is presented in **Figure 5-9**.

Biodiversity and ecosystems are critical components to be considered in any infrastructure projects. A preliminary biodiversity assessment was conducted in January 2024 to identify and evaluate the potential risks and impacts of the spur alignment adjacent to the KBA/IBA in Sector 101, Basai and to proposed appropriate mitigation measures.

**Figure 5-9: KBA/IBA in Sector 101, Basai**



Source: RITES

#### **A. Preliminary Biodiversity Assessment of the KBA/IBA in Sector 101, Basai**

The preliminary assessment is based on site visits, public consultation and a review of secondary data sourced from various national and international websites, research articles, etc.

A habitat refers to the place or environment where an organism or a biological population lives and sustains itself. As per WB ESS 6, this area falls under modified habitat.

The study approach utilizes measurable and field-monitorable indicators to assess habitat conditions, particularly the status of the water spread area. The specific criteria and indicators adopted for the assessment are presented in **Table 5-20**. Photographic documentation from the January 2024 site visit is provided in **Figure 5-10**.

Table 5-20 Indicators for KBA/IBA in Sector 101, Basai

S. No.	Indicator	Explanation	Method of Assessment	Remarks
<b>Criteria 1: Ecosystem Level</b>				
1.	Surrounding land use	Adjacent land use has an influence on the overall water spread area. Agriculture practices, settlements, encroachments negatively affect water spread area.	Field observation and Satellite imagery (google earth)	The urban settlements surrounding KBA/IBA in Sector 101, Basai include real estate development, flyover, roads, expressway, railway line, sewage treatment plant, water treatment plant. As per Gurugram Master Plan 2031, the land use of in Sector 101, is categorized as "Public Utilities" for Water Works, Disposal Works, and Grid Sub Station.
2.	Shallow water zone (depth<2m)	Most productive zone of water spread area and indicates good health of KBA/IBA in Sector 101, Basai.	Field observation	Migratory bird species, especially those using the Central Asian Flyway, frequently visits Sultanpur National Park. Due to the close proximity of KBA/IBA at Sector 101, Basai, some of these birds are also observed to migrate to this area for resting.
3.	Impervious structures	Presence of impervious structures around KBA/IBA in Sector 101, Basai site such as flyovers, expressway, buildings, railway tracks, embankments etc. can reduce percolation and disturb water availability from catchment.	Field observation, satellite imagery (google earth)	Permanent impervious structures in the vicinity of KBA/IBA in Sector 101, Basai includes Dwarka Expressway, Gurugram-Rewari railway line, Rail overbridge/ flyovers, residential complexes including high-rise building apartments, sewage treatment plant, water treatment facility.
<b>Criteria 2: Water Quality</b>				
1.	Physico-Chemical properties	The physico-chemical properties of water, such as pH, BOD, and TSS, serve as key indicators of the ecological health of the water spread area.	Sampling and analysis carried out as per the IS standards	Water quality status: <ul style="list-style-type: none"> <li>• pH: 7.35</li> <li>• BOD: 15.6 mg/l</li> <li>• COD: 77 mg/l</li> <li>• Turbidity: 25.5 NTU</li> <li>• TSS: 36 mg/l</li> <li>• D.O: 3.9 mg/l</li> </ul>

S. No.	Indicator	Explanation	Method of Assessment	Remarks
				The primary source of water in KBA/IBA at Sector 101, Basai is treated effluent from the STP. Water quality analysis indicates that the dissolved oxygen levels are slightly below the optimal range for sustaining fish health and reveal the presence of a considerable amount of organic matter.
2.	Algal Bloom /Water Hyacinth invasion	The dissolved oxygen level reflects the ecological functions and also indicates a high level of eutrophication due to the presence of sewage and fertilizers.	Field observation	Visual inspection revealed the presence of algal mats and water hyacinth on the water surface when inundation is high.
<b>Criteria 3: Biotic Indicators</b>				
1.	Free Floating invasive species	Floating invasive species form thick mats on the water surface, hindering light penetration and affecting native aquatic species.	Field observation	Invasive species such as Water Hyacinth ( <i>Eichhornia crassipes</i> ) are present on the water surface and are a primary factor contributing to the deterioration of water quality.
<b>Criteria 4: Biotic Indicators (Fauna)</b>				
1.	Native aquatic fauna	The presence of native fauna such as fish, crabs, shrimps, amphibians, snakes, etc.	Field Observation/ Literature review	Occasional sightings of a water snake species and an amphibian species have been reported in KBA/IBA in Sector 101, Basai.
2.	Birds	Presence of aquatic birds (Local and migratory)	Field Observation/ Consultation with NGO	Bird presence in the water spread area has been confirmed through field observations and consultation with local NGOs
3.	Resting Area	Presence of resting area of birds in KBA/IBA in Sector 101, Basai	Field Observation/ Consultation with NGO	Field observation and consultation with the NGO have helped in identifying areas where migratory birds usually rest. The nearest resting area is located approximately 308m from the spur alignment centerline.
<b>Criteria 5: Anthropogenic disturbances (Indicates severity of disturbances/pressure which results in KBA/IBA in Sector 101, Basai degradation and water pollution)</b>				

S. No.	Indicator	Explanation	Method of Assessment	Remarks
1.	Water withdrawal from KBA/IBA in Sector 101, Basai	Water withdrawal from this area for any purpose reduces the water spread and depth, thereby impacting the local ecology	Field Observation	During field observation, it was found that no water is currently being withdrawn from the area for irrigation activities.
2.	Discharge of Sewage	Sewage discharge in this area may lead to degradation of water quality and contribute to eutrophication, which affects the overall ecological health of the water spread area.	Field observation/ Consultation with NGO	No sewage discharge was observed near the KBA/IBA at Sector 101, Basai. However, the primary source of water in the area is treated effluent from the nearby STP.
3.	Discharge of any industrial effluent	Industrial discharges can degrade water quality and adversely affect the ecological health of the area	Field observation	There is no industry found near KBA/IBA at Sector 101, Basai.

**Figure 5-10 Photographs of KBA/IBA in Sector 101, Basai**



Source: RITES Field Visit

## Flora

KBA/IBA in Sector 101, Basai is predominantly covered with invasive species such as Water Hyacinth and dense beds of Typha. Tree species like Kabuli Kikar are predominantly present in the vicinity of this area. The details of flora in KBA/IBA in Sector 101, Basai is provided in **Table 5-21**.

**Table 5-21 Flora at KBA/IBA in Sector 101, Basai**

S. No.	Type	Common Name	Scientific Name	Family	Description of Species
1.	Shrub	Elephant Grass	<i>Typha elephantina</i> Roxb.	Typhaceae	Shrub up to 1.5 - 2 m in height with erect leaves and stems.
2.	Shrub	Water Hyacinth	<i>Eichhornia crassipes</i>	Pontederiaceae	It is a floating aquatic plant characterized by clusters of leaves with spongy stalks, emerging from a base of dark purple, feathery roots
3.	Tree	Kabuli Kikar	<i>Acacia juliflora</i>	Mimosaceae	Branches are greyish with stipular spines up to 1 cm long. The pods are pale yellow, glabrous, constricted between the seeds, and contain multiple seeds.

Source: IBA, 2004

## Fauna

According to the assessment conducted by the Bombay Natural History Society in 2004, species such as Nilgai, Indian Mongoose, and Jungle Cat are occasionally observed in the area. However, during the visual inspection, no faunal species were sighted in the vicinity of KBA/IBA in Sector 101, Basai. The details of the fauna reported through secondary sources are provided in **Table 5-22**.

**Table 5-22 Fauna near the KBA/IBA in Sector 101, Basai**

S. No.	Common name	Scientific name	Family	IUCN list	IWPA, 1972 Schedule
1.	Nilgai	<i>Boselaphus tragocamelus</i>	Bovidae	LC	II
2.	Indian Mongoose	<i>Herpestes edwardsii</i>	Herpestidae	LC	II
3.	Jungle Cat	<i>Felis chaus</i>	Felidae	LC	II
4.	Common Rat Snake	<i>Ptyas mucosa</i>	Colubridae	LC	II
5.	Checkered Keelback	<i>Xenochrophis piscatar</i>	Colubridae	LC	II

Source: Bombay Natural History Society, 2004

## Avifauna

As per the IBA assessment conducted in 2004, the avifaunal species visiting this area are listed in **Table 5-23**, along with their IUCN Status and the corresponding schedules of the IWPA, 1972.

For the present study, species of global or national conservation importance include those categorized as Least Concerned, Near Threatened, or Vulnerable under IUCN Red List. As per the IWPA, 1972, avifaunal species falling under Schedules I, II and IV have been recorded at Sector 101, Basai.

Table 5-23 Avifauna recorded at KBA/IBA in Sector 101, Basai

S. No.	Common Name	Scientific Name	Family	IUCN List	WPA, 1972 Schedule
1.	Asian dowitcher	Limnodromus semipalmatus	Scolopacidae	NT	I
2.	Bar-headed Goose	Anser indicus	Anatidae	LC	I
3.	Black-headed ibis	Threskiornis melanocephalus	Threskiornithidae	NT	IV
4.	Black-necked Stork	Ephippiorhynchus asiaticus	Ciconiidae	NT	I
5.	Black bittern	Dupetor flavicollis	Ardeidae	LC	II
6.	Cattle egret	Bubulcus ibis	Ardeidae	LC	IV
7.	Cinnamon bittern	Ixobrychus cinnamomeus	Ardeidae	LC	I
8.	Common redshank	Tringa totanus	Scolopacidae	LC	IV
9.	Common Shelduck	Tadorna tadorna	Anatidae	LC	II
10.	Eurasian curlew	Numenius arquata	Scolopacidae	NT	II
11.	Grey lag Goose	Anser anser	Anatidae	LC	II
12.	Great bittern	Botaurus stellaris	Ardeidae	LC	II
13.	Greater spotted eagle	Aquila clanga	Accipitridae	VU	I
14.	Imperial eagle	Aquila heliaca	Accipitridae	VU	I
15.	Glossy Ibis	Plegadis falcinellus	Threskiornithidae	LC	II
16.	Indian pond-heron	Ardeola grayii	Ardeidae	LC	IV
17.	Lesser kestrel	Falco naumanni	Falconidae	LC	II
18.	Marbled Teal Duck	Marmaronetta angustirostris	Anatidae	NT	I
19.	Oriented Darter	Anhinga melanogaster	Anhingidae	NT	IV
20.	Pallid Harrier	Circus macrourus	Accipitridae	NT	I
21.	Painted Stork	Mycteria leucocephala	Ciconiidae	NT	IV
22.	River tern	Sterna aurantia	Laridae	NT	I
23.	Red-crested pochard	Netta rufina	Anatidae	LC	II
24.	Sarus Crane	Grus antigone	Gruidae	VU	I
25.	Water Rail	Rallus aquaticus	Rallidae	LC	II
26.	Yellow bittern	Ixobrychus sinensis	Ardeidae	LC	II
27.	Yellow wagtail	Motacilla flava	Motacillidae	LC	II
28.	Citrine wagtail	Motacilla citreola	Motacillidae	LC	IV

Source: IBA, 2004 LC – Least Concerned, VU – Vulnerable, NT – Near Threatened,

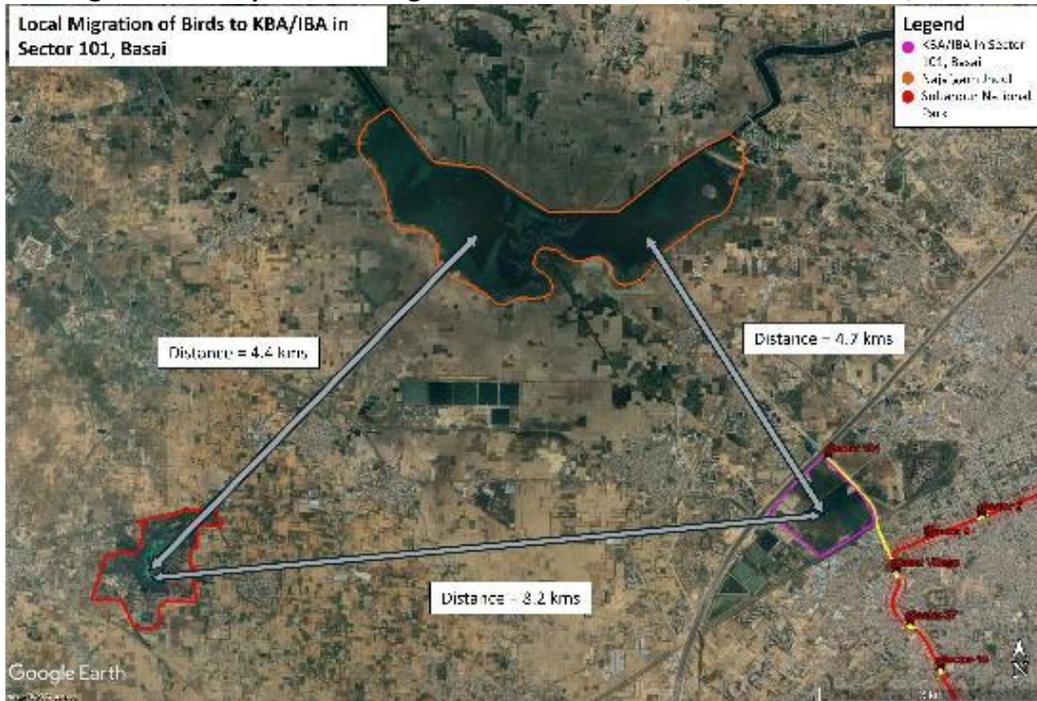
### Migration of Birds to KBA/IBA in Sector 101, Basai

Sultanpur National Park lies along the Central Asian Migratory Flyway and hosts thousands of migratory waterbirds during the winter season, primarily from Central Asia and the Western Palearctic region. These migratory bird species reach the National Park after covering extensive distance. Similarly, Najafgarh Jheel attracts many migratory birds, including waterbirds such as Ruffs and Bar-headed Geese, as well as raptors like the Steppe Eagle and Greater Spotted Eagle. The wetland further serves as a habitat for migratory land birds.

Since KBA/IBA in Sector 101, Basai is located at approximately aerial distance of 8.2 km from Sultanpur National Park and about 4.7 km from Najafgarh Jheel. Due to its proximity, birds are often observed making local movements to this area for resting. The map depicting local

migration routes of birds from Sultanpur National Park and Najafgarh Jheel to KBA/IBA in Sector 101, Basai is presented in **Figure 5-11**.

**Figure 5-11 Map of Local Migration of Birds to KBA/IBA in Sector 101, Basai**



Source: RITES

**Resting area of birds at KBA/IBA in Sector 101, Basai**

During the site visit and consultation with the NGO, the resting area for birds visiting the KBA/IBA in Sector 101, Basai was identified. This area is located approximately 308m from the proposed spur alignment, as shown in **Figure 5-12**.

**Figure 5-12: Satellite Imagery Depicting Bird Resting Area at KBA/IBA in Sector 101, Basai**



Source: RITES

## Present Status

Field studies and consultation were conducted in October 2024 and in April 2025 to understand the present status of KBA/IBA in Sector 101, Basai. The key findings are summarized below:

The primary source of water sustaining in the area was treated wastewater discharged from a damaged sewage drain connected to a nearby STP. This discharge led to water ponding, which supported avifaunal activity, particularly among local and migratory bird species. Following the repair of the damaged drain, the discharge of treated effluent into the area has ceased. Subsequently, the site has been backfilled with soil and is currently being converted for agricultural use.

During a consultation held on October 15, 2024, participants who were local residents confirmed that the land where ponding occurred comprises both privately owned plots and land under the jurisdiction of the Basai Panchayat. Photographs taken in April 2025 are presented in **Figure 5-13** and Google Earth images showing the site before and after the drainage repair are provided in

Figure 5-14.

**Figure 5-13 Photographs of the Area of April 2025**





Source: RITES Field Study

Figure 5-14 Google Earth Screenshot



Figure A: Google Earth Image of February 2024 - Prior to Drainage Repair

Figure B: Google Earth Image of May 2025 - Post Drainage Repair

### 5.9.4.3 Najafgarh Jheel

Najafgarh Jheel is the largest surface water body in Delhi, located approximately 4.7 km from the GMRP alignment. In the past, it was fed by the Sahibi River and stormwater runoff from surrounding areas. However, its primary water sources now include wastewater from the Badshahpur Drain, Outfall Drain No. 8, and monsoonal rainwater.

The Jheel previously served as a recharge zone for surrounding aquifers and functioned as a natural catchment for surface runoff, thereby mitigating flood risks in the adjacent areas. As per the Hon'ble Supreme Court order dated 08.02.2017, the Jheel was directed to be notified under the Wetlands (Conservation and Management) Rules, 2017. However, as per the current status, it has not yet been notified as a wetland.

- **Flora:** The flora of Najafgarh Jheel includes a diverse mix of aquatic and terrestrial plant species such as Prickly chaff flower (*Achyranthes aspera*), Alligator weed (*Alternanthera*

sp.), Water hyacinth (*Eichhornia crassipes*), Munj grass (*Sachharum munja*), Field bindweed (*Convolvulus arvensis*), Nut Sedge (*Cyperus rotundus*), Indian mallow (*Abutilon indicum*), Kanta chaulai (*Amaranthus spinosus*), Jungle chaulai (*Amaranthus viridis*), Krishn neel (*Anagallis arvensis*), Vajradanti (*Barleria prionitis*), Punarnava (*Boerhavia diffusa*), Milkweed (*Calotropis procera*), Ivy gourd (*Coccinia grandis*), Ground cherry (*Physalis minima*), Karanj (*Pongamia pinnata*), Flannel weed (*Sida cordifolia*), Malabar gulbel (*Tinospora sinensis*), Kantakari (*Solanum surattense*), Kans grass (*Sachharum spontaneum*), Patera (*Typha elephanta*), Giant Reed (*Arundo donax*), Neem (*Azadirachta indica*), Babool (*Acacia nilotica*) and Vilayati kikar (*Prosopis juliflora*).

- **Fauna:** The Jheel supports several terrestrial mammalian species including Jungle cat (*Felis chaus*), Golden jackal (*Canis aureus indicus*), fox (*Vulpes vulpes*), Indian hare (*Lepus nigricollis*), Nilgai (*Boselaphus tragocamelus*), etc.
- **Avifauna:** The Jheel is a significant habitat for avifauna, hosting approximately 281 bird species, comprising both resident and migratory birds, including land and water birds. Few of the species found at the Jheel include Egyptian vulture (*Neophron percnopterus*), Sarus crane (*Antigone antigone*), Steppe eagle (*Aquila nipalensis*), Greater Spotted eagle (*Clanga clanga*), and Imperial Eagle (*Aquila heliaca*).

#### 5.9.4.4 Aravali Range

The Aravalli Range, situated approximately 3 km from the GMRP, comprises semi-arid and dry deciduous forests interspersed with patches of thorn scrub and rocky outcrops. This ecologically significant landscape supports a diverse range of flora, fauna, and avifauna characteristic of the Northern Indian Aravalli ecosystem.

- **Flora:** The Aravalli Range in Gurugram comprises tropical dry deciduous and thorn scrub forest types, characterized by a rich diversity of native plant species. Prominent flora includes *Acacia senegal*, *Acacia leucophloea*, *Prosopis cineraria*, *Capparis zeylanica*, *Salvadora spp.*, *Grewia spp.*, *Gardenia spp.*, *Boswellia serrata*, *Anogeissus pendula*, *Butea monosperma*, *Mitragyna parvifolia*, *Commiphora wightii*, *Sterculia urens*, *Wrightia tinctoria*, *Albizia odoratissima*, *Mallotus philippensis*, along with various native shrubs and grasses.
- **Fauna:** The region supports a variety of terrestrial wildlife, including species such as *Panthera pardus*, *Hyaena hyaena*, *Canis aureus*, *Boselaphus tragocamelus*, *Sus scrofa*, *Macaca mulatta*, *Felis chaus*, *Herpestes edwardsii*, *Paradoxurus hermaphroditus*, *Hystrix indica*, *Lepus nigricollis*, and *Pavo cristatus*. Reptilian fauna includes *Varanus bengalensis*, *Calotes versicolor*, *Ptyas mucosa*, *Fowlea piscator*, and other species of water snakes.
- **Avifauna:** The Aravalli range in Gurugram, includes areas such as Mangar Bani and the Aravalli Biodiversity Park, supports a diverse assemblage of avifauna. Notable bird species observed include *Pitta brachyura*, *Terpsiphone paradisi*, *Rhipidura aureola*, *Leiopicus maharattensis*, *Ocyrceros birostris*, *Psittacula cyanocephala*, *Treron phoenicoptera*, *Pycnonotus cafer*, *Copsychus saularis*, *Argya striata*, *Prinia socialis*, *Anthus similis*, *Dicrurus macrocercus*, *Curruca curruca*, *Aquila nipalensis*, *Pycnonotus leucotis*, *Sarcogyps calvus*, *Neophron percnopterus*, along with other raptors and waterbirds.

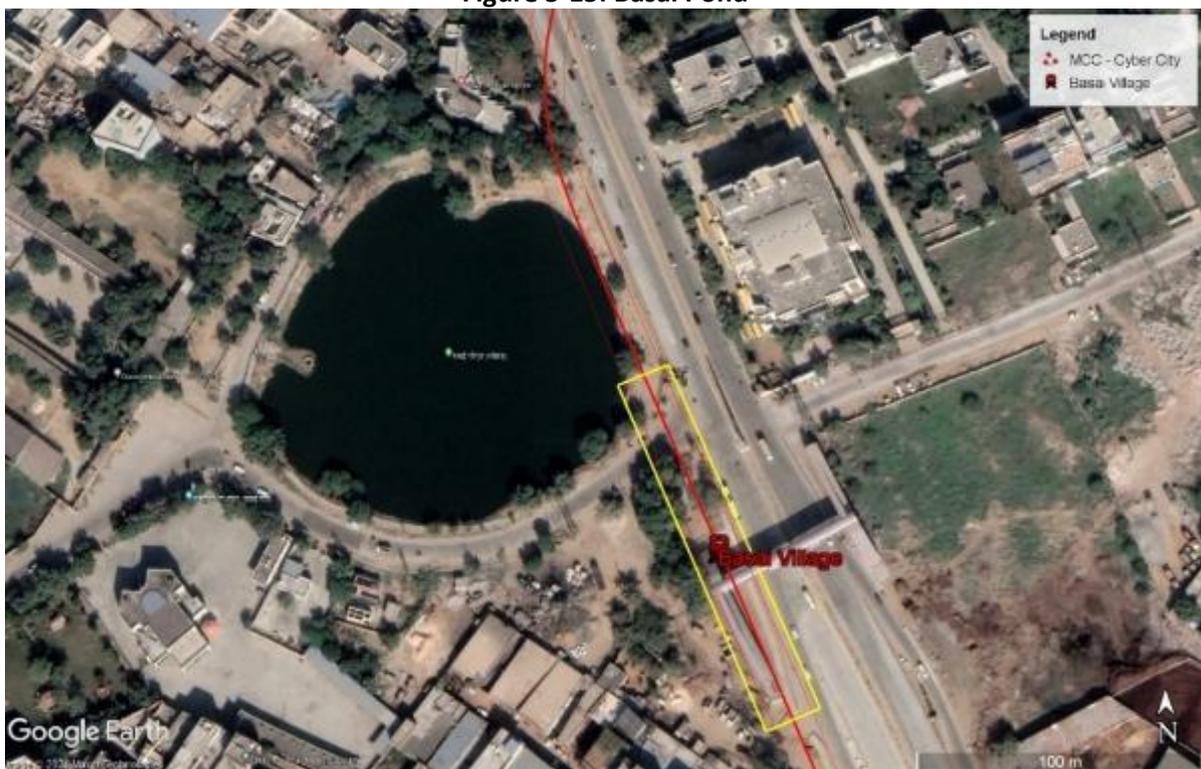
#### 5.9.4.5 Basai Pond

Basai Pond is a manmade waterbody located adjacent to the proposed Basai Village Metro Station, between Ch. 11690 to Ch. 11789. Rainwater is the only source of water for this pond.

It is primarily used by local residents for cattle bathing. Seasonal fluctuations in water levels are common, with the water rising near the outer edge of the pond during the monsoon season and retreating to about 10m away from the boundary during drier months.

The pond's water quality has significantly deteriorated due to solid waste dumping. Human activities have significantly degraded the pond, resulting in the absence of avifauna in the area. Also, during the field studies no avifauna was observed at Basai Pond. The Municipal Corporation of Gurugram is planning to develop ramps around the pond for facilitating religious activities. The location of the pond and the GMRP are depicted in **Figure 5-15**.

**Figure 5-15: Basai Pond**



Source: RITES

## 5.10 Sensitive Receptors

The sensitive receptors within the RoW and within 100m on either side from the centerline of the GMRP alignment have been identified and presented in **Table 5-24** and the details of these receptors are provided in **Annexure 5.3**.

**Table 5-24: Details of Sensitive Receptors along the GMRP Alignment**

	Within RoW			Within 100 m on either side from the CL of the GMRP alignment					
	Temple	Pond	Forest	Temple	School/ College	Hospital	Pond	Forest	Park
Start Point – Millennium City Centre	-	-	-	1	-	-	-	-	-
Millennium City Centre - Sector 45	-	-	-	1	-	1	-	-	-
Sector 45 - Cyber Park	-	-	-	-	-	1	-	-	-
Cyber Park - Sector 47	-	-	-	2	1	3	-	-	-
Sector 47 - Subash Chowk	-	-	-	-	-	-	-	-	-
Subash Chowk - Sector 48	-	-	-	-	1	-	-	-	1
Sector 48 - Sector 72A	-	-	-	-	2	-	-	-	-
Sector 72A - Hero Honda Chowk	-	-	-	-	1	-	-	-	-
Hero Honda Chowk- Udyog Vihar Ph-6	-	-	-	-	-	-	-	-	1
Udyog Vihar Ph-6 - Sector 10	-	-	-	4	-	1	-	-	-
Sector 10 - Sector 37	-	-	1	1	-	-	-	1	-
Sector 37 - Basai Village	-	-	-	-	-	3	-	-	-
Basai Village - Sector 9	1	1	-	-	1	2	1	-	-
Sector 9 - Sector 7	-	-	-	-	1	2	-	-	-
Sector 7 - Sector 4	-	-	-	1	2	-	-	-	4
Sector 4 - Sector 5	-	-	-	2	1	2	-	-	-
Sector 5 - Ashok Vihar	-	-	-	-	2	3	-	-	1
Ashok Vihar - Sector 3	-	-	-	3	2	2	-	-	2
Sector 3 - Bajghera Road	-	-	-	-	2	-	-	-	-
Bajghera Road - Palam Vihar Ext.	-	-	-	1	2	-	-	-	-
Palam Vihar Ext. - Palam Vihar	-	-	-	1	1	1	-	-	-
Sector 23A - Sector 22	-	-	-	1	2	-	-	-	-
Sector 22 – Cyber City (End Point)	-	-	-	-	-	-	-	-	-
Spur from Basai Village to Dwarka Expressway	-	-	-	-	-	-	-	-	-
<b>Total</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>18</b>	<b>21</b>	<b>21</b>	<b>1</b>	<b>1</b>	<b>9</b>

Source: RITES Field Study, 2023

## 5.11 Cultural Heritage

Tangible cultural heritage encompasses objects, sites, structures and landscapes of cultural, historical, or aesthetic significance, while intangible heritage includes the practices, expressions, and knowledge passed down and continuously adapted by communities. Both forms are integral to preserving cultural identity and legacy.

Tangible cultural heritage in the project area includes cultural assets, archaeological monuments, and structures listed by INTACH, which are described in the following sections. No intangible cultural heritage sites or practices have been identified within the project area.

One cultural heritage asset, a temple at Basai Village Metro Station (Ch. 11684) is likely to be impacted by the GMRP. The impact on the temple is expected to be significant and is depicted in **Figure 5-16**.

**Figure 5-16: Photograph of Religious Place within the ROW**



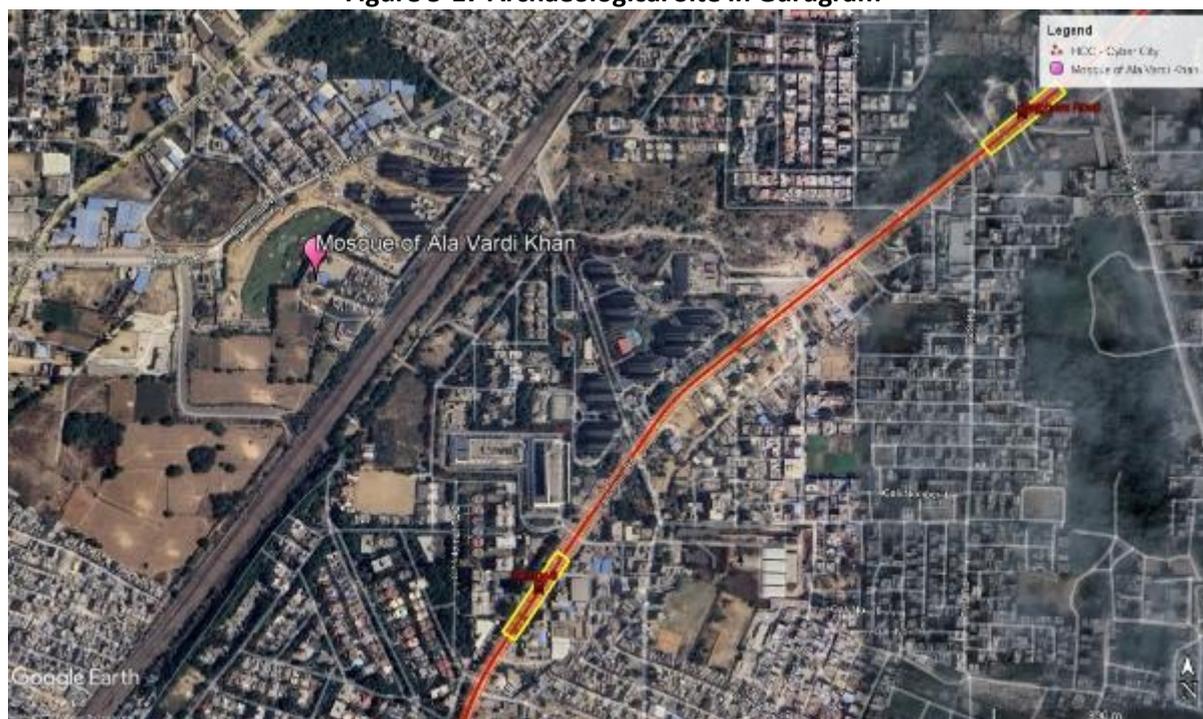
### 5.11.1 Archaeological Sites

The following archaeological monuments/sites are located in Gurugram district:

1. Sheesh Mahal, Farukh Nagar, Gurugram
2. Lal Gumbad, Sohna, Gurugram
3. Qutub Khan ki Masjid, Sohna, Gurugram
4. Baoli Ghauss Ali Shah, Farukh Nagar, Gurugram
5. Mosque of Ala Vardi Khan, Gurugram

Among these, the Mosque of Ala Vardi Khan is a Centrally Protected Monument under the jurisdiction of the Archaeological Survey of India (ASI) and is located approximately 490m from the GMRP alignment, as shown in **Figure 5-17**. The remaining monuments are located beyond 10 km from the alignment. No impact is anticipated on the monuments due to the GMRP.

Figure 5-17 Archaeological Site in Gurugram



Source: RITES

### 5.11.2 Indian National Trust for Art and Cultural Heritage (INTACH) listed Structures

The INTACH-listed structures located within 10 km on either side of the GMRP alignment are as follows:

- Water Body: Bhim Kund
- Temples: Sita Ram Temple, Sheetla Mata Devi Temple, Dronacharya Temple and Eklavya Temple
- Mosques: Sarai Allawardi Mosque, Eidgah Mosque, Shahi Jama Mosque and Jama Masjid
- Church: Church of Epiphany

Among these, the Mosque of Ala Vardi Khan is a Centrally Protected Monument under the jurisdiction of the Archaeological Survey of India (ASI) and is located approximately 490m from the GMRP alignment. Therefore, no impact is anticipated on the monuments due to the GMRP.

### 5.12 Valued Environmental Components

Valued environmental components (VECs) refer to specific aspects of the natural and cultural environment that are important to maintain and protect their intrinsic value or their benefits to humans and other living organisms. These components are critical to environmental assessment and conservation planning. The VECs identified within the project area include water bodies, streams/nalas, temples, mosque, church and heritage structures and discussed below:

- **Waterbodies:** A total of 34 water bodies, including Najafgarh Jheel and KBA/IBA in Sector 101, Basai have been identified within 10 km buffer on either side of the alignment. Basai Pond is located within the RoW of the GMRP alignment.
- **Streams/nalas:** The GMRP alignment is crossing streams/nalas at two locations as detailed in Section 5.3.3.
- **Religious Places:** A total of 19 temples have been identified within 100m on either side of the GMRP alignment; out of which one temple falls directly within the RoW.
- Indian National Trust for Art and Cultural Heritage (INTACH) Listed Structures are detailed in 5.11.2.

### 5.13 Socio-Economic Profile

The objectives of the socio-economic survey are as follows:

- To generate a socio-economic profile of the PAPs and groups in order to categorize them for appropriate entitlements and subsequently to monitor and evaluate their socio-economic status.
- To understand the impacts of the GMRP, including related concerns, and to capture the perceptions of PAPs and beneficiary.
- To integrate these issues and impacts into the design and implementation of the project.
- To enhance the sustainability of the project.

The survey used both quantitative household questionnaires and qualitative Focus Group Discussions (FGDs) to gather comprehensive data. The survey was conducted among the identified project affected households; however, some did not share socio-economic information. Additionally, FGDs with beneficiary communities, including women and vulnerable groups, were held to assess impacts and capture perceptions and aspirations regarding the GMRP.

The survey was conducted between December 2023 and February 2024 and covered 154 households, and collected data on demographics, livelihoods, education, etc. The collected data was meticulously scrutinized, entered into a customized database and analyzed. Qualitative information was coded and integrated. Findings are presented in the following sections.

**Sample Selection:** The purposive sampling technique was used for the survey. The project socio-economic survey was carried out with PAHs, and a structured questionnaire was administered during the data collection. In total, 154 households were covered under the study.

#### 5.13.1 Demographic Profile of Households

##### 5.13.1.1 Distribution by Age Group

The surveyed households were categorized into five age groups. The distribution shows that 65 members (7.63%) are below 5 years, 239 members (28.05%) are aged between 6-18 years, 394 members (46.24%) are aged between 19-45 years, 95 members (11.15%) are aged between 46-60 years, and 59 members (6.92%) are above 61 years. The majority of members belong to the 19-45 years age group. The distribution of age groups is depicted in **Table 5-25**.

**Table 5-25 Age Group of Population**

S. No	Age Group	Nos.	%
1	Less than 5 Years	65	7.63
2	6 – 18 Years	239	28.05
3	19 – 45 Years	394	46.24
4	46 – 60 Years	95	11.15
5	61 and above	59	6.92
<b>Total</b>		<b>852</b>	<b>100</b>

**5.13.1.2 Gender**

Gender data is crucial for assessing male and female participation in society, which is a significant factor contributing to the human development index. Among the surveyed population, 52.58% are male and 47.42% are female. The detailed distribution of sampled population is presented in **Table 5-26**.

**Table 5-26 Gender Composition of Population**

S. No	Gender	Nos.	%
1	Male	448	52.58
2	Female	404	47.42
3	Third Gender	-	-
<b>Total</b>		<b>852</b>	<b>100</b>

**5.13.1.3 Family Pattern and Size**

The majority of households surveyed live in nuclear families (77.92%), followed by joint families (20.13%), and a small percentage live alone (1.95%). The average household size of the surveyed family is 5.53.

Household sizes vary, with 27.27% categorized as small (1-4 persons), 59.09% as medium (5-7 persons), and 13.64% as large (more than 8 persons). These patterns reflect varying degrees of sentimental attachment, social values, and economic structures among households. The details of family patterns and family sizes are presented in **Table 5-27**.

**Table 5-27 Family Pattern and Size of HHs**

S. No	Particular	Nos	%
<b>Family Pattern</b>			
1	Joint	31	20.13
2	Nuclear	120	77.92
3	Individual	3	1.95
<b>Total</b>		<b>154</b>	<b>100</b>
<b>Family Size</b>			
1	1– 4 Member	42	27.27
2	5– 7 Member	91	59.09
3	8 and above Member	21	13.64
<b>Total</b>		<b>154</b>	<b>100</b>

### 5.13.1.4 Religious Composition

The study area reports three religious' groups: Hindu, Muslim, and Sikh. The study results reveal that approximately 133 (86.36%) of the HHs are Hindu, 17 (11.04%) are Muslim, and the remaining Sikh (2.60%) are Sikhs. Detailed religious composition is presented in **Table 5-28**.

**Table 5-28 Religion Details of HHs**

S. No	Religious Group	Nos.	%
1	Hindu	133	86.36
2	Muslim	17	11.04
3	Sikh	4	2.60
<b>Total</b>		<b>154</b>	<b>100</b>

### 5.13.1.5 Social Composition

The survey reveals that 40.91% of households belong to the Other Backward Classes (OBC) category, 33.77% to the general category, and 25.32% to Scheduled Castes (SC). The social groups (SC/ST and OBC) receive preferential treatment in government schemes to address socio-economic backwardness. The details are given in **Table 5-29**.

**Table 5-29 Caste Composition of HHs**

S. No	Social Group	Nos.	%
1	SC	39	25.32
2	OBC	63	40.91
3	General	52	33.77
<b>Total</b>		<b>154</b>	<b>100</b>

### 5.13.1.6 Educational Attainment

Education is a vital means for social vertical mobility, enabling individuals to participate in developmental opportunities. Despite its potential to exacerbate disparities, education is essential for socio-economic progress, serving as a fundamental indicator of regional development.

Education levels among the surveyed persons vary widely: 32.16% are illiterate, 24.30% have education up to primary level, 11.62% up to upper primary, 19.72% up to high school, 9.98% are graduates, 1.76% are postgraduates, and 0.47% have technical education. The details of education attainment are presented in **Table 5-30**.

**Table 5-30 Education Attainment of Surveyed Population**

S. No	Education Level	Nos.	%
1	Illiterate	274	32.16
2	Primary	207	24.30
3	Upper Primary	99	11.62
4	High School	168	19.72
5	Graduate	85	9.98
6	Postgraduate	15	1.76
7	Technical	4	0.47
<b>Total</b>		<b>852</b>	<b>100</b>

### 5.13.1.7 Work Status

Out of the total survey persons, 220 (25.82%) persons comes under working group and 632 (74.18%) persons comes under not-working group. Details of work status is presented in **Table 5-31**.

**Table 5-31 Working Status**

S. No	Working Status	Nos.	%
1	Working	220	25.82
2	Not Working	632	74.18
<b>Total</b>		<b>852</b>	<b>100</b>

### 5.13.1.8 Occupational Details

The survey records the occupational patterns of individuals to assess their skills for devising suitable income generation plans and identifying prevalent economic activities in the area. Approximately 25.82% of surveyed individuals are engaged in economic activities, including artisans (0.47%), labourers (2.70%), business/trade workers (19.13%), government employees (0.59%), private sector workers (1.41%), and maids (0.59%). Students, young children not of school-going age, the elderly, housewives, and individuals with disabilities are not considered part of the working group. The detail of occupational status is presented in **Table 5-32** and the reasons for not working is tabulated in **Table 5-33**.

**Table 5-32 Occupation Status of Surveyed Population**

S. No	Occupation Status	Nos.	%
1	Artisans	4	0.47
2	Labour	23	2.70
3	Business/Trade	163	19.13
4	Govt. Service	5	0.59
5	Private Service	12	1.41
6	Maid Servant	5	0.59
7	Unemployed	0	0.00
8	Retired	1	0.12
9	Others(specify)	7	0.82
10	Not Working	632	74.18
<b>Total</b>		<b>852</b>	<b>100</b>

**Table 5-33 Reasons for Not Working**

S. No	Occupation Status	Nos.	%
1	No Work Available	19	3.01
2	Seasonal Inactivity	2	0.32
3	Household Family Duties	172	27.22
4	Old/young	118	18.67
5	Differently Abled	3	0.47
6	Students	312	49.37
7	Others	6	0.95
<b>Total</b>		<b>632</b>	<b>100</b>

### 5.13.1.9 Vulnerability among the Surveyed Population

Out of the total surveyed population of 852, 82 individuals fall into the category of vulnerable persons. This includes four (4.88%) who are differently abled, 56 (68.29%) who are elderly, 17 (20.73%) who are widowed, four (4.88%) who are Women Headed Household, and one (1.22%) who is below poverty line (BPL). The details of vulnerability among the surveyed population are presented in **Table 5-34**.

**Table 5-34 Vulnerability among the Surveyed Population**

S. No	Vulnerable Population	Nos.	%
1	Differently Abled	4	3.31
2	Persons above 60 Years of Age	56	46.28
3	Widow	17	14.05
4	Women Headed Household	4	3.31
5	BPL	1	0.83
6	SC	39	32.23
<b>Total</b>		<b>82</b>	<b>100</b>

### 5.13.1.10 Housing Pattern

Out of the total surveyed population, 24.68% of households reside in owned properties, while 75.32% live in rented accommodations. Regarding housing structure, 79.22% of households reside in pucca structures, 16.23% in kutcha structures, and 4.55% in semi-pucca houses. The details of ownership and typology of housing structure are presented in **Table 5-35 & Table 5-36**.

**Table 5-35 Ownership of House**

S. No	Ownership	Nos.	%
1	Owned	38	24.68
2	Rented	116	75.32
<b>Total</b>		<b>154</b>	<b>100</b>

**Table 5-36 Type of House Structure**

S. No	Typology	Nos.	%
1	Kutcha	25	16.23
2	Semi-Pucca	7	4.55
3	Pucca	122	79.22
<b>Total</b>		<b>154</b>	<b>100</b>

### 5.13.1.11 Access to Facilities

According to the surveyed households, 78.57% have separate bathroom and toilet facilities, 81.82% have piped water supply, and 79.22% have separate kitchen facilities within their premises. The details are given in **Table 5-37**.

**Table 5-37 Access to Facilities**

S. No	Basic Facilities	Availability			
		Total	Yes	No	%
1	Separate Bathroom, Toilet	154	121	33	78.57
2	Electricity	154	141	13	91.56

S. No	Basic Facilities	Availability			
		Total	Yes	No	%
3	Piped Water Supply	154	126	28	81.82
4	Separate Kitchen	154	122	32	79.22

#### 5.13.1.12 Income

Income and asset ownership serve as indicators of household living standards. The survey shows that 0.65% of households have an average monthly income of less than Rs. 5000, 12.99% earn between Rs. 5001 and Rs. 10000, 54.55% earn between Rs. 10001 and Rs. 20000, and 14.94% earn between Rs. 20001 and Rs. 30000 monthly. The detail of average monthly income is presented in **Table 5-38**.

**Table 5-38 Average Monthly Income**

S. No	Monthly Income Categories	Nos.	%
1	Below 5000	1	0.65
2	Above 5001 and up to 10000	20	12.99
3	Above 10001 and Below 20000	84	54.55
4	Above 20001 and up to 30000	23	14.94
5	Above 30001 and up to 50000	14	9.09
6	50001 and above	12	7.79
<b>Total</b>		<b>154</b>	<b>100</b>

#### 5.13.1.13 Household Assets Details

Possession of household assets offers insights into the socio-economic status and comfort level of surveyed households. Most own mobile phones (90.26%), televisions (47.40%), two-wheelers (30.52%), food processors/mixers/grinders (27.27%), air coolers (26.62%), refrigerators (24.03%), washing machines (14.94%), etc. The details of assets owned are presented in **Table 5-39**.

**Table 5-39 Assets Owned**

S. No	Assets	Nos.	%
1	Telephone/ Mob. Phone	139	90.26
2	Television	73	47.40
3	Two-Wheeler	47	30.52
4	Food Processor/Mixer/Grinder	42	27.27
5	Air Cooler	41	26.62
6	Refrigerator	37	24.03
7	Washing Machine	23	14.94
8	Air Conditioner	16	10.39
9	Microwave Oven	17	11.04
10	Computer/Laptop	17	11.04
11	Four-Wheeler	16	10.39
<b>N = 154</b>			

#### 5.13.1.14 SHG Membership

It is observed from table, only 5.84% sampled households' members are members in Self Help Groups (SHG). Out of total HH sample, 5.19% have one member in SHGs and 0.65% HHs has

three members in SHGs. The details of SHG membership and members are presented in **Table 5-40** and **Table 5-41**.

**Table 5-40 SHG Membership**

S. No	SHG Membership	Nos.	%
1	SHG Member	9	5.84
2	No	145	94.16
<b>Total</b>		<b>154</b>	<b>100</b>

**Table 5-41 No. of Family Member who have SHG Membership**

S. No	No. of Family Member	Nos.	%
1	No Membership	145	94.16
2	1	8	5.19
3	2	-	-
4	3	1	0.65
<b>Total</b>		<b>154</b>	<b>100</b>

### 5.13.1.15 Participation, Perception and Information

#### Participation

The survey found that 48.70% of households were aware of the project. Efforts were made to inform affected individuals about project details through consultations and outreach, promoting transparency and trust. This approach encourages stakeholder engagement, gathers feedback, and addresses concerns promptly, fostering community participation and accountability in decision-making processes. The details about the awareness of the project are given in **Table 5-42** and **Table 5-43**.

**Table 5-42 Awareness about the Project**

S. No	Awareness about the Project	Nos.	%
1	Aware	75	48.70
2	Not Aware	79	51.30
<b>Total</b>		<b>154</b>	<b>100</b>

The households reported that they learned about the project through various channels, with the following distribution:

- Print media: 7.14% of households.
- Electronic media: 4.55% of households.
- Internet: 1.30% of households.
- Word of mouth: 35.71% of households.

**Table 5-43 Source of Information about the Project**

S. No	Awareness about the Project	Nos.	%
1	Print Media	11	7.14
2	Electronic Media	7	4.55
3	Internet	2	1.30
4	Word of Mouth (Family, Friends, and Public Interaction)	55	35.71
6	Not Aware	79	51.30

S. No	Awareness about the Project	Nos.	%
	<b>Total</b>	<b>154</b>	<b>100</b>

## Perception

### Perceived Positive Impacts

- Generation of Employment Opportunities: 8.15% of respondents anticipate that the project will generate increased employment opportunities.
- Development of City: 10.37% of respondents believe the project will improve city infrastructure.
- Traffic Reduction: 24.44% of respondents believe that the proposed metro corridor will reduce traffic congestion in the city.
- Reduction in Travel Time and Convenient Mode: 32.59% of respondents believe the proposed project will reduce travel time and offer convenient transportation options.
- Reduction in Accidents: 9.63% of respondents believe the upcoming project will decrease road accidents.
- Sense of Safety and Security: 14.81% of respondents believe this mode of transportation will enhance safety and security for users.

The perceived positive impacts listed below and presented in **Table 5-44**.

**Table 5-44 Perception of HH – Positive impacts due to project**

S. No	Positive Impacts	Nos.	%
1	Generation of Employment Opportunities	11	8.15
2	Development of City	14	10.37
3	Traffic Reduction	33	24.44
4	Reduction in Travel Time and convenient mode	44	32.59
5	Reduction in Accidents	13	9.63
6	Safety and Security	20	14.81
	<b>Total</b>	<b>135</b>	<b>100</b>

### Perceived Negative Impacts

Any development project will also have some negative impacts. It's essential mitigate negative impacts through planning, stakeholder engagement, and environmental and social management plans. Continuous monitoring and evaluation ensure benefits are maximized and adverse effects minimized, adapting strategies as needed. The perceived negative impacts listed below and presented in

**Table 5-45**.

- Loss of Land: 20% of respondents expressed concerns regarding land loss due to the project, which can disrupt livelihoods, causing displacement and property rights loss.
- Loss of Structures: 26.67% of respondents are worried about possible structure loss due to the project.
- Loss of Livelihood: 40.00% of respondents foresee livelihood loss from the project.
- Pollution and Traffic Jams: 13.33% of respondents are concerned about pollution and traffic congestion during the project's construction phase.

**Table 5-45 Perception of HH – Negative impacts due to project**

S. No	Negative Impacts	Nos.	%
1	Loss of Land	3	20.00
2	Loss of Structures	4	26.67
3	Loss of Livelihood	6	40.00
4	Pollution during construction	1	6.67
5	Traffic jams during construction	1	6.67
<b>Total</b>		<b>15</b>	<b>100</b>

### Participation

Out of 154 samples, 23.38% expressed their willingness to work during construction phase of the project and the rest 85.71 percent were unwilling to work. The details of willingness to work are presented in **Table 5-46**.

**Table 5-46 Willingness to Work**

S. No	Willingness to Work	Nos.	%
1	Willing to Work	36	23.38
2	No	118	76.62
<b>Total</b>		<b>154</b>	<b>100</b>

### Suggestions

Respondents' suggestions for mitigating negative project impacts are vital for addressing people's concerns and optimizing project benefits while minimizing adverse effects. Here's a summary of the suggestions provided by respondents:

- Location of Staircase: 5.19% of respondents think staircases at metro stations should be placed carefully to ensure smooth accessibility and minimize disruptions to local businesses.
- Provision of Employment: 9.09% of respondents suggested for providing employment to affected families.
- Proper Compensation for Affected Structures and Households: 9.09% of respondents emphasized giving fair compensation for affected properties.
- Provision of Shops for Businesses and Livelihoods: 34.42% of respondents emphasized the need to provide shops and jobs to those affected by the project.
- Affordable Ticket Prices and Free Metro Cards: 5.19% of respondents suggested reducing ticket prices for all commuters and providing free metro cards to Below Poverty Line (BPL) card holders.
- No Suggestions Provided: 37.01% of respondents did not provide any specific suggestions to mitigate the project's negative impacts.

The details of suggestions for better implementation are presented in the **Table 5-47**.

**Table 5-47 Suggestions for Better Implementation**

S. No	Suggestions for Better Implementation	Nos.	%
1	Consideration of the location of staircase to avoid obstruction	8	5.19
2	Provision of employment to the affected households	14	9.09
3	Provision of Proper Compensation	14	9.09

S. No	Suggestions for Better Implementation	Nos.	%
4	Provision of Shop for Business and Livelihood	53	34.42
5	Ticket cost should be cheaper/ free metro card for BPL Card holders	8	5.19
6	Did not Suggest	57	37.01
<b>Total</b>		<b>154</b>	<b>100</b>

**Approaches to Cover Absent PAPs (Titleholder):** The measures to be taken to identify the missing PAPs are detailed in the RAP.

#### 5.13.1.16 Sexual Exploitation & Abuse and Sexual Harassment

Sexual crimes reported in Gurugram district from 2022 to 2024 are presented in **Error! Reference source not found.** These crimes include rape, sexual harassment and domestic violence. The police record show an increasing trend over these years. In 2022, Gurugram Police recorded 302 cases. This number slightly dropped to around 280 cases in 2023 but then rose significantly to 355 cases by November 2024. This rise in 2024 suggests that more people are becoming aware of these crimes and are reporting them, or that such crimes are becoming more common in the area.

Data from the National Crime Records Bureau (NCB) shows a similar pattern, with 250 cases reported in 2022, a small decrease to 230 cases in 2023 and then an estimated increase to 290 cases in 2024. Differences between the police and NCB numbers may be due to how and when they collect data. However, both sources show that sexual crimes remain an important issue in Gurugram.

#### 5.13.1.17 Labour Prevalence of Child Labour

The data indicates that the number of registered child labour cases in Gurugram district has remained relatively steady over recent years, with 12 cases in 2021, 15 in 2022, 12 in 2023 and 10 cases till November 2024.

Child labour mostly occurs in informal sectors such as roadside eateries, domestic work, construction, small retail shops, workshops, hotels and auto repair garages. In 2023, Haryana Police under 'Operation Smile' rescued and rehabilitated 1,308 missing children, including child beggars and labourers, with Gurugram being among the leading districts in child rescues, reunited 27 children and 20 adults with their families.

## Chapter 6: Stakeholder Consultations

### 6.1 Objectives of Public Consultation

The objectives of the stakeholder consultations for the project, and Environmental and Social Impact Assessment (ESIA) study are as follows:

- **Inform and Disclose the Proposed Project:** It aims to ensure transparency and clarity by informing stakeholders, including affected communities and local authorities, about the proposed project's details, objectives, scope, and potential impacts.
- **Assess Stakeholder Interest and Involvement:** It assess stakeholder interest, involvement, concerns, priorities, and expectations regarding the project, informing decision-making by understanding diverse perspectives and needs.
- **Enable Stakeholders to Provide Views and Options:** Stakeholders are provided a platform to express their views, concerns, and preferences about the project, and encouraged to offer feedback and suggestions to improve project design, implementation, and mitigation measures.
- **Disclose Environmental and Social Risks and Impacts:** It ensures stakeholders receive timely, clear, and accessible information about environmental and social risks associated with the project, promoting informed decision-making and transparency.
- **Provide Effective and Inclusive Engagement:** It ensures active and inclusive engagement with project-affected parties, involving them in discussions and decision-making to effectively address their perspectives and concerns.

Overall, the objectives of the public consultations for the project and ESIA aim to foster meaningful stakeholder engagement, transparency, and accountability. This contributes to sustainable and responsible project development, respecting the interests and rights of all stakeholders involved.

### 6.2 Consultations during field work of ESIA

As a part of ESIA Study, stakeholder consultations (about 30% of PAF) were carried out from December 2023 to October 2024 during the field visits. These involved both formal and informal interviews and consultations with likely affected people and interested groups at the project level. The objective was to disseminate project information and ascertain stakeholder's views on probable environmental and social (E&S) risks associated with the GMRP. Based on the suggestions received, mitigation plans to avoid or minimize the impacts of the project are proposed in the report.

Consultations have been carried out with various stakeholders including affected residents, vulnerable groups, shop owners, police officials, women as metro and transport users (at existing metro stations and bus stops), Auto drivers (both formal and informal) etc. Total 194 persons (127 male and 67 female) participated in the consultation including 69 PAPs (63 male and 6 female) including vulnerable groups, 63 other interested parties, 13 police officials (1 male and 12 female), 49 women as transport user. At depot location, consultation was carried out with president and other member of Marble Market Association.

The stakeholder categories and No. of Participants in consultations are given in **Table 6-1**. Detailed information on stakeholder consultations and interviews is provided in **Table 6-2**, while issues raised, discussed and mitigation measures are provided in **Table 6-3**. The detailed summaries of the consultations and interviews are provided in **Annexure 6.1**, and the pictures of these consultations are presented in **Annexure 6.2**.

**Table 6-1 Stakeholder Categories and No. of Participants**

S. No.	Type of Stakeholder	Male	Female	Total	%	
1	PAPs	55	3	58	29.90	
2	Project Affected Vulnerable Groups	Elderly	3	1	4	2.06
3		Banjaras	5	2	7	3.61
4	Other Interested Groups	General Public	19	-	19	9.79
5		RWA Members	7	-	7	3.61
6		Street & Fruit Vendors	16	-	16	8.25
7		Auto Drivers	13	-	13	6.70
8		E-Rickshaw	5	-	5	2.58
9		NGO	3	-	3	1.55
10		Police Officials	1	12	13	6.70
11		Women as Transport User	-	49	49	25.26
<b>Total</b>		<b>127</b>	<b>67</b>	<b>194</b>	<b>100</b>	

**Table 6-2 Details of Stakeholder Consultations and Interviews**

S. No.	Date	Location	Type of Stakeholder	Male	Female	Total
<b>Consultations and discussions with Affected Persons including Vulnerable Groups</b>						
1	21.12.2023	Sector 4, Gurugram	Affected Vulnerable Group, (Elderly)	3	1	4
2	21.12.2023	Sector 4 & 5	Affected Persons (Fruit Vendors)	8	-	8
3	22.12.2023	Rezangla Chowk	Affected Vulnerable Group (Banjaras)	5	2	7
4	29.12.2023	Ashok Vihar	Affected Persons (including Vulnerable Group: Elderly and WHH)	9	1	10
5	08.01.2024	RITES Office, Gurugram	Affected Persons	4	-	4
6	10.01.2024	Ashok Vihar	Affected Persons	17	2	19
7	25.01.2024	Rao Gajraj Singh Chowk	Affected Persons	5	-	5
8	29.01.2024	Rao Gajraj Singh Chowk	Affected Persons	5	-	5
9	30.01.2024	Rao Gajraj Singh Chowk	Affected Persons	3	-	3
10	05.02.2024	Sector 33, Depot	Affected Persons	4	-	4
<b>Consultations and Discussions with Other Interested Groups</b>						
1	21.12.2023	Sector 10A	RWA Members	7	-	7
2	21.12.2023	Sector 10	Fruit Vendors	8	-	8
3	21.12.2023	ESIC Hospital, Sector 7	Auto Drivers	8	-	8

S. No.	Date	Location	Type of Stakeholder	Male	Female	Total
4	21.12.2023	Sector 7	General Public	5	-	5
5	21.12.2023	Sector 48	Street Vendors	8	-	8
6	27.12.2023	RITES Office, Gurugram	General Public	4	-	4
7	25.01.2024	Jwala Mill, Phase 4	E-rickshaw Driver	5	-	5
8	25.01.2024	Rao Gajraj Singh Chowk	General Public	6	-	6
9	29.01.2024	Udyog Vihar Phase 4	General Public	4	-	4
10	30.01.2024	Palam Vihar Mor	Auto Drivers	5	-	5
11	15.10.2024	KBA/IBA in Sector 101, Basai	NGO	3	-	3
<b>GBV Consultation and Discussions with Police Officials</b>						
1	21.12.2023	Palam Vihar	Police Officials	-	5	5
2	22.12.2023	Sector 51	Police Officials	-	5	5
3	29.12.2023	Palam Vihar	Police Officials	-	2	2
4	29.12.2023	Jhadsa, Sector 39	Police Officials	1	-	1
<b>GBV Consultation and Discussions with Women as Transport User</b>						
5	29.12.2023	Gurugram	Women as Transport User	-	49	49

Women participants reported encountering physical threats and eve-teasing while using various forms of public transport, including buses, autos, and shared autos, as well as during their travels on the metro. Despite these challenges, they indicated that metro travel is currently the safest transportation option. They highlighted safety features such as police presence, CCTV surveillance, dedicated women's coaches, and clearly visible helpline numbers as key factors contributing to their sense of security.

### 6.3 Issues raised and discussed during Consultation

The issues raised & discussed and mitigation measures during consultations are presented in **Table 6-3** and details are given in Stakeholder Engagement Plan (SEP).

**Table 6-3 Issues Raised & Discussed and Mitigation Measures**

Stakeholder Groups	Issues Raised and Discussed	Responses Provided
Project Affected Persons	<p>a. Requested to review the alignment and station plan to avoid impact on their structure.</p> <p>b. Requested to share the timelines of construction and land acquisition.</p> <p>c. Requested to share how their loss will be compensated and what will happen to the remaining land.</p> <p>d. Suggested the station entry and exit need to be reconsidered and proposed along</p>	<ul style="list-style-type: none"> <li>The Detailed Design Team will review the alignment and if possible, the alignment shall be modified. The findings will be communicated to the participants.</li> <li>The construction work will likely start at the end of 2024.</li> <li>The land shall be acquired through Mutual Negotiation, in case of failure in negotiation, it</li> </ul>

Stakeholder Groups	Issues Raised and Discussed	Responses Provided
	<p>the station extension rather than on the left and right sides of the station.</p> <p>e. The locations where ramp/stairs for entry &amp; exit points is proposed to be constructed may be expected to block the roads, which is the only entry-exit points for residents residing in said lane.</p> <p>f. Proposed metro facilities shall close front of the shops which shall be covered by the wall of metro project. It will lead to huge financial losses to shopkeepers and may also lead them to vagrancy.</p> <p>g. Fruit Vendors have concerns that the metro project would have negative impacts in terms of loss of income and customers during construction period.</p> <p>h. Suggested that the traffic management is very necessary during construction as the area is very congested.</p> <p>i. Marble merchants in Sector 33 (Depot location) filed a petition alleging that the authority (HSVP earlier known as HUDA) has not adopted fair and appropriate criteria/methods for the newly allotted site. The marble market area falls in the proposed depot location got stay order by Hon'ble Court for operations of Marble Market. They have stated that they will not participate in the census and socio-economic survey until the Hon'ble Court orders them to vacate the location.</p>	<p>shall be acquired through RFCTLARR Act, 2013<sup>9</sup>.</p> <ul style="list-style-type: none"> <li>• They were informed that the remaining land will be acquired by GMRL, if the remaining land is unviable.</li> <li>• Compensation will be paid as per the RFCTLARR Act, 2013 for their losses.</li> <li>• The participants were informed that the entry/exit will not be blocked during construction.</li> <li>• The participants were informed that traffic during construction will be managed with the support of traffic police.</li> <li>• The marble merchants were informed that the census and socio-economic survey will be conducted after the Hon'ble Court issues its verdict on the matter</li> </ul>
<p>Other Interested Groups</p>	<p>a. Proper and designated space for autos and e-rickshaws to avoid chaos at metro stations.</p> <p>b. Street vendors near metro station would increase the chances of traffic jams.</p> <p>c. Parking space would be beneficial for metro users.</p>	<ul style="list-style-type: none"> <li>• The participants were informed that the issue will be discussed with GMRL and based on the applicability it shall be incorporated into the design.</li> <li>• The compensation will be paid as per the RFCTLARR Act, 2013<sup>10</sup>.</li> </ul>

<sup>9</sup> Land will be purchased in accordance with the GMRL Policy for Direct Purchase of Private Land/Property through Mutual Negotiations.

<sup>10</sup> The Entitlement Matrix (EM) has been developed in accordance with the RFCTLARR Act and ESS5. The Entitlement Matric outlines the provisions to address impacts occurring during the construction phase and compensated accordingly

Stakeholder Groups	Issues Raised and Discussed	Responses Provided
	<p>d. Provisions for dust pollution reduction and management of service lanes during the construction phase.</p> <p>e. Seasonal street vendors will not have any impact due to the proposed project.</p> <p>f. Auto, e-rickshaw, taxi, and feeder services would be beneficial for metro users for last-mile connectivity.</p> <p>g. Traffic management plan for temporary interruptions to vehicular and pedestrian traffic to avoid jams.</p> <p>h. Project will have negative impacts in terms of loss of income as road traffic diverted to metro.</p> <p>i. Auto fare would be reduced during construction phase.</p> <p>j. Requested to pay compensation if their shops will be closed or affected during the construction phase of the metro.</p> <p>k. Provisions for CCTV at major GBV hotspots.</p> <p>l. Provisions for cameras at stations and nearby locations should be proposed.</p> <p>m. Screening of GBV related major crimes and their punishment to be displayed at the metro stations to make commuters aware.</p> <p>n. Only those auto and taxi driver shall be allowed at metro stations whose police verification is being done on a regular basis.</p> <p>o. Suggested photographs of those auto and taxi drivers with criminal records should be displayed at metro stations.</p> <p>p. Concerned police stations should be consulted at the time of construction to identify grey areas and hotspots for regular police patrolling and CCTV installation.</p> <p>q. Separate and dedicated space for autos and taxis.</p> <p>r. Police booth with a residential facility at station location for 24x7 police officials' deployment.</p> <p>s. Provisions for the deployment of police officials both men and women at the entry or exit of metro stations to restrict bad elements at and near metro premises.</p>	<ul style="list-style-type: none"> <li>Participants were informed that first aid kits are already incorporated in the design, and their concerns of dedicated auto and taxi parking will be discussed with the GMRL and Detailed Design Team.</li> </ul>

Stakeholder Groups	Issues Raised and Discussed	Responses Provided
	<p>t. Metro premises must have Sanitary Pad Vending Machines, Transparent Elevators, Gender Neutral Toilets, Dedicated Women Coaches and Apps for Online Complaint.</p> <p>u. Emergence helpline numbers must be displayed at and near metro premises and require immediate response from them.</p> <p>v. Provisions for Platform Screen Door (PSD) to prevent accidents, objects falling on track, and trespassing</p>	
<p>Vulnerable and Disadvantage Group (including Elderly People, Banjaras, etc.)</p>	<p>a. Requested to share the timelines of construction and land acquisition.</p> <p>b. Requested to share how their loss will be compensated and what will happen to the remaining land.</p> <p>c. Vendors have concerns that the metro project would have negative impacts in terms of loss of income and customers during construction period.</p> <p>d. They do not want compensation in monetary form; instead, a license from a local body is to be provided to all affected vendors against their losses.</p> <p>e. Requested to avoid the impact, and if their structures gets affected, compensation shall be paid or provide space nearby.</p>	<ul style="list-style-type: none"> <li>• The construction work will likely start at the end of 2024.</li> <li>• The land shall be acquired through Mutual Negotiation, in case of failure in negotiation, it shall be acquired through RFCTLARR Act, 2013.</li> <li>• They were informed that the remaining land will be acquired by GMRL, if the remaining land is unviable.</li> <li>• Compensation will be paid as per the RFCTLARR Act, 2013 for their losses.</li> </ul>

#### 6.4 Consultations and Disclosures

The draft ESIA study report shall be made available to stakeholders. Executive summaries of the ESIA and other E&S documents shall also be translated into Hindi and disclosed on the GMRL website for feedback and comments. Stakeholders feedback will be incorporated into the SEP and LMP, and ESIA and RAP as appropriate. The revised reports will be disclosed in accordance with the WB’s disclosure requirements on the GMRL website and the Bank’s external website.

## Chapter 7: Assessment of Environmental and Social Risks and Impacts

### 7.1 Impact Assessment Methodology

E&S risks & impacts can be positive or negative, direct or indirect, and may occur at the local, regional, or global scale. These impacts may also be reversible or irreversible in nature. This chapter focuses on the potential negative risks & impacts arising from the GMRP activities. The assessment is based on the Project Description (Chapter 3) and the E&S Baseline Data (Chapter 5).

### 7.2 ESS 1: Assessment and Management of E&S Risks and Impacts

The E&S risks and impacts of the project in consistent with ESS1, are detailed in the following section.

#### 7.2.1 Change of Land Use

The development of GMRP requires land acquisition station buildings, platform structures, depot, office complexes, and other associated facilities. Government land will be transferred, and private land will be acquired for the project. The required land is located in existing commercial areas or along road verges characterized by mixed land use. Land acquisition will be limited in small parcels and hence, large-scale land conversion is not anticipated for the alignment.

The spur line passes through an open space demarcated as 'Public Utilities' under the Gurugram Master Plan 2031, after crossing the railway track in Sector 101. This land is currently used by villagers for agricultural activities. With proper planning, there will be no access restrictions for the local community during both the construction and operation phases of GMRP. The alignment passes in proximity to residential and sensitive areas such as forest, temple and water body, which will be changed to 'Transport and Communication' land use. The design shall ensure uninterrupted pedestrian movement through provision of footpaths and parking spaces.

The depot is planned over an area of 22.37 ha. According to the Master Plan 2031 of the Department of Town and Country Planning, Haryana, the existing land use of the proposed depot site is categorized as commercial and open space. The development of the depot will result in permanent conversion of the current land use.

#### 7.2.2 Utilities

Numerous utility services such as sewer lines, water mains, electrical lines, telecom cables, gas supply pipelines, cables, traffic signals systems, etc. are present along the GMRP alignment. The construction of the Spur Line from Basai Village to Dwarka Expressway (Sector 101) is expected to restrict the use of area designated as 'Public Utilities' in Sector, as per the Gurugram Master Plan 2031. The shifting, maintenance and potential impacts on construction activities must be addressed through well-planned temporary or permanent diversions. Proactive planning and timely action will be required to manage these challenges effectively.

The organizations and departments responsible for the concerned utility services are listed in **Table 7-1**.

**Table 7-1 Organizations Responsible for Utilities and Services**

S. No.	Organization/ Department	Utility/Services <sup>11</sup>
1.	Gurugram Municipal Corporation	Sewerage and drainage lines. Water mains and their service lines, including hydrants and fountains etc., water treatment plants, pumping stations, roads, surface water drains, nallahs, sewer lines, streetlights, high mast lights etc.
2.	Public Works Department	Roads, foot over bridges, large surface water drains, nallahs etc.
3.	National Highway Authority of India (NHAI)	Roads
4.	Haryana Vidyut Prasaran Nigam Limited and Dakshin Haryana Bijli Vitran Nigam Limited	Sub Stations, Power cables and their appurtenances, pole mounted transformer and high-tension line
5.	Bharat Sanchar Nigam Limited (BSNL), Vodafone, Bharti Airtel, Reliance Jio, Cable TV operators etc.	Telecommunication cables, junction boxes, telephone posts, Overhead lines etc.
6.	Office of Commissioner of Police, Gurugram	Traffic signal posts, junction boxes and cable connection etc.
7.	Haryana City Gas Distribution Ltd.	Gas Pipelines

### Mitigation Measures

The following measures are recommended for effective planning and execution of utility service diversions:

- **Uninterrupted Services:** Utility services must remain operational throughout the construction phase and after project completion to ensure uninterrupted functioning.
- **Coordination and Timing:** The contractor shall coordinate closely with the concerned utility providers to schedule utility shifting activities preferably during dry weather conditions to minimize disruptions. The utility providers shall also ensure appropriate alternate arrangements and public awareness through timely communication.
- **Minimal Disruption:** Elevated viaduct construction poses minimal utility disruption. Where utilities are located at pier positions, they should be diverted away from pile cap zones to avoid conflict.
- **Design Flexibility:** In cases where major utilities cannot be easily relocated, the viaduct layout and pile foundation layout should be modified to avoid such crossings.

<sup>11</sup> There may be additional utilities not listed in the table above. The contractor should coordinate with the relevant utility providers to plan and execute the utility shifting accordingly.

Alternatively, utilities may be safely encased within the pile foundations if technically feasible.

- **Risks of Service Disruptions:** There is a possibility of disruptions to utility services such as water supply, electricity, telephone, internet, etc., during construction.
- **Minimise Interruptions:** Disruptions should be minimized through careful planning, activity scheduling, and effective coordination among relevant departments. Implementation of temporary access roads and traffic diversion plans will also be necessary.
- **Stakeholder Engagement:** Continuous stakeholder engagement and transparent information disclosure related to utility shifting must be maintained to ensure constructive relationships throughout the project implementation.
- **Work Scheduling and Communication:** The construction schedule shall be shared in advance with line departments (such water supply, electricity, road & transport, etc.) and to enable them to prepare for any necessary adjustments and ensure service continuity.
- **Regulatory Compliance:** The contractor must comply with the terms and conditions specified by the respective utility authorities for all utility shifting activities.
- **Sewage Management and Safety:** During the relocation of sewage lines and manholes, appropriate precautions must be taken to address potential hazards such as gas accumulation and burst risks. Manual entry into manholes shall be strictly prohibited; all sewage-related work must be carried out using mechanical equipment to ensure worker safety.

### 7.2.3 Traffic Diversion/ Management

During the construction period, partial or complete traffic diversions will be required, as most of the construction activities will take place along the road median. Additionally, the proposed entry and exit points of the metro stations may create conflicts with both pedestrian and vehicular traffic.

#### **Mitigation Measures:**

Any reduction in road space during metro construction is likely to constrain traffic flow. To address this, DDC team shall incorporate the widening of footpaths and provide designated bays for the safe pick-up and drop-off of metro passengers in the design. To maintain acceptable traffic flow levels during construction, appropriate traffic management and engineering interventions need to be implemented. These may include road widening, traffic segregation, one-way traffic arrangements, traffic diversions to adjacent roads, use of service lanes, etc. Various construction methodologies shall be adopted to minimize traffic disruptions and ensure efficient vehicular movement.

The implementation of traffic management and diversion plans will be essential to maintain smooth and safe traffic operations throughout the construction period. The DDC shall propose appropriate conceptual traffic diversion plans for construction zones, prioritizing the safety of both construction workers and road users.

**Traffic Management Guidelines:** The primary objective of the following guidelines is to lay down procedures to be adopted by contractor to ensure the safe and efficient movement of traffic and the safety of workers at construction sites.

- A Traffic Management Plan shall be prepared, incorporating safety measures with special attention to sensitive areas such as schools, hospitals, residential areas, etc., The plan must be developed in consultation with the traffic police, municipal authorities & other relevant stakeholders.
- High-visibility jackets with reflective tapes shall be provided to all construction workers. Enhanced visibility of workers is essential to protect them from high-speed vehicular traffic, particularly during night-time or low-visibility conditions.
- The safety of road users in the impacted areas shall be prioritized.
- Traffic diversion plans must be clearly communicated to road users.
- Safe, clearly marked lanes and diversion routes shall be provided, along with well-lit signage positioned ahead of diversion points to guide road users.
- Provide safe and clearly marked, and barricaded buffer (with lighting, reflectors) and work zones.
- Provide adequate measures that control driver behaviour in and around construction zones.
- Within work zones, primary traffic control devices shall be deployed to maintain order and safety. These include signage, delineators, hard barricades, cones, pylons, pavement markings, flashing lights, reflectors, and adequate day and night lighting. Large information boards shall be installed at least 200 m before the work zone on both sides to alert and guide approaching drivers.
- The contractor shall ensure that all pits and excavations within the work zone are promptly backfilled and closed upon completion of work. Where temporary closures are required, barricades should be robust, equipped with reflective tapes and proper lighting, and designed to remain upright to prevent hazards to vehicles and pedestrians.
- Traffic marshals shall be deployed as per the requirement of the traffic police department to manage movement and ensure public safety.
- A qualified traffic consultant shall be engaged by the contractor to conduct traffic survey, suggest alternative routes, and support the development of an effective traffic management strategy. A traffic safety audit shall be conducted periodically, including assessment for city traffic. Corrective measures identified during the audit shall be implemented within defined timeframes.
- Where applicable, utility shifting activities shall be integrated into the TMP.

#### 7.2.4 Associated Facilities

The associated facilities identified for the GMRP are discussed in **Section 3.4**. This section provides an overview of the potential impacts of these facilities and presents the corresponding mitigation measures, as detailed in **Table 7-2**.

Table 7-2 Associated Facilities - Impacts and Management Plans

Activity	Impacts	Mitigation Measures
Road expansion/ Diversion of roads due to the GMRP	<ul style="list-style-type: none"> <li>• Land Acquisition and R&amp;R<sup>12</sup> issues if any</li> <li>• Impact on sensitive receptors.</li> <li>• Accidents due to improper signages.</li> <li>• Usage of borrow and quarry areas</li> <li>• Emissions from various construction activity</li> <li>• Loss of avenue trees.</li> <li>• Impact on utilities and common property resources.</li> <li>• Impact on natural drainage pattern.</li> <li>• Health impact on workers.</li> <li>• Impacts due to un-scientific dumping of demolition and construction waste. Disruption to public services due to utility shifting.</li> <li>• Risk of damage to infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• R&amp;R compensation as per the RFCTLARR Act 2013 and other acts.</li> <li>• Noise barriers should be provided at sensitive receptors if unavoidable.</li> <li>• Road infrastructure shall be provided to avoid the accidents.</li> <li>• Borrow and quarry areas-mitigated by reuse of demolition material.</li> <li>• Plantation of native species.</li> <li>• Suitable scientific measures such as water sprinkling, regular maintenance of vehicles, will be adopted to minimize the emissions during construction activity.</li> <li>• Compensatory plantation for tree felling.</li> <li>• All utility services should be kept operational during construction and operational phases.</li> <li>• Flow of natural drainage should not be affected, and proper cross drainage structures should be constructed.</li> <li>• Health and safety of the workers and communities should be ensured.</li> <li>• Waste generated from the construction sites will be disposed in pre-identified landfill sites.</li> <li>• Mitigation measures as presented in EHS manual should be implemented.</li> <li>• detailed utility mapping to develop a comprehensive utility relocation plan.</li> <li>• Preference for trenchless technology to shift underground utilities without extensive digging, reducing the need for road cuts (with OHS/CHS plans). No manual scavenging or related activities (such as for cleaning manholes during shifting)</li> <li>• Management of all types of solid &amp; liquid wastes</li> <li>• Plan for Disposal of spoils, sludges during utility shifting</li> </ul>

<sup>12</sup> The National Highways Authority of India (NHAI) is undertaking the road widening from Hero Honda Chowk to Umang Bhardwaj Chowk as part of NH-352W (Gurugram–Pataudi–Rewari Road). GMRP Alignment from Ch. 8300 to Ch. 9910 is planned within NHAI land for placing of pillars between Hero Honda Chowk and Umang Bhardwaj Chowk. NHAI initiated compensation to the PAPs in this section, therefore, PAPs of this section are not considered under GMRP

Activity	Impacts	Mitigation Measures
		<ul style="list-style-type: none"> <li>• Implement TMP in coordination with Traffic Police &amp; Department of Roads.</li> <li>• Critical controls for high energy hazards in place during construction and operations phase.</li> <li>• Impacts on open areas &amp; public activity areas</li> <li>• Detailed utility mapping and preference for trenchless technology to shift underground utilities with minimal disruption.</li> </ul>

All such future associated facility activities will be screened, and their E&S risks and impacts will be assessed in accordance with the WB’s ESF principles. GMRL will update the ESIA at a later stage to incorporate the findings of these assessments.

### 7.3 ESS2: Labour and Working Conditions

GMRL will engage agencies or contractors for civil works, core functional support, material and equipment supply, and implementation support, according to their procurement plan. The construction works will require a labour force and associated goods and services. A standalone LMP, has been prepared to guide the management of labour throughout the project implementation.

#### 7.3.1 Types of Workers involved in the Project

**Direct workers:** Under the GMRP, direct workers refer to individuals employed directly by GMRL. These employees are responsible for managing and supervising the overall implementation of the project, including supervision of construction activities carried out by contractors. The number of direct workers is expected to vary across different phases of the project preparation to completion. The estimated number of direct workers is approximately 40.

**Contracted Workers:** As GMRL may not possess the full range of technical expertise required to manage the entire project independently, they will require support from consultants in specific technical areas such as project management and coordination, financial management, procurement, construction, environmental and social experts, monitoring and evaluation, among others. To implement various components of the project, GMRL will engage contractors, General Consultants (GC), Detailed Design Consultant (DDC), Independent Monitoring Consultants, and other relevant entities.

The estimated number of contracted workers will likely be 1310 (1200 construction labour/workers and consultants, 110 GC, DDC, audit, quality and safety audit, and independent monitoring consultants). The different categories of anticipated contracted workers are presented below.

- **Skilled permanent staff of contractors:** The contractor’s permanent technical staff will be engaged in GMRP, including key personnel such as project managers, project engineers, environmental engineers, construction foreman, medical officers, administrative officer, finance officer and other team members.

- **Skilled workers engaged by contractors:** Contractor may engage subcontractors for technical work, like heavy machine operations, if required.
- **Unskilled community members engaged by contractor:** Project aims to maximize employment by engaging community members as unskilled workers. Contractor may prioritize host communities and vulnerable groups, including females and persons with disabilities, in close coordination with the GMRL.
- **GC, DDC, etc:** A GC (national or international organization) will be engaged by GMRL to provide day-to-day construction oversight for civil works. The GC team will consist of both national and international experts, including specialists in Planning & Coordination, Structural Design, Quality Assurance, Quality Control, Construction Safety, Signal Train, Telecom, Traction and Power Supply, Track, Rolling Stock, Geospatial Technology, Quantity and Cost Estimation, Community Liaison /Public Relations, Environmental, Social, Environment, Health and Safety (EHS), etc. The procurement process for the consultant team will start during project preparation phase, with the consultants expected to be onboard in the early stages of project implementation. The GC will support GMRL throughout the implementation period, until the completion of civil works. Also, a DDC will be engaged to prepare the designs for elevated stations and viaduct superstructures.
- **Independent Monitoring Consultants:** An Independent Monitoring Consultants for E&S issues to ensure compliance with approved plans. They will be engaged at the start of implementation and will review all resettlement/ environmental activities for satisfactory completion.

**Primary Supply Workers:** The GMRL will procure essential goods, including metro cars and rolling stock for the development of the GMRP. These materials will be sourced directly from primary suppliers on an ongoing basis. Workers engaged by these suppliers are classified as "primary supply workers," as defined in ESS2. The estimated number of primary supply workers will likely be 200.

**Community workers:** The project will not have community workers as defined under ESS2.

### 7.3.2 Expected Negative Risks and Impacts

#### Key Labour Risks:

The most significant OHS hazards associated with construction of metro facilities occur during the construction phase and include activities with high risk for workers if not managed properly. These are applicable to workers/labours engaged in implementation of the project. The risks associated during construction are provided below:

1. **Child Labour Risks:** Child labour shall be strictly prohibited at the construction site of the proposed project. To ensure adherence to this mandate, all workers will be required to provide legally recognized documents as proof of age, such as Aadhar Card, Birth Certificate, Voter ID Card, or 10th Grade Marksheet/Certificate. Age regulations for project labour will be included in the contractor's bidding documents to monitor E&S compliance during project implementation.
2. **Risks due to Labour influx:** Migrant workers may require for the construction activities, although a large influx is not anticipated due to local labour availability. Cultural

differences can cause tensions between local and migrant workers at construction sites and camps. Furthermore, male migrant workers may pose risks of GBV and SH.

3. **Risks of Labour Disputes:** Labour disputes on metro construction sites may arise from various factors such as limited job opportunities, wage rates, delays in payment, working conditions, contractual issues, union activities, and health and safety concerns. Employers, including contractors and subcontractors, might retaliate against workers who seek improvements or voice grievances, which could escalate into labour unrest.
4. **Discrimination and exclusion of vulnerable/disadvantaged groups:** Vulnerable and disadvantaged groups, such as women and persons with disabilities, may face higher risks of being excluded from job opportunities.
5. **GBV:** Construction workers, who are mostly males, often work far from home, isolated from their families and usual social controls. This situation can contribute to inappropriate and criminal behaviours such as SH of women and girls, exploitative or illicit sexual relationships, including with minors from the local community.
6. **Noise:** Construction activities are expected to produce noise levels in the range of 76-88 dB(A) at 15 m distance. Due to the high noise levels of some construction machinery, the personnel operating near the machines and the workers stationed close to the machines are prone to exposure of high levels of noise.
7. **Occupational Health and Safety Risks**
  - **Health Risks:** Health risks may rise from working in a polluted environment with high dust concentrations generated by construction activities such as site clearance, soil excavation, levelling, machine operation and material transportation.
  - **Collapse of nearby structures:** Excavation and demolition activities can damage the foundations of nearby existing structures, potentially leading to structural collapse and causing serious injuries to workers.
  - **Risks of Falling from High Levels:** Workers may fall from heights due to improperly installed scaffolding, unsecured ladders and unprotected steel bars during construction of metro facilities, which may lead to labour accidents.
  - **Risks of Falling Objects:** Workers working below under construction metro facilities may be injured by hard objects falling from heights.
  - During metro operations, several risks may arise, including fire and explosion hazards, accidents, power substation failures, stampedes at platforms or station entry and /exit points.
  - **Risks due to Heavy Machineries:** The construction of metro facilities requires the use of heavy machinery; however, its movement poses a risk of injury to nearby workers if they are struck or hit.
  - **Risks due to Fatigue:** During both the construction and operational phases of the metro project, workers may be required to work irregular or extended hours, potentially leading to fatigue. Such fatigue can impair concentration, reduce alertness, and negatively affect performance in safety-critical tasks. This poses a significant safety risk not only to the workforce but also to the general public.
  - **Risks due to Maintenance of Rolling Stock:** These hazards include physical risks from moving equipment and machinery, chemical exposure to hazardous substances such as asbestos, PCBs, and VOCs, risks of fire or explosion during hot work, biological exposure from sewage systems, and confined space entry risks during the maintenance of tanks and compartments. These factors may pose significant health and safety risks to maintenance personnel if not properly managed.

- **Risks due to derails of metro train:** Metro train derailments pose significant risks to both passengers and staff, including physical injuries and fatalities.
- **Risks due to birds:** Bird presence at metro lines and maintenance depots can lead to safety hazards, equipment damage, electrical issues, health hazards, and increased maintenance costs due to collisions, droppings, and nesting activities.
- **High Energy Hazards:**
  - a. **Risks of Fire and Explosion:** During construction, welding activities can generate sparks that may ignite nearby flammable materials, such as fuels and gases, leading to fires or explosions with potentially serious consequences for both workers and surrounding communities. During the operational stage, the risk of fires at stations and depot locations is also anticipated, which could impact employees, passengers and nearby communities.
  - b. **Electrical Hazards:** During construction workers may exposed to live electricity while testing TLs, substations or using electrical power for soldering, which can result in serious injuries or fatalities due to electric shock.  
During metro operation, electrical accidents may happen due to following reasons:
    - Live mains: LT or HT,
    - Overhead power lines,
    - Parts which have become live due to leakage either because of low insulation resistance of the electrical windings, high earth resistance or discontinuity of the earthling leads.
    - Areas that develop a high potential gradient, such as near an earth electrode where fault currents flow are insufficient to trip circuit breakers or blow fuses.

The impact associated with electricity includes electric shocks or burn whether minor, major or fatal affecting both metro personnel and others.
  - c. **Possible risks due to depot:** Depot operations involve various potential risks, such as handling heavy parts, the possibility of collisions, tripping or falling into maintenance pits, electrical hazards, and slipping on oily floors. Additionally, improper waste handling can lead to safety risks, environmental pollution, and operational inefficiencies.
  - d. **Risks due to storage of Gas/LPG:** During the construction period, workers may face significant risks of serious injury due to the storage of GAS/LPG cylinders, particularly from potential explosions caused by gas leaks or damaged to cylinders.
  - e. **Risks Associated with Iron Cutting and Soldering:** Workers engaged in cutting iron and soldering without proper personal protective equipment (PPE), such as face shields, hand protection, safety glasses, and high-top boots, may be at significant risk of serious injuries. The absence of high-top boots increases the risk of electrical shock, while the lack of gloves can lead to injuries to the wrists and forearms from heat, sparks, molten metal, and radiation.
- **Other Occupational Risks:**
  - Risks due to lack of full height fences, barriers, or barricades around the construction site.
  - Obstructions caused by vehicles parked in no-parking zones.

- Use of vehicles, machinery and other equipment without valid fitness certificates.
- Safety issues, including injuries or fatalities, due to lack of PPE and inadequate safety measures.
- Exposure to mental or physical harassment, including SEA/SH.
- Health risks related to HIV/AIDS and other sexually transmitted diseases among labourers.
- Risk of contamination during infectious disease outbreaks if proper and frequent hygiene practices are not maintained.

### 7.3.3 Management Strategies

1. **Child labour:** Minimum age for project workers is 18 years; no one under 18 years will be permitted. Contractors must adhere to these age requirements, with penalties for non-compliance. They must also maintain a labour registry that verifies workers' ages.
2. **Labour influx:** GMRL will require contractors to prioritize recruiting unskilled labour from local communities for basic tasks. All workers must sign and adhere to a code of conduct addressing the risk of GBV. Training will be organized with a focus on expected behaviour, local norms, and raising awareness about GBV/SH.
3. **Labour Disputes over Terms and Conditions of Employment:** To prevent labour disputes, fair terms and conditions will be enforced for all project workers. Grievance mechanisms will be established to promptly address workplace issues for both direct and contracted workers. Additionally, the project will respect workers' rights to join labour unions and freedom of association.
4. **Discrimination and Exclusion of vulnerable/disadvantaged Groups:** Employment under the project will uphold equal opportunity and fair treatment, without discrimination. Contractors are required to include vulnerable groups such as women, SC/ST groups, and persons with disabilities in their unskilled workforce. To mitigate the risk of exclusion of these groups from job opportunities, the project will require the contractor to employ them as part of their workforce. Compliance with national legislation on gender equality, including provisions for maternity leave, nursing breaks, and separate toilet facilities for men and women, is mandatory.
5. **GBV:** Approximately 80-85% of contract workers are expected to be men, while women's participation is likely to be around 15-20% and will primarily involve unskilled and semi-skilled positions. Contractors will enforce Code of Conduct (CoC) for all workers, subcontractors, and suppliers. CoC will include sanctions for non-compliance, including gender-based violence policies, etc. Contractor will ensure that the CoC is written in plain language, understandable to local and migrant workers and signed by each worker to indicate that they have:
  - Received a copy of the CoC as part of their contract.
  - CoC has been explained to them as part of induction process.
  - Acknowledged that adherence to CoC is a mandatory condition of employment.
  - Understood that violations of the CoC can result in serious consequences, up to and including dismissal, or referral to legal authorities.
6. **Noise:** Use of personal protective equipment will help in reducing noise impact on personnel. All construction activities will have to comply with Noise Pollution

(Regulation and Control) Rules, 2000 & amendments and World Bank Environmental and Social Standards. This could be achieved by:

- Job rotation to the extent possible
- Automation
- Construction of permanent and temporary noise barriers including greenery
- Re-route and regulate the traffic, a main source of noise.
- Use electric equipment instead of diesel-powered equipment
- Use hydraulic tools instead of pneumatic tools
- Acoustic enclosures should be provided for individual noise generating construction equipment
- Scheduling of truck loading, unloading and hauling operation
- Proper operation and maintenance of the construction vehicles and equipment would keep them within noise limit
- Schedule work to avoid simultaneous activities
- Anti drumming floor and noise absorption material
- Low speed compressor, blower and air conditioner
- Mounting of under frame equipment on anti-vibration pad

The workers employed in high noise level area could be employed in low noise level areas and vice-versa from time to time. Special acoustic enclosures should be provided for individual noise generating equipment, wherever possible. Noise level from loading and unloading of construction materials can be reduced by using various types of cranes and placing materials on sand or sandy bag beds.

7. **OHS:** The construction activities have its own challenges and contributes significantly to OHS concerns. OHS concerns for can increase due to various factors including site conditions, awareness of OHS preventive and protective measures, provisions in contracts, and inadequate supervision, monitoring, and enforcement by the implementing agency.
- **Mitigation for health risks:** The contractor shall take measures to minimize fugitive dust emissions during construction activities. Dust emissions should not be visible beyond the source's boundary for longer period, and equipment should be used to control air pollution and provide respiratory protection to workers in high-dust areas.
  - **Mitigation for risks of accidents:** Erection, excavation, dismantling of structures, temporary work, shoring, or any other tasks must be performed by trained workers under competent supervision.
  - **Mitigation measure for risks of falling from high levels:** Contractor shall ensure that work at height is properly planned for emergencies and rescue, adequately supervised, and conducted in a manner that is reasonably safe. Safety nets and harnesses must be used for work over 2 meters to prevent falls and injuries.
  - **Mitigation measure for risks of falling objects:** Contractor shall take measures to prevent injuries from falling materials, including prohibiting throwing or tipping from heights, and ensuring proper barricading, safety nets, and fall arrest systems are in place in high-risk areas.
  - **Mitigation measures for risks of electrical shock:** Contractor shall ensure safe power usage and electrical equipment practices, including the use of protection

devices. Cables should be selected according to the exposure conditions and specific requirements of the project. Regular inspections should be conducted to detect any cuts or cracks in the cables.

- **Risks of fire and explosion:** Contractor shall provide workplace with fire extinguishing equipment that is regularly recharged and maintained to meet Indian National Standards. Additionally, combustible scrap and debris must be disposed of regularly.
- **Mitigation measures for risks due to use of heavy machineries:** All workplace equipment must be in sound mechanical condition and certified by a competent authority. Vehicles should have audible reverse alarms and be well maintained. Reversing shall be done with adequate rear-view visibility or under the banksman's direction.
- **Mitigation measures for Heat Stress:** Provide shaded rest areas and hydration for workers. Allow for regular breaks to prevent heat-related illnesses. Monitor workers for signs of heat exhaustion.
- **Mitigation measures for Traffic Hazards:** Designate safe walking paths and vehicle routes. Use signage and barriers to separate pedestrian and vehicle areas.
- **Mitigation measures for Lockout/Tagout Failures:** Follow lockout/tagout procedures during maintenance. Train workers on safe handling of rolling stock components. Use machine guards and safety interlocks on equipment.
- **Mitigation measure for other occupational risks:**
  - Maintain all stairways, passageways, gangways, and emergency exits clear and unobstructed.
  - Erect full-height fences, barricades, and barriers around the construction site to contain excavated soil and rubbish.
  - Prohibit parking of vehicles on roads to prevent traffic obstruction.
  - Enforce a zero-tolerance policy for employees entering the work area under the influence of alcohol or drugs.
  - Ensure all vehicles, machinery, and equipment have valid fitness certificates.
  - Mandate the use of PPE for all workers at the construction site.
  - Provide essential facilities such as first aid boxes, clean drinking water, separate latrine facilities, temporary living accommodations, and childcare rooms as per regulatory standards, etc. for labours at labour camps/construction sites.
  - Contractor shall ensure that EHS supervisor is engaged during conduction work.
  - First-aid box is provided and maintained at labour camp and construction site as specified in BOCWA.
  - Contractor shall ensure that an adequate canteen on 'no profit no loss' basis is provided where 250 workers are employed.
  - In case of works like track laying, the zone of work is constantly moving at elevated level or at ground level. In such cases mobile urinals with proper facility to drain the sullage shall be provided at reasonably accessible distance.
  - In every workplace, where more than 50 female workers are ordinarily employed, a well-maintained suitable room is provided for use of children in accordance with Section 35 of BOCWA.
  - Contractor shall organise awareness camps for GBV and STDs (HIV/AIDS)
  - Contractor shall organise regular HIV/AIDS check-ups and medical health camps.

### 7.3.4 Training

The training for engineers and managers will be imparted by GMRL on regular basis to monitor implementation of ESMP during construction and operation phases. The details of training programs are given at **Table 7-3**.

**Table 7-3 Details of proposed Training Programs**

Training Program	Objectives	Participants	Number of Trainings
T1. Orientation/ Sensitization Training Programs – 1 Day	<ul style="list-style-type: none"> <li>To orient/ sensitize the project staff at the project launch towards the environmental and social issues of the project.</li> <li>To orient the project staff about the ESMF and its importance, provisions and implications.</li> </ul>	<ul style="list-style-type: none"> <li>MD GMRL</li> <li>EHS and Social Experts and other Staff, GMRL</li> <li>GC</li> <li>NGO</li> </ul>	<ul style="list-style-type: none"> <li>2 (during first year of project)</li> </ul>
T2. Training on the ESMP, and RAP, – 2 Days	<ul style="list-style-type: none"> <li>To equip with knowledge and skills necessary for use of ESMF, undertaking environmental and social screening and appraisal as per the requirements of the ESMF, conduct ESIA and preparation of management/ mitigation plans</li> <li>To prepare for undertaking periodic supervision of the implementation of environmental and social management/ mitigation plans and performance monitoring of sub-projects</li> </ul>	<ul style="list-style-type: none"> <li>EHS and Social Experts of GMRL</li> <li>E&amp;S Experts, GC</li> <li>NGO Staff</li> </ul>	<ul style="list-style-type: none"> <li>8 (During project Implementation).</li> <li>A minimum of 2 trainings per year</li> </ul>
T3. Training on World Bank's ESF	<ul style="list-style-type: none"> <li>WB's ESF Training will address potential E&amp;S risks during project implementation, such as aspects related to working conditions, employment, OHS and safety, CHS, GM, GBV (SEA/SH), security management plan, etc.</li> </ul>	EHS and Social Experts or other Staffs, GMRL	<ul style="list-style-type: none"> <li>1 Training</li> </ul>
T3. Training on OHS and EHS	<ul style="list-style-type: none"> <li>To enhance competency of the project staff of EHS and OHS risks during construction and operation, including Biodiversity Management Plan.</li> </ul>	EHS and Social Experts or other Staffs, GMRL	<ul style="list-style-type: none"> <li>A minimum of 2 trainings per year.</li> </ul>

About 10 to 20 trainees would participate in each of the training programs. It is intended that these trained persons will, in turn, provide onsite training to NGOs, resource persons, etc., onsite. The estimated total budget for training is Rs. 49.00 Lakh for proposed corridor. Contractor will arrange training for staff/ employees on Environmental Management Systems, Hazard Awareness, Environmental and Drainage Management, and Project Management.

## 7.4 ESS 3: Resource Efficiency and Pollution Prevention and Management

To promote the sustainable use of resources, the following measures shall be implemented to ensure the efficient consumption of energy, water, and raw materials.

### 7.4.1 Resource Efficiency

Resource efficiency in metro projects involves the optimal use of materials, energy, and other resources throughout the project lifecycle to minimize environmental impacts, reduce costs, and improve sustainability. It offers an opportunity to implement practices such as recycling and reusing waste and wastewater, improving energy and water use efficiency (considering demand supply dynamics), and optimizing the use of raw materials in line with applicable national and state policies and guidelines. Although the National Resource Efficiency Policy (NREP), 2019 remains in draft form and is not applicable to this project, alignment with ESS3 is maintained through the application of relevant national regulations and the adoption of established good practices.

#### 7.4.1.1 During Detailed Design Stage

##### 1. Green Buildings

All stations and depot buildings shall be designed as green buildings as per IGBC rating system. This system serves as a framework for integrating green concepts into MRTS and addresses the green features under the following categories:

- Site Selection and Planning
- Water Efficiency
- Energy Efficiency
- Material Conservation/ Building Materials and Resources
- Indoor Environment and Comfort
- Innovation in Design and Construction

The IGBC rating system integrates circularity principles in metro projects by encouraging the reuse of construction and demolition (C&D) wastes, thereby reducing resource consumption and minimizing the impact on landfill. It awards credits for the use of recycled materials, adoption of sustainable construction practices, and implementation of effective waste management strategies that support a closed-loop system.

Haryana has five, and Delhi has two, C&D waste recycling facilities. Recycled Materials from these recycling units will be preferably used for construction works, including pavement construction, subject to testing and confirmation of their structural soundness.

##### 2. Energy Efficiency

- Maximization of Natural and Renewable Energy Use: Natural lighting and alternative energy sources, particularly solar power shall be harnessed to the maximum extent feasible.
- Integration of Energy-Efficient Systems: Energy-efficient technologies shall be incorporated in trains, stations and supporting infrastructure. This includes LED lighting system, energy efficient HVAC (heating, ventilation, and air conditioning) and advanced signalling systems.

- **Solar Energy Development and End of Life Management:** Renewable energy sources, such as solar panels with anti-reflective coatings, shall be integrated at station buildings and depots. Upon reaching the end of their operational life, solar panels installed under the GMRP shall be disposed of or recycled in accordance with the E-Waste (Management) Rules, 2022, and relevant guidelines issued by the Central Pollution Control Board (CPCB).
- **Regenerative Braking System:** The proposed metro system shall be equipped with regenerative braking technology to recover and reuse energy during train operations.
- **Variable Voltage Variable Frequency (VVVF) Technology:** All escalators and elevators shall be equipped with VVVF technology to enhance energy efficiency.
- **Occupancy Sensors:** Occupancy sensors shall be installed in public toilets to minimize energy wastage.
- **Energy Efficient Office Equipment:** All office equipment including computers, printers, fax machines, etc. shall be certified with Energy Star or equivalent energy efficiency labelling.
- **Environmentally Safe Fire Suppression Systems:** Fire suppression systems used in stations shall be free from halons and ozone depleting substances.
- **Eco-Friendly Refrigerants:** Refrigerants used in the station systems shall have low or no Ozone Depleting Potential (ODP) and Global Warming Potential (GWP). Proper recycling and end of life management of refrigerants shall be mandated in procurement documents.
- **Adoption of Good International Practices:** Contractors shall implement measures specified in the WB's EHSGs to optimize the use of energy, water and raw materials, to the extent that it is technically and financially feasible.

### **3. Water Use**

- **Installation of High-Efficiency Water Fixtures:** Water-efficient fixtures shall be installed at stations and maintenance facilities, including low-flow toilets, dual flush systems, sensors based electronic taps, foam taps, waterless urinals, bio-digester (compositing) toilets, faucets, showers, dishwashers, etc. to significantly reduce water consumption.
- **Rainwater Harvesting:** Provision of rainwater harvesting systems at stations, along the alignment, and at depot to aid in groundwater recharge.
- **Water-Efficient Landscaping:** Landscaping at stations and depot (wherever feasible) shall be designed using native or adaptive plant species.
- **Permeable Pavements:** Wherever feasible, permeable pavement shall be used for access roads to stations, depots and service areas to promote water infiltration and reduce surface runoff.
- **Water Reuse:** Treated wastewater shall be reused for non-potable applications such as landscape irrigation and toilet flushing, thereby minimizing freshwater use.

#### **7.4.1.2 During Construction & Operation Phase**

##### **1. Water Use**

During the construction phase, water requirement will be met through treated effluent from nearby STP and municipal water supply sources. In the operation phase, water for air conditioning, cleaning and use of staff and passengers at stations will be sourced from the municipal supply. This will be supplemented by the reuse of treated wastewater generated

on-site, particularly for non-potable applications such as toilet flushing, landscaping, etc. To facilitate this, a double plumbing system will be incorporated into the design, included in procurement specifications and implemented accordingly. Water supply for depots will similarly be sourced from municipal supply and supplemented by on-site reuse of treated wastewater and harvested rainwater, wherever feasible. All sludge generated from wastewater treatment facilities will be managed and treated in line with prevailing guidelines and regulatory standards.

## 2. Raw Material Use-Sustainable Building Materials

Wherever feasible and available, construction materials recommended by the BIS such as fly ash and other approved waste-derived materials shall be utilized, provided they exhibit properties comparable to conventional building materials. To promote circular economy principles, the project may utilize recycled materials available at several C&D waste recycling facilities in Delhi. As per the Construction and Demolition Waste Management Rules, 2016, it is mandatory for municipal and government contracts to procure 10–20% of construction materials from C&D waste sources, subject to strict quality control standards. The use of such recycled materials significantly reduces dependence on virgin resources in the building structure, thereby enhancing environmental sustainability in infrastructure development.

### 7.4.2 Dust from construction/demolition activity

**Impact:** During the construction phase of the metro, activities such as excavation, material transportation and operation of heavy machinery generate significant quantity of dust particles. These emissions can adversely affect both human health and the environment.

#### Mitigation Measures:

- Regularly spray water or use of dust suppressants at work sites to minimize airborne dust.
- Cover all construction materials with green nets to prevent wind-blown dust.
- Ensure material and waste storage areas, as well as transport vehicles, are adequately covered to prevent dispersion due to wind, rain, or flooding. A full green net enclosure shall be provided around construction zones, supplemented by hard barricading equipped with lighting and reflectors for safety.
- Schedule construction activities in a manner that avoids operations during high wind speeds or extremely dry conditions. Additionally, comply with the Graded Response Action Plan (GRAP) guidelines to address air pollution in the National Capital Region.
- Conduct frequent water sprinkling on local roads and worksites to control dust emissions. The Contractor shall mobilize an adequate number of water sprinkling trucks.
- Install wheel washing facilities at the exit points of all construction sites.

### 7.4.3 Supply of Construction Material

Construction material such as aggregate and earth will be sourced from approved quarries to ensure minimal environmental impact and efficient utilization of natural resources.

**Mitigation Measures:**

- Procedures for the storage, handling, transportation and reuse of construction materials shall be outlined in the GMRL EHS Manual. This manual will be prepared in line with WB EHS guidelines and applicable national regulations.
- Designated facilities for processing and disposal of C&D waste are available in Gurugram. In the event of these are unavailable or have limited capacity, the waste shall be transported to alternate authorized facilities, including those in Delhi.
- The construction materials to be used include coarse aggregates, cement, coarse sand, reinforcement steel, structural steel, water supply components, drainage and sanitary fittings etc. Loading and unloading of these materials shall be carried out by labour engaged by the contractor.
- The procurement source of the construction materials will be decided by the contractor; however, all materials must be procured from licensed and approved suppliers.
- The contractor shall be responsible for the management of all construction materials during entire construction phase. Sufficient quantities of all materials must be available before the commencement of each construction activity.
- All construction materials shall be tested government labs or labs approved by the government to ensure quality compliance prior to use. This responsibility shall be clearly mentioned in the contractor's agreement.
- The contractor's responsibilities will also include supervision and monitoring of all aspects related to the storage, loading and transportation of construction materials and equipment.
- The construction material storage area shall be regularly inspected to ensure there is no uncontrolled waste, and appropriate measures shall be taken to prevent silt runoff and & pollution due to improper storage or handling.
- Close coordination with designated GMRL officer and the head of the construction team shall be required to promptly address environmental concerns and to implement necessary mitigation measures.
- Scheduling of material procurement and transportation shall be linked with the overall project construction schedule.
- All stairways and passageways shall be kept free from obstructions. Emergency exits, passageways, fire doors, alarm points, fire-fighting equipment, first aid stations, and other emergency stations must be kept clean, unobstructed and in good working condition at all times.
- Empty cement bags and other packaging material shall be properly stacked and removed.

**7.4.4 Impact due to Pre-casting yards and Material stockpiling**

Construction yard is a storage yard or assembly yard for building materials and equipment directly related to a specific construction project and subject to removal at completion of construction. Activities such as casting structural concrete elements and material stockpiling at these sites can potentially lead to air and water pollution, increased noise levels, diversion of open spaces such as parks, and temporary displacement.

**Mitigation Measures:**

- Site selection criteria for a construction yard are as under:

- Away from the right-of-way of a highway/ or any road
- Away from the footpath
- Away from habitation and settlements
- Away from the flood plains, water bodies
- Away from the notified areas- reserved forests, wetlands, nature protection, wildlife sanctuary, eco-sensitive zones, historical monuments, places of tourist interest, etc.
- Proper and safe stacking of materials at constriction yards and storage areas is of paramount importance. The storage area shall be well laid out with easy access and material stored / stacked in an orderly and safe manner without affecting movement of people, health & safety of workers or communities, & environment.

#### 7.4.5 Risk of Soil and Water pollution due to construction works

**Impact:** Metro construction activities such as foundation laying and structural development can lead to soil erosion, which may contribute to sedimentation in nearby water bodies. Additionally, construction related pollutants including sediments, debris, waste, and chemical runoff, pose a risk of contaminating water sources, degrading aquatic habitats and impacting the quality of essential water reservoirs.

No contaminated sites have been identified during the ESIA Study in the project area. However, if required, contamination assessments and site-specific cleanup plans will be developed in accordance with applicable guidelines. An outline for Site Clean-Up/Remediation Plan for Contaminated Sites are provided in Annexure 7.1.

#### Mitigation Measures:

- Construction materials shall be stored at a safe distance from water bodies to prevent contamination, especially during heavy rainfall or flooding.
- Properly treat and manage stormwater runoff to prevent pollutants from entering water bodies.
- Fuel and oil would be stored in cement lined, elevated storage yards equipped with cut-off drains to prevent leakage or spillage and subsequent soil or water contamination.
- All fuels and chemicals must be stored in contained, designated facilities. Preventive measures should be implemented to avoid spillage or leakage.
- In case of accidental spills, contaminants must be contained immediately. Oil spills shall be cleaned using spill kits, and standard operating procedures (SOPs) shall be prepared and strictly followed for spill response and cleanup.
- Improper site management and spills from construction equipment may cause soil contamination; therefore, appropriate housekeeping and spill prevention practices must be in place.
- Sedimentation control measures, such as sedimentation tanks, shall be installed at batching plants to minimize runoff-related pollution
- Contractors shall adopt water conservation practices, including the use of energy efficient water fixtures at sites and project offices.
- Water leakages through pipes and valves must be prevented through regular inspection and maintenance.
- Reuse of water used for curing and other construction uses shall be planned and implemented to reduce overall water consumption.

#### 7.4.6 Air Pollution during Construction

Air pollution may result from activities such as excavation, loading and unloading construction materials, and emissions from vehicles, construction equipment and DG sets. Additional sources include muck disposal sites, debris disposal locations and pre-casting yards.

DG sets will be used to provide power backup supply during construction. For estimation purposes, a DG set of 50 KVA capacity has been considered. The predicted maximum incremental load on applicable averaging hour 24 hours for criteria pollutants SO<sub>2</sub>, NO<sub>x</sub>, PM2.5, PM10 and 8 hour for CO due to the operation of DG set during daytime construction activity between 0800 IST and 1800 IST are predicted to be about 0.70 µg/m<sup>3</sup>, 7.0 µg/m<sup>3</sup>, 0.07 µg/m<sup>3</sup>, 0.14 µg/m<sup>3</sup> and 7.40 µg/m<sup>3</sup> respectively and occurs within 100 m from the DG set location.

While the impact on ambient air quality during construction phase is expected to be minimal and temporary, the implementation of a comprehensive EMP is essential to mitigate potential adverse effects.

##### **Mitigation Measures:**

The following mitigation measures shall be adopted to minimize air pollution during the construction period, particularly focusing on PM, gaseous emissions, and fugitive dust:

- The contractor shall take all necessary precautions to minimize fugitive dust emissions during excavation, grading, land clearing, and waste disposal. Dust emissions from material handling, storage, and transport activities must not be visible beyond the property boundary for any extended period without prior notification to the Employer.
- All vehicles and construction equipment used by the contractor shall comply with the latest emission standards prescribed by the GoI and the GoH. Periodic emission checks shall be conducted, and necessary corrective actions, including equipment replacement, shall be taken to ensure compliance
- Loose materials such as soil and debris being transported shall be covered adequately. Trucks must be loaded with sufficient freeboard and secured to prevent spillage through tailboards or sideboards.
- Barricades or enclosures shall be installed around open construction sites prior to the commencement of work.
- Temporary storage areas must be barricaded, well-lit, and maintained with appropriate pollution prevention measures. Excavated material shall be reused for backfilling or managed as directed by the Employer. Dust suppression measures must continue even during work stoppage or public holidays
- Materials shall be placed in a manner that minimizes dust generation. Regular wetting of materials shall be conducted, particularly during dry or windy weather conditions.
- Water sprinkling shall be undertaken at construction sites during excavation, demolition, or debris handling. Adequate water sprinkling equipment must be available at all times. Dust screens should be used in areas close to sensitive receptors when additional dust control is required.

- Wheel washing or vehicle cleaning facilities equipped with high-pressure water jets shall be installed at site exits, including batching plants and construction depots, to prevent off-site dirt transfer.
- In compliance with the GRAP, the use of DG sets from Stage II onward shall be regulated in all NCR sectors as per CAQM Directions No. 76 and 83.
- The contractor shall installed sealed construction enclosures near air intake points of hospitals to block entry of pollutants.
- Water sprinkling shall be intensified near schools during school hours to minimize dust exposure to children.
- Dust-generating activities shall be scheduled during non-peak hours to reduce exposure risks for sensitive receptors.

### 7.4.7 Noise Pollution

#### 7.4.7.1 Construction Phase

Noise generated during the construction phase may become a nuisance to nearby residents and passersby. Construction workers are also at risk of exposure to elevated noise levels while working on-site. The most prevalent noise source at the project construction sites would be internal combustion engines used to power various types of equipment. Earth-moving equipment, material-handling equipment, and stationary machines are all engine-powered, typically generate continuous noise. Activities involving the handling of heavy precast panels and the casting of pillars are also expected to contribute significantly to construction noise levels. While mobile equipment operates in a cyclical manner, stationary equipment tends to emit noise at constant level over time. Additionally, trucks transporting materials to and from the site could impact a wider range of receptors, as their movement is not confined to the project site alone. Other noise sources would include equipment and tools such as pile drivers.

Construction noise will be intermittent and localized, varying with the type and intensity of construction activities. These activities are expected to occur seasonally and at different locations across the project area.

An analysis of construction related noise has been conducted based on typical activities and equipment associated with demolition, excavation, and erection phases. For prediction purpose, no ground attenuation has been considered, assuming that the ground is undisturbed, consolidated and hard in nature. The estimation of noise levels during construction phase has been carried out in accordance with guidelines specified in the “Transit Noise and Vibration Impact Assessment, May 2006 published by the Federal Transit Administration (FTA)”. Noise Levels for all equipment have been modelled accordingly and are provided in **Table 7-4**.

**Table 7-4: Construction Equipment Noise**

Equipment	Noise level (in Leq dB(A) at 50 ft)	Equipment Noise (Leq) in dB (A) at various distances				
		50m	100m	200m	300m	400m
Auger drill	84	72	64	57	53	50
Generator	81	69	61	54	50	47
Chiseling	88	76	68	61	57	54

Equipment	Noise level (in Leq dB(A) at 50 ft)	Equipment Noise (Leq) in dB (A) at various distances				
		50m	100m	200m	300m	400m
Crane	88	76	68	61	57	54
Concrete Pump truck	81	69	61	54	50	47
Dumper	76	64	56	49	45	42
Dozer	85	73	65	58	54	51
Compactor	82	70	62	55	51	48
Grader	85	73	65	58	54	51
Concrete Mixer	85	73	65	58	54	51
Truck	88	76	68	61	57	54

Construction activities are expected to generate noise levels in the range of 76-88 dB(A) at a distance of 15 m, with sound levels decreasing as the distance from the source increases. As noted from the table, noise levels without any shielding attenuate to within the permissible daytime limits for residential areas at approximately 400 m. However, with the provision of source-level shielding, compliance with the standard is achieved at a reduced distance of approximately 140 m. Further reduction in noise levels can be achieved through the implementation of mitigation measures outlined under S. No. 6 of Section 7.3.3. Overall, the noise impact during the construction phase is anticipated to be short-term and manageable with appropriate control measures.

To minimize disturbance to nearby communities, noise barriers shall be installed along the construction boundaries in proximity to sensitive receptors, as identified in Section 5.10. Environmental Health & Safety Expert of ESMU shall monitor the noise levels at these sensitive receptors during construction. If noise levels are found to exceed permissible limits, implement the mitigation measures will be undertaken to ensure compliance.

#### 7.4.7.2 Noise during Operation

Noise generated during metro operations primarily originates from train movements, auxiliary systems, and activities within the depot. Key contributors include train acceleration and braking, ventilation systems, use of power tools, and machinery employed for train maintenance. Among these, the most significant source of noise is the operation of running metro trains. The primary sources of wayside airborne noise during metro operations include:

- i. Wheel/ Rail Noise: Due to wheel/rail roughness
- ii. Propulsion Equipment: Traction motors, cooling fans for TM, reduction gears etc.
- iii. Auxiliary Equipment: Compressors, motor generators, brakes, ventilation systems, other car mounted equipment
- iv. Elevated Structure Noise
  - At low speed (<15 km/h) auxiliary equipment may predominate
  - At speeds up to approx. 50 km/h, W/R noise predominate
  - At speeds greater than 50 km/h, the propulsion equipment noise predominates
  - For light weight steel elevated structures, the structure noise can predominate at all speeds above 15 km/h

The information related to metro operations, which has been considered for predicting noise levels, is sourced from the DPR and is also provided in **Table 7-5**.

**Table 7-5: Data Considered for Noise Level Predictions**

Corridor	Train Speed (Kmph)	No. of Cars	Corridor	Trains per day in both directions					
				Year 2026		Year 2031		Year 2041	
				Day	Night	Day	Night	Day	Night
Millennium City Centre to Cyber City	80	3/6	Viaduct	137	14	278	28	285	28

Note: Day: 06:00-22:00 hrs and Night 22:00-06:00 hrs

Source: DPR, October 2021

Predicted noise levels at all metro stations were modelled based on the guidelines outlined in the “Transit Noise and Vibration Impact Assessment, May 2006 by the Federal Transit Administration (FTA)”. The parameters used for the modelling are as follows:

- SELref: 82 dB (A) for fixed guideway rail cars operating at @ 50mph, measured at a distance of 50 feet,
- Ground Factor (G) for ground attenuation is considered as zero,
- Attenuation due to shielding between source and receptor is considered as zero,
- Adjustment Factor of +4 is considered for aerial structure with slab track,
- Performance Parameters considered for the project as per DPR are:
  - Max Acceleration 1.0 m/s<sup>2</sup>
  - Max Deceleration 1.1 m/s<sup>2</sup>

The maximum acceleration and deceleration values were used to determine the distance between stations where the metro train attains the maximum operating speed of 80 kmph. It is assumed that the metro enters and leaves station at a speed of 20 kmph. Accordingly, the predicted noise levels at a distance 15 m are given in **Table 7-6**. Additionally, Leq noise contours are generated along the GMRP corridor for the year 2026 and presented in **Figure 7-1**.

**Table 7-6: Predicted Noise Levels due to Metro Operations**

Year	Predicted Noise Levels in dB (A) at 15 m distance			
	20 KMPH		80 KMPH	
	Leqd	Leqn	Leqd	Leqn
<b>Corridor:</b> Millennium City Centre to Cyber City				
2026	52.41	49.77	64.45	61.81
2031	55.48	52.78	67.52	64.82
2041	56.59	53.75	68.63	65.79

The predicted noise levels estimated due to metro operations for the years 2026, 2031, and 2041 reveals the following:

**Speed 20 KMPH**

- The Leqd noise levels generated will be within the CPCB permissible limits prescribed for Residential areas at a distance of 11 m for year 2026, 16 m for year 2031; and 18 m for year 2041.

- The Leqn noise levels generated will be within the CPCB permissible limits prescribed for Residential areas at a distance of 26 m for year 2026, 37 m for year 2031; and 41 m for year 2041.

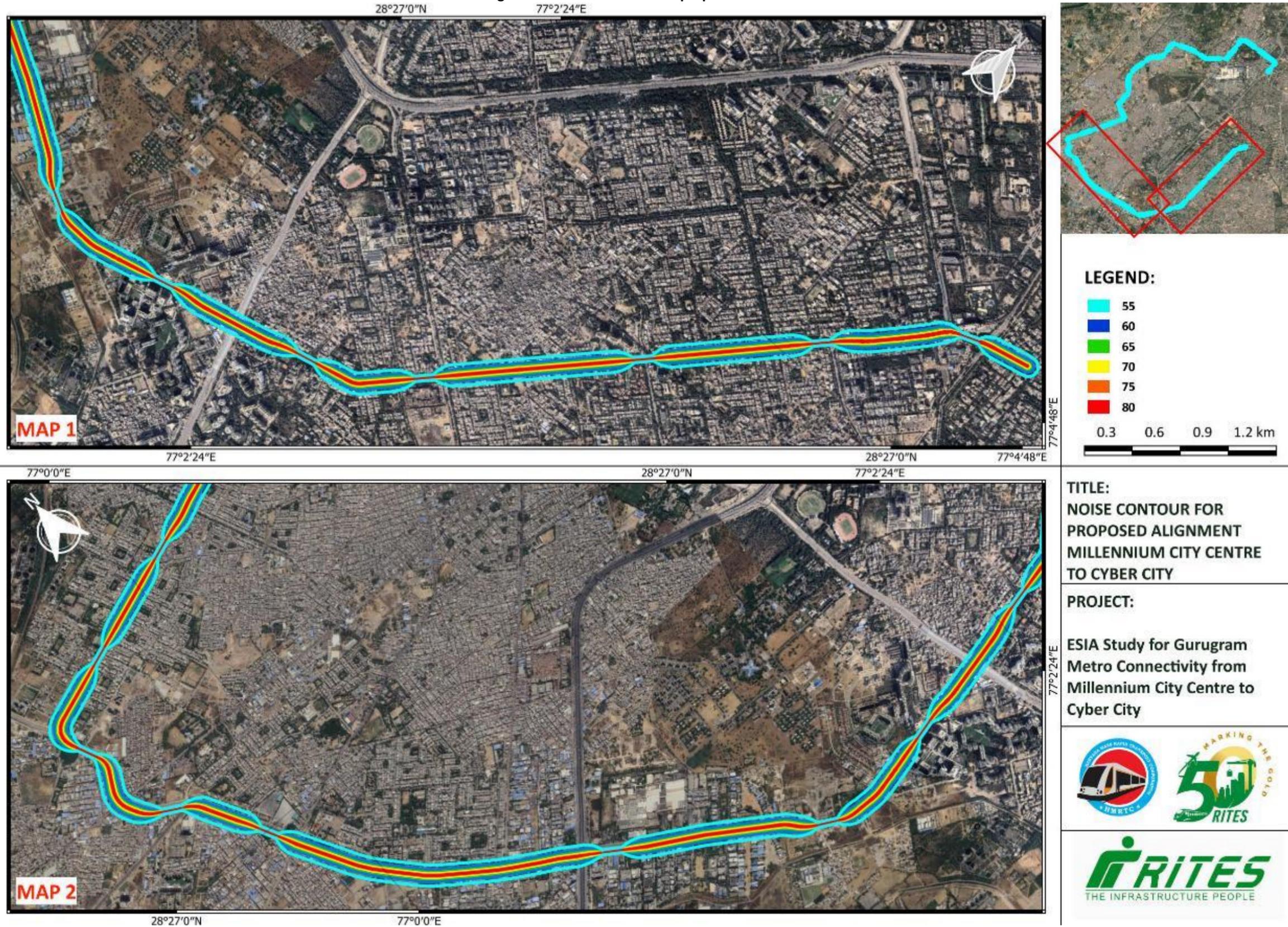
#### **Speed 80 KMPH**

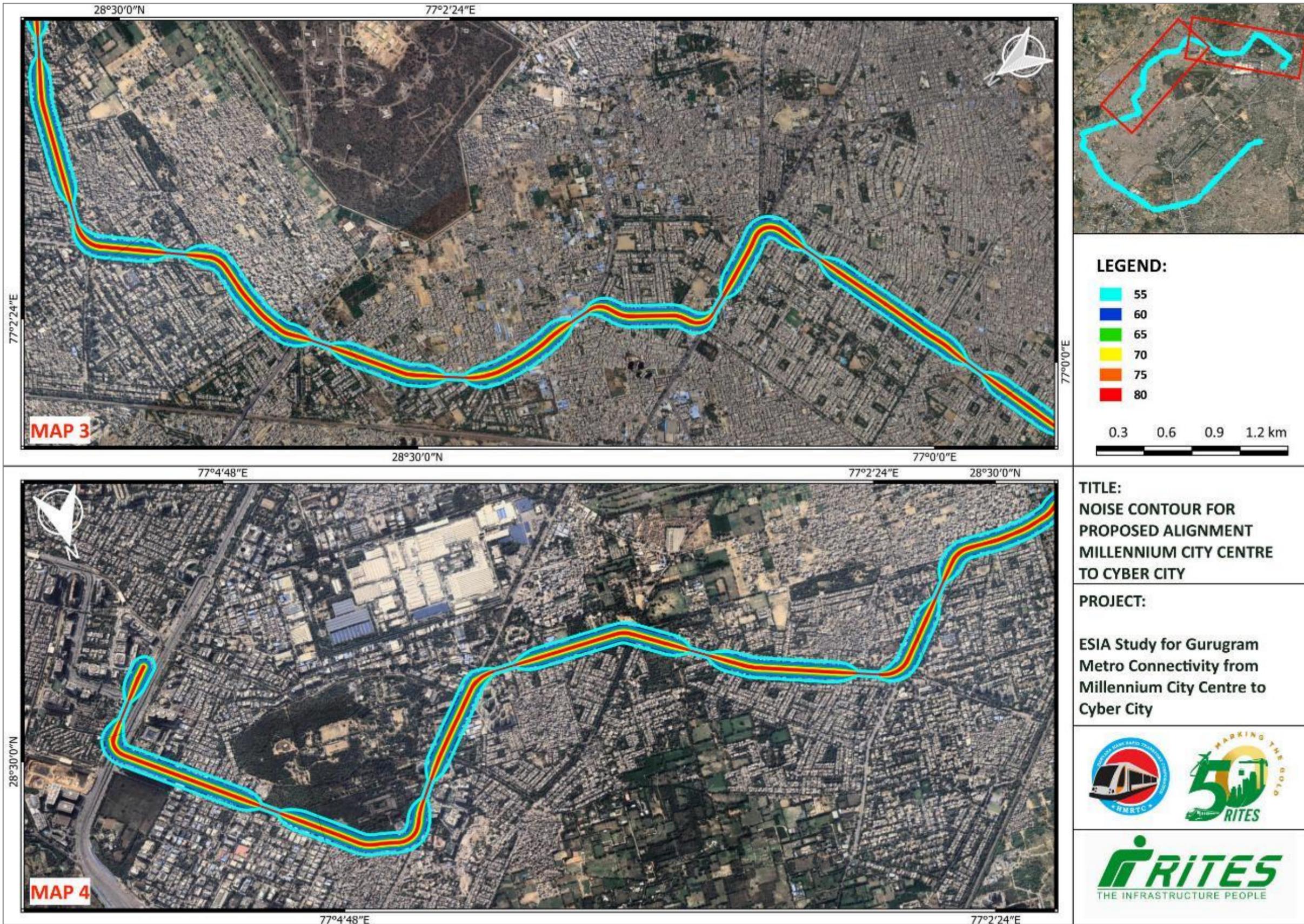
- The Leqd noise levels generated will be within the CPCB permissible limits prescribed for Residential areas at a distance of 45 m for year 2026, 63 m for year 2031; and 72 m for year 2041.
- The Leqn noise levels generated will be within the CPCB permissible limits prescribed for Residential areas at a distance of 104 m for year 2026, 147 m for year 2031; and 164 m for year 2041.

Cumulative noise levels in the project area have been modelled based on existing measured sound levels and predicted noise levels due to future daily metro rail operations. Cumulative noise levels at each noise monitoring location are given in **Table 7-7** and summarized below:

- Silence Zone (N1, N3, N4, N5, N6, N10, N11) Locations: Cumulative day and night noise levels for all years exceeding the permissible levels for Silence Zones prescribed by CPCB
- Residential Zone (N2, N7, N8) Locations: Cumulative day and night noise levels for all years exceeding the permissible levels for Residential Zones
- Commercial Zone (N9) location: Cumulative night noise levels for all years exceeding the permissible levels for Commercial Zones
- Commercial Zone (N16 and N17) locations: Cumulative day and night noise levels for all years exceeding the permissible levels for Commercial Zones
- Commercial Zone (N12, N13, N14, N15, N18, N19, N20) Locations: Cumulative day and night noise levels for all years within the permissible levels for Commercial Zones.

Figure 7-1: Noise Contours for proposed Corridor





**Table 7-7: Noise Levels at Monitoring Locations due to Metro Train Operations**

S. No	Monitoring Locations	Distance from Metro Centreline in m	Ambient Noise Levels in dB(A)		Predicted Noise Levels in dB(A) at Monitoring Locations						Cumulative Noise Levels in dB(A) at Monitoring Locations					
			Lday (6:00 AM-10:00 PM)	Lnight (10:00 PM - 6:00 AM)	2026		2031		2041		2026		2031		2041	
					Lday	Lnight	Lday	Lnight	Lday	Lnight	Lday	Lnight	Lday	Lnight	Lday	Lnight
<b>Corridor: Millennium City Centre to Cyber City</b>																
N1	Millennium City Center	150	63.9	49.9	32.4	29.8	35.5	32.8	36.6	33.7	63.9	49.9	63.9	50.0	63.9	50.0
N2	Subash Chowk	20	64.4	52.2	61.9	59.3	65.0	62.3	66.1	63.3	66.4	60.1	67.7	62.7	68.4	63.6
N3	Udyog Vihar Phase 6 Metro station	70	54.1	44.6	39.0	36.4	42.1	39.4	43.2	40.4	54.2	45.2	54.4	45.7	54.4	46.0
N4	Near Greenwood Public school (Basai Pond)	10	54.9	44.8	55.9	53.3	59.0	56.3	60.1	57.3	58.5	53.9	60.4	56.6	61.3	57.5
N5	ESIC Hospital	22	54.5	44.8	49.1	46.4	52.2	49.5	53.3	50.4	55.6	48.7	56.5	50.7	56.9	51.5
N6	Near Jain Sant Phool Chand Ji Charitable Hospital	60	54	43.7	52.4	49.8	55.5	52.8	-12.0	53.7	56.3	50.7	57.8	53.3	54.0	54.2
N7	Blossoms Primary School	25	54.3	44.5	48.0	45.3	51.0	48.3	52.2	49.3	55.2	47.9	56.0	49.8	56.4	50.6
N8	G A V International School	25	64.7	45.7	60.0	57.4	63.1	60.4	64.2	61.4	66.0	57.7	67.0	60.5	67.5	61.5
N9	Presidium School, Palam Vihar	36	62.6	48.3	56.8	54.2	59.9	57.2	61.0	58.2	63.6	55.2	64.5	57.7	64.9	58.6
N10	Manipal Hospital, Palam Vihar	56	54.1	44.4	53.0	50.4	56.1	53.4	57.2	54.3	56.6	51.3	58.2	53.9	58.9	54.8
N11	Near Rotary Public School	20	54.8	44.7	61.9	59.3	65.0	62.3	66.1	63.3	62.7	59.5	65.4	62.4	66.4	63.4

S. No	Monitoring Locations	Distance from Metro Centreline in m	Ambient Noise Levels in dB(A)		Predicted Noise Levels in dB(A) at Monitoring Locations						Cumulative Noise Levels in dB(A) at Monitoring Locations					
			Lday (6:00 AM-10:00 PM)	Lnight (10:00 PM - 6:00 AM)	2026		2031		2041		2026		2031		2041	
					Lday	Lnight	Lday	Lnight	Lday	Lnight	Lday	Lnight	Lday	Lnight	Lday	Lnight
N12	Cyber City	20	61.2	50.1	49.9	47.3	53.0	50.3	54.1	51.3	61.5	51.9	61.8	53.2	62.0	53.7
N13	Near Unittech Cyber Park	20	64.5	50.5	49.9	47.3	53.0	50.3	54.1	51.3	64.6	52.2	64.8	53.4	64.9	53.9
N14	Sector 47 Metro station	5	54.5	44.4	61.9	59.3	65.0	62.3	66.1	63.3	62.7	59.4	65.4	62.4	66.4	63.3
N15	Sector 72/A Metro station	20	54.8	44.9	49.9	47.3	53.0	50.3	54.1	51.3	56.0	49.3	57.0	51.4	57.5	52.2
N16	HeroHonda Chowk	15	66	52.9	64.4	61.8	67.5	64.8	68.6	65.8	68.3	62.3	69.8	65.1	70.5	66.0
N17	Sector 4-7 Chowk	10	54.3	44.1	68.0	65.3	71.0	68.3	72.2	69.3	68.2	65.4	71.1	68.4	72.2	69.3
N18	Sector 5 gol chakkar	32	54.8	44.2	45.8	43.2	48.9	46.2	50.0	47.2	55.3	46.7	55.8	48.3	56.0	48.9
N19	Sector 22 Metro station	40	64.8	47.4	43.9	41.3	47.0	44.3	48.1	45.2	64.8	48.3	64.9	49.1	64.9	49.5
N20	Udyog Vihar Phase V Metro station	20	54.5	44.6	49.9	47.3	53.0	50.3	54.1	51.3	55.8	49.1	56.8	51.3	57.3	52.1

Source: RITES Field Study

The noise impact on sensitive receptors located along the GMRP corridor has been modelled and presented in **Annexure 7.2**. Background noise levels at each receptor have been considered from the nearest baseline noise monitoring location. Key observations from the analysis are as follows:

- Cumulative noise levels at all these receptors are exceeding the permissible limits prescribed by the CPCB and WBG EHS except at few locations during night-time.
- Noise barriers need to be provided wherever noise impact criteria are severe at all the receptors, which occurs when the project results in a substantial increase in noise levels over existing conditions (typically more than 15 dB(A)), and the resulting absolute noise level meets or exceeds the threshold defined by the FTA's noise impact criteria for transit projects.

#### Mitigation Measures:

- Use of ballast-less track with elastic and absorbent fittings is a standard provision for noise control.
- At depot location, development of green belt with vegetation of thick foliage helps reduce noise; where site layout permits barrier blocks of less-vulnerable buildings can be used.
- Screening of noise shall be ensured by providing parabolic noise barriers on each side of the track along the curved portion of the viaduct and at sensitive receptors during operation.
- Providing tree buffers having multilayered approach to enhance sound attenuation consisting of deciduous and evergreen trees to provide year-round noise control wherever possible.
- Use of sound-absorbing materials in maintenance areas, such as acoustic panels and insulation, to reduce noise emissions from maintenance activities.
- Use of low-noise machinery and tools wherever feasible to reduce noise generated during maintenance activities at depot.

Even though the predicted noise levels from metro operations are generally lower than the existing ambient noise levels at most locations, noise barriers are proposed at sharp curves, and sensitive receptors locations such as educational institutions and hospitals, where noise impact criteria are exceeded or considered severe. The proposed location for noise barriers along the GMRP alignment are presented in **Table 7-8** and the estimated cost for the implementation of these barriers is **Rs. 522.105 Lakh**. Project proponent needs to monitor the noise environment at these locations before erecting the noise barriers during operation. By implementing these noise mitigation measures, the project is expected to remain compliant with applicable Indian Standards and WB EHS Guidelines.

**Table 7-8: Location of Noise Barrier**

S. No.	Chainage in m		Length(m)		Total Length in m	Cost in Rs. Lakh
	From	To	LHS	RHS		
1	117.613	145.137	27.3	29	56.3	8.445
2	4118.495	4174.614	26.2	27.4	53.6	8.04
3	6210.59	6258.395	49.3	47.5	96.8	14.52
4	10649.91	10687.1	35.7	39.3	75	11.25

S. No.	Chainage in m		Length(m)		Total Length in m	Cost in Rs. Lakh
	From	To	LHS	RHS		
5	10958.48	11015.28	58.5	54.1	112.6	16.89
6	11153.65	11245.02	96.2	89.3	185.5	27.825
7	11445.42	11520.51	71.9	79.2	151.1	22.665
8	11812.87	11987.54	182	167	349	52.35
9	12008.2	12038.7	-	30.5	30.5	4.575
10	14744.65	14914.81	163	179	342	51.3
11	15575.59	15715.93	150	136	286	42.9
12	15795.93	15827.91	31.5	34.2	65.7	9.855
13	16161	16213.77	54	51.7	105.7	15.855
14	16314.41	16394.16	76.4	83	159.4	23.91
15	18667.38	18704.17	38.4	35.3	73.7	11.055
16	19266.25	19357.61	88	95.6	183.6	27.54
17	20135.37	20287.13	157	147	304	45.6
18	21985.77	22020.66	34.2	36.6	70.8	10.62
19	22917.84	22992.75	71.8	78.4	150.2	22.53
20	24071.42	24200.1	134	123	257	38.55
21	24405.02	24451.34	47.9	45.3	93.2	13.98
22	26149.13	26288.75	146	133	279	41.85
<b>Total</b>					<b>3480.7</b>	<b>522.105</b>

Source: RITES Field Study

#### 7.4.8 Impacts due to Vibration

##### A. Pre-Construction

Vibration due to earthquakes: The proposed project corridor is situated in seismic Zone IV of the seismic zoning map of India. Accordingly, the design of all structural components the suitable seismic coefficient in line with the provisions of 1893, to ensure seismic resilience. High quality, durable materials shall be used to ensure structures can withstand long-term weathering, stress, and seismic loads. The elevated structures must be designed to be earthquake resistant and possess adequate load-bearing capacity to support the weight of trains, passengers, and additional loads such as wind, and seismic activity.

During the DDC, dynamic analysis should be carried out to assess and mitigate the effects of dynamic forces generated by train movement, wind, and other external factors. If significant vibration impacts are expected, appropriate vibration mitigation measures shall be implemented. Furthermore, building condition surveys have to be conducted before, during and after construction.

##### B. During Construction

The Transportation and Construction Vibration Guidance Manual (Caltrans, September 2013) specified threshold vibration criteria for various types of structures, which are presented in Error! Reference source not found.. These criteria for monuments are more stringent than

those prescribed in UK, Germany, Switzerland and Japan. Vibration source levels for typical construction equipment used in the project are provided in **Table 7-10**.

**Table 7-9 Guideline Vibration Damage Threshold Criteria**

Structure and condition	Maximum PPV (in/sec)	
	Transient Sources	Continuous/Frequent Intermittent Sources
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structures	0.5	0.3
New residential structures	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous / frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

Source: Transportation and Construction Vibration Guidance Manual, Caltrans, September 2013

**Table 7-10 Vibration Source levels for Construction Equipment**

Equipment		PPV at 25 ft (in/sec)	Approximate Lv# at 25 ft
Pile Driver (impact)	upper range	1.518	112
	Typical	0.644	104
Pile Driver (sonic)	upper range	0.734	105
	Typical	0.170	93
Calm shove drop (slurry wall)		0.202	94
Hydromill (slurry wall)	in soil	0.008	66
	in rock	0.017	75
Large bulldozer		0.089	87
Caisson drilling		0.089	87
Loaded trucks		0.076	85
Jackhammer		0.0345	79
Small bulldozer		0.003	58
# RMS velocity in decibels (VdB) re 1 µinch/sec			

Source: Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006

**i. Vibration due to Vibratory Pile Driving**

Vibratory pile driving generates continuous vibrations. A vibro-driver is clamped to the top of the pile and operates using one or more pairs of horizontally opposed contra-rotating eccentric weights. These drivers typically operate at frequencies between 25 and 50Hz. The vibration reduces the shear strength of the surrounding soil, thereby lowering friction at the pile-soil interface. The combined weight of the pile and the driver facilitate the penetration of pile into the ground.

**ii. Vibration due to Impact Pile Driving**

In impact pile driving, the hammer strike generates a stress wave that travels down the pile. Upon reaching the pile toe, part of the energy is reflected, while the remaining is transmitted into the ground. At the vertical pile-soil interface, where the angle of incidence is nearly 90°, most of the energy is reflected, with minimal transmission into the surrounding soil. However,

some energy is also transferred into the ground through friction as the pile moves downward, producing vertically polarized shear waves.

The energy transmitted into the ground through impact piling results in transient or intermittent vibration, with frequencies primarily determined by soil characteristics. While soils do not have specific resonant frequencies, they generally act as band-pass filters, possessing a limited range of frequencies within which most vibration energy propagates.

#### **Mitigation Measures:**

Although ground borne vibration is not common as an environmental issue compared to airborne noise, it can significantly impact sensitive structures and must be addressed through proactive planning and site-specific mitigation. The current vibration impact assessment is based on a worst-case scenario. A detailed vibration study shall be carried out during construction using data from geotechnical investigations. The following measures are recommended during construction of metro:

- Conduct detailed geotechnical investigation before initiating construction activities.
- Perform pre-construction structural integrity assessments for historic and vibration sensitive structures.
- Install continuous vibration monitoring systems during construction.
- Information dissemination about the construction method, potential vibration effects, and associated safety and quality control measures.
- Notify residents, particularly those in buildings near the alignment, about expected vibrations and mitigation strategies.
- Coordinate with school administrations to plan vibration-intensive activities (e.g., piling) to avoid disruption during examinations or key school events.
- Schedule vibration intensive work (e.g., piling) during off-peak park hours (typically midday).

### **iii. Vibration due to Blasting**

Blasting activities are not anticipated for the GMRP. However, if blasting becomes necessary due to the presence of hard rock formations, only controlled blasting shall be carried out in accordance with all relevant safety procedures and regulatory requirements. Before initiating any blasting operations, the necessary licenses and NOC must be obtained from the District Magistrate and/or the DGMS, as applicable, for the possession, transportation, and use of explosives. All prescribed safety protocols related to the transportation, handling, storage, inventory, and use of explosives must be followed. This includes measures to prevent fire, accidents, theft, pilferage, and ensure safe disposal or destruction of unused or expired explosives in compliance with legal and safety standards.

### **C. During Operation**

Impacts: Ground-borne vibrations from metro operations are generated by two prime excitation mechanisms.

- The quasi-static displacement caused by the axle load as the wheel moves along the track,

- The inertia forces due to the acceleration of the unsprung mass of the train as it rolls over the irregular profile of the railhead.

According to the U.S. Department of Transportation, (1998) the human perception threshold for peak particle velocity is about 0.04 mm/s (65VdB with reference 1e-6 inch/sec). For individual inside residences, the annoyance threshold is 72 VdB as per FTA, 2006 guidelines. Prolonged exposure to vibrations above permissible limits can have adverse effects on human health, including fatigue, increased pulse & respiration rates, dizziness & loss of balance, anger and irritation.

As per Research Designs and Standards Organisation (RDSO) Guidelines on Noise & Vibrations, a LRT system operating at 80 kmph generates vibration level of 72 VdB (threshold for residential land uses and buildings) at a distance of 18.3 m from the track centreline. The same system generates 75 VdB (threshold for Institutional land use with daytime use) at 12.2 m from the track centreline.

A vibration impact assessment for the GMRP has been carried out using the FTA guidelines, and the predicted vibration levels are presented in **Table 7-11**.

**Table 7-11: Predicted Vibration Level due to Rapid Transit Rail**

S No.	Location	Distance (D) from Metro alignment (m)	Monitored Vibration Level (VdB)	Predicted Vibration Level (VdB)	Resultant Vibration Level (VdB)	Permissible Limits* in (VdB)
1.	Manipal Hospital	15	51.5	58.8	59.6	65
2.	Fortis Hospital	70	56.0	53.3	57.9	65
3.	ESIC Hospital	50	47.8	54.5	55.3	65
4.	INOX Mall	45	36.6	54.9	54.9	75
5.	Future Pathway School	52	53.8	54.3	57.1	75
6.	Greenwood School	50	69.4	54.5	69.6	75
7.	Sec 22 Palam Vihar	10	40.0	60.3	60.3	72
8.	Apartment near Subhas Chowk	60	51.2	53.8	55.7	72
9.	Infosys ltd.	150	46.4	50.5	51.9	75
10.	Unitech Cyber Park	100	47.0	52.0	53.2	75

Note: Permissible Limits as per FTA guidelines

The predicted vibration levels, in the absence of control measures, indicate that all receptor locations fall within permissible limits. However, based on the vibration levels predicted at sensitive receptors (**Annexure 7.3**), it is observed that two sensitive receptors (both hospitals) may be impacted during operation phase due to vibrations, as detailed in **Table 7-12**.

**Table 7-12 List of Sensitive Receptors impacted due to Vibration**

S. No.	Sensitive Receptors (SR)	Chainage of SR (in m)	Distance (D) from Metro alignment (m)	Predicted Vibration Level (VdB)	Permissible Limits* in (VdB)
<b>Hospitals</b>					
1.	Jannat Hospital	16810	15	65.07	65
2.	Balaji Life Care Hospital and Maternity Centre Hospital	16939	15	65.07	65

Note: Permissible Limits as per FTA guidelines

Mitigation Measures: Vibration can be reduced through proper design, regular monitoring and preventive maintenance of the project infrastructure will be conducted by GMRL to ensure its efficient and safe operation.. In the case of ballast-less tracks, the following vibration damping measures shall be adopted: Installation of resilient soft base plates between rail and track slab; Use of resilient rubber pads between the base plate and track slab; Adoption of soft elastic fastening systems.

To further reduce vibrations, bogies with bolster-less designs equipped with secondary air springs shall be used. In addition, regular vibration monitoring shall be carried out at these sensitive receptors during operation phase. Wherever feasible, tree buffers with a multilayered foliage approach comprising both deciduous and evergreen species should be planted to aid in year-round vibration attenuation and environmental screening.

#### 7.4.9 Generation of Municipal Solid Waste

**Impact:** Solid waste generated during the construction and operation of the metro corridor includes both biodegradable and non-biodegradable municipal waste. During construction, waste primarily originates from labour camps, workspace canteens, and rest areas. In the operational phase, solid waste will be generated at metro stations and the depot, including sludge from the ETP and STP at depot and support facilities. During construction, municipal solid waste generated from labour camps is estimated to be 360 kg per day, while during operation, waste generation from all metro stations is expected to be around 5,064 kg per day.

MCG is divided into 35 wards and four zones. Gurugram's estimated per capita waste generation is approximately 560 gm/day, accounting for residential, commercial and institutional waste. Currently, approximately 1,100 tons of municipal waste is generated and managed with the MCG jurisdiction, comprising:

- Wet waste: 576 metric tons,
- Dry waste: 448 metric tons
- Composition: 50-52% biodegradable, 12-15% recyclable dry waste, and 30-35% inert components.

MCG is also addressing legacy waste through a treatment facility with a capacity of 6,000 tons/day, using 15 trommels and 3 high-capacity waste processing machines. These utilize bioremediation and bio-mining methods to treat legacy waste at landfill sites.

During both construction and operation, solid waste generated at the depot and stations will be temporarily stored at designated collection points. Once an adequate quantity is accumulated, waste will be collected by authorized contractors on a daily or weekly basis and transported in covered vehicles to approved municipal disposal sites or landfills, as designated by GMRL, in line with the Solid Waste Management Rules, 2016 and Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

Mitigation Measures:

- Maintain adequate sanitary facilities for the temporary storage of refuse at all premises.
- Install clearly labelled bins for biodegradable, non-biodegradable, hazardous, e-waste, and biomedical waste using a color-coded system for easy identification. Storage containers should not exceed 50 litres and should be equipped with side handles for easy handling.
- Establish a regular collection schedule for stations and depot based on waste volume. Staff must be trained in waste segregation and handling techniques to prevent contamination.
- Ensure all waste transportation containers are sealed and leak proof, particularly for hazardous and biomedical waste.
- Provision dedicated spaces for segregation and collection of recyclable wastes such as paper, plastic, metal and organic waste (e.g., food, landscape waste) during both construction and operation.
- Non-biodegradable waste shall be recycled through authorized recyclers. Implement safe handling protocols for hazardous waste, including incineration or specialized recycling methods. Collaborate with certified e-waste recyclers for the disposal of electronic waste. Follow stringent guidelines for the treatment of biomedical waste.
- Prevent waste spillage along roads during transportation.
- Wash garbage containers frequently to avoid odour and the accumulation of fly-supporting materials.
- Ensure that storage and transfer points are covered and cleaned daily to prevent nuisances and maintain hygienic conditions.
- Strictly prohibit burning, burying, or open dumping of waste in public areas or streets.

The solid waste shall be managed in accordance with Solid Waste Management, Rules 2016 and its amendments.

#### **7.4.10 Generation of Construction & Demolition Waste**

Construction Phase: During the construction phase of the metro project, significant quantities of Construction and Demolition (C&D) waste are generated. This includes excavation materials such as soil and rocks, concrete and masonry debris, metal and steel scraps, wood, gravel, silt, bitumen, muck, and waste arising from utility shifting, pile cap construction, excavation works, demolition activities, and excess construction materials. Improper disposal of C&D waste can lead to land, air, water, and noise pollution, impacting both the environment and public health. Additionally, C&D waste dumped on streets and footpaths, obstructs vehicular and pedestrian movement, contributing to traffic congestion, and posing accident risks.

C&D waste is also a valuable resource when appropriately processed and reused in future construction projects. However, unmanaged C&D waste becomes a primary source of fugitive dust emissions, further deteriorating urban air quality. Percentage composition during construction phase is represented in **Table 7-13**.

**Table 7-13: Waste Composition - during Construction Phase**

S. No	Constituents	% Composition
1.	Soil, Sand and Gravel	34.99
2.	Brick and Masonry	29.95
3.	Concrete	24.98
4.	Metal	4.97
5.	Bitumen	2.04
6.	Wood	2.04
7.	Other	1.02
Total		100

Source: TIFAC Report "Utilization of Waste from Construction Industry,"

As per the CPCB guidelines on Environmental Management of Construction & Demolition (C&D) Waste, new construction projects generate approximately 40-60 kg of C&D waste per square meter. For the entire construction period of the project, the estimated generation of C&D waste is approximately 17,650 tonnes (approx. 12 t/day). The construction waste shall be managed as per the Construction and Demolition Waste Management Rules, 2016 and its subsequent amendments. The C&D waste generated will be reused to the extent possible and remaining quantity will be disposed of in a manner that does not affect human health or the environment. As per the Rules, if C&D waste generation exceeds 20 tonnes per day or 300 tonnes in a month per project; the waste generator shall:

- Segregate waste into five streams: concrete, soil, metal, wood and plastic, bricks and masonry.
- Submit a waste management plan and obtain prior approval from the local authority before starting construction, demolition or remodelling activities.
- Pay applicable charges for collection transportation, processing and disposal as notified by the local authority.

C&D waste can be used for backfilling, elevation enhancement, or as a top layer in construction works. Materials with high reuse potential, such wood frames, unbroken bricks and ceramics items can be used for temporary or even permanent structures with appropriate treatment. Additionally, C&D waste can serve minor construction applications such as filler material in roofing, wall decorative chips, etc.

Currently, one C&D waste processing facility is operational at Sector 101, Gurugram, with a capacity of 300 TPD, managed by M/s Indo Enviro Integrated Solutions Limited. The waste generator is responsible for transporting and dumping the waste at this facility. This processed waste is converted into aggregate, M-sand, silt, interlocking tiles and bricks. In Delhi, five C&D waste processing facilities are operational at (i) Jahangirpuri, Burari (2000 TPD) (ii) Rani Khera (1000 TPD) (iii) Shastri Park (1000 TPD) (iv) Bakkarwala (1000 TPD) and (v) Mundka (150 TPD).

**Mitigation Measures:**

- C&D waste should not be mixed with other types of waste and must be disposed of separately.
- All generated C&D waste shall be collected at designated locations and segregated into categories such as soil, inert material (e.g., concrete, bricks, mortar), and recyclables (e.g., plastic, steel etc.)
- Inorganic construction waste such as waste concrete, mortar, left over aggregate, debris, etc. shall be recycled and used in base layers of paved areas, such as parking zones or road construction or for filling low lying areas.
- Recycled coarse aggregate may be used in concrete for bulk fill, embankment protection, base or fill for drainage structures, pavements, sidewalks, kerbs, gutters, etc.
- Up to 30% of natural crushed coarse aggregate may be replaced by recycled concrete aggregate.
- The soil will be stacked and use for landscaping, recyclable materials will be sold to authorized recyclers; remaining C&D waste shall be handed over to authorized facilities.
- C&D waste generated from metro construction has high reuse potential once appropriately processed, graded and recycled. It shall be handled and disposed of at the Sector 101 processing facility or as directed by the MCG.

**7.4.11 Generation of Plastic Waste**

Plastic waste generation during both construction and O&M phases includes a variety of plastic materials and packaging. During construction, plastic is commonly used in pipework, insulation, wall coverings, flooring, interior fittings, window frames, scaffolding boards and kerbstones. The common sources of plastic waste include construction packaging waste, over ordering and disposal of offcuts and unused materials, over-specified project designs, improper storage and handling, and packaging from food consumed by construction workers. During the operation phase, waste collection facilities will be set up near the metro line to manage plastic waste. The recyclable plastic waste will be collected and sent to authorized recyclers in accordance with the Plastic Waste Management Rules, 2016 and its subsequent amendments. In most municipal corporations, door to door collection and segregation of waste is being done through private agencies in municipal corporations. All MCs have been directed to setup MRF as required and to manage plastic waste in accordance with the SWM Rules, 2016 and the Plastic Waste Management Rules, 2016. The State is also exploring the possibility of RDF as an energy source. Currently, plastic waste is being used on road construction and co- processing in cement plants.

In FY 2022–23, Gurugram generated approximately 25,500 tonnes of plastic waste, all of which was collected and channelized for recycling through approved recyclers.

**Mitigation Measures:**

- Plastics is categorized into seven types based on their recyclability, properties, and applications. Source segregation must be implemented accordingly to facilitate effective recycling.

- Plastic waste management shall be done in accordance with Plastic Waste Management Rules 2016 and its amendments.

#### 7.4.12 Generation of E-Waste

The waste generated during the construction and operation of the GMRP includes electrical and electronic equipment listed under Schedule-I of the E-Waste Management Rules, 2022 and its subsequent amendments. This includes information technology and telecommunication equipment, consumer electrical and electronics items, photovoltaic panels and solar modules, refrigerants from air-conditioners and cooling systems, computers, laptops and peripherals, digital displays, announcement systems, wiring and other associated components. In addition, waste batteries and plastic packaging material fall under the purview of the Batteries Waste Management Rules, 2022, and the Plastic Waste Management Rules, 2016, respectively.

Mitigation Measures:

- E-waste shall be transported in compliance with the manifest system.
- All e-waste, including solar panels, shall be sent recyclers or facilities authorized by the Haryana SPCB.
- An inventory of solar photovoltaic modules, panels, and cells shall be put in place.
- E-waste may be stored for a maximum period of 180 days. Records of e-wastes transfer, and storage shall be maintained. If required for the development of a recycling or reuse process, the storage period may be extended up to 365 days with approval from the CPCB.
- E-waste shall not be mixed with municipal solid waste. It must be properly segregated, collected and channelised to registered recyclers or refurbishers.
- All e-waste management practices shall be undertaken in accordance with the E-Waste Management Rules, 2022 and any subsequent amendments.

#### 7.4.13 Generation of Hazardous Waste

Hazardous waste is expected to be generated mainly from the maintenance of equipment and vehicles. This may include used engine oils, hydraulic fluids, waste fuel, spent mineral oils, cleaning fluids, scrap batteries or spent acid/alkali, spent solvents, potential hazardous materials such as asbestos and silica. Additionally, small quantities of hazardous waste will also be generated from vehicle maintenance activities including liquid fuels and lubricants, hydraulic oils, antifreeze chemicals, spillage control materials (used to absorb oil and chemical spills); machine/engine filter cartridges; oily rags, spent filters, contaminated soil, etc. Improper disposal of such wastes may lead to significant human health risks and environment impacts.

**Asbestos Handling:** Asbestos is commonly found in old buildings and structures. During the field study, it was observed that no such structures likely to be demolished as part of the project contain asbestos materials. The Draft Haryana Occupational Safety, Health and Working Conditions Rules, 2021 propose Standard Operating Procedures (SOPs) for the handling and processing of asbestos. However, since these rules are still in draft stage, they are currently not applicable to this project. In the event that asbestos-containing material is

encountered during demolition activities, it will be handled and disposed of in accordance with the Asbestos Management Plan (**Annexure 7.4**) and the provisions of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, and subsequent amendments.

#### Mitigation Measures:

- The contractor shall develop a comprehensive Waste Management Plan that includes provisions for the safe handling, use, storage, transportation, and disposal of hazardous materials and wastes.
- Adequate containers of appropriate size and number shall be placed at worksites for segregated collection of different waste streams (e.g., metals, rubber, used fuels, batteries). These shall be transported regularly to a centralized storage facility. Only authorized recyclers and treatment/disposal facilities shall be engaged for handling hazardous waste, under prior intimation to the GMRL.
- The contractor shall ensure that all workers handling hazardous materials receive adequate training and information to ensure safe operations.
- Hazardous and other wastes must be clearly labelled, recorded, and stored in impermeable containers for a period not exceeding 90 days, in accordance with applicable handling, storage, and transport guidelines.
- A detailed record of sale, transfer, and storage of hazardous wastes shall be maintained and made available for inspection by relevant authorities.
- Hazardous and other wastes generated shall be either sent to or sold to an authorised user or disposed of at an authorised facility in compliance with the Hazardous and Other Wastes (Management, Handling & Trans-boundary movement) Rules 2016 and its amendments.
- In the event of any accident at the contractor's facility involving hazardous or other wastes, the contractor shall immediately intimate the State Pollution Control Board via telephone and email, followed by a detailed report in Form 11.

#### 7.4.14 Generation of Batteries Waste

During construction phase, battery waste shall mainly be generated from battery powered machinery. In the operation phase, such waste may be generated from UPS systems, inverters and similar equipment.

#### Mitigation Measures:

- Waste batteries shall be safely stored separately from other waste streams, particularly from domestic or mixed wastes, and away from fire-prone or hazardous areas.
- It shall be ensured that waste batteries are disposed of in an environmentally responsible manner. Disposal shall be carried out through authorized recyclers, either via refurbishment, recycling, or a buyback method, in compliance with the Batteries Waste Management Rules, 2022.

### 7.4.15 Water supply

#### A. Construction Phase

The estimated water requirement during the construction phase is approximately 400 KLD. This demand will be met through municipal water supply or recycled treated water from STPs. Groundwater extraction is not permitted for the proposed project, as treated sewage water is readily available within a 10 km radius.

**Labour Camps:** The establishment of labour camps will begin with obtaining permits from the relevant local authorities for the proposed location. A detailed site plan must be prepared and submitted for approval by the designated engineer or competent authority. Construction of the camps can commence only after obtaining this approval.

In addition, separate permissions for sanitation, wastewater discharge, and overall camp infrastructure must be obtained in accordance with national environmental and health regulations. The employment of labourers must comply with applicable labour laws, including Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996; the Contract Labour (Regulation and Abolition) Act, 1970; the Employees' State Insurance Act, 1948; the Inter-State Migrant Workmen Act, 1979; and the Factories Act, 1948. Registration under the BOCW Act is mandatory to ensure the safety, welfare, and legal protection of workers. Approximately 1,200 workers are expected to be engaged during the construction phase. Accordingly, two labour camps (one for each package) shall be established at appropriate locations, with a capacity of 600 persons per camp. The water requirement across all labour camps is estimated at 162 KLD, with wastewater generation of approximately 130 KLD.

Contractor should provide facilities like uncontaminated water for drinking, cooking and washing, health care, latrines and urinals, system for conveyance, treatment and disposal of sewage and solid waste, adequate and clean washing and bathing places at labour camps. The water requirement will be met from municipal supply. Wastewater generated at labour camp shall be treated in the 40 KLD packaged STP in each camp and the treated water shall be reused for flushing and dust suppression. Solid waste generated at the camps will be collected and transported to local municipal bins for onward disposal to treatment site by municipal corporation.

#### B. Operation Phase at Stations

Provision of adequate public health facilities, including water supply, sanitation, and toilet facilities, is essential at all metro stations to ensure public hygiene and environmental health. Water supplied for station use shall be treated to meet Indian Drinking Water Standards before consumption. The collection and safe disposal of human waste is a key for good environmental health requirement. Accordingly, safe and efficient sewage disposal systems would be provided at all station locations.

The total estimated water requirement across all stations for the year 2041 is projected to be 760 KLD, which includes both domestic and flushing demands. Th water supply will be sourced from the MCG.

Based on standard norms, the daily sewage flow is estimated to be approximately 80% of the total water demand i.e. 608 KLD. This sewage will be treated using Bio Digesters with Reed Bed System, developed by DRDO, India, which can treat both human waste and wastewater.

The area required depends on the plant's capacity. Typically, a 5 KLD (kiloliters per day) plant requires approximately 20sqm. With increasing capacity, the area requirement grows at a reduced rate due to economies of scale. Potential safeguards for a reed bed include installing fencing (around 1m high), lining the base with geotextile or an HDPE liner to prevent wastewater from seeping into the groundwater, implementing mosquito control measures, managing odors by planting aromatic grasses, and providing proper overflow handling systems. The estimated cost of the Bio-Digester System, based on wastewater estimation for the year 2041, is provided in **Table 7-14**.

**Table 7-14: Capacity and Cost of Bio Digester at Each Station**

S. No.	Station Name	Year 2041		
		Wastewater (KLD)	Capacity of Biodigester (KLD)	Cost of Biodigester in Rs. Lakh
1	Millenium City Centre	79.2	80	20.0
2	Sector 45	12.5	15	3.8
3	Cyber Park	11.7	15	3.8
4	Sector 47	17.7	20	5.0
5	Subhash Chowk	15.0	15	3.8
6	Sector 48	70.2	75	18.8
7	Sector 72A	8.3	10	2.5
8	Hero Honda Chowk	7.9	10	2.5
9	Udyog Vihar Ph 6	19.7	20	5.0
10	Sector 10	38.8	40	10.0
11	Sector 37	46.0	50	12.5
12	Basai Village	5.1	10	2.5
13	Sector 9	14.2	15	3.8
14	Sector 7	12.1	15	3.8
15	Sector 4	7.6	10	2.5
16	Sector 5	12.7	15	3.8
17	Ashok Vihar	29.7	30	7.5
18	Sector 3	9.9	10	2.5
19	Bajghera Road	17.9	20	5.0
20	Palam Vihar Ext	11.8	15	3.8
21	Palam Vihar	10.7	15	3.8
22	Sector 23A	11.5	15	3.8
23	Sector 22	77.2	80	20.0
24	Sector 21	19.0	20	5.0
25	Udyog Vihar Ph 1	15.0	15	3.8
26	Cyber City	26.1	30	7.5
<b>Total</b>		<b>607.6</b>	<b>665</b>	<b>166.3</b>

Source: RITES Study

**Bio Digesters:** The bio-digester based eco-friendly sanitation technology is designed to convert human faecal waste into water and biogas. The treatment process is based on anaerobic biodegradation, carried out in an oxygen-free environment using a specialised

anaerobic microbial consortium. This biological process involves multiple, interdependent biochemical steps that occur sequentially.

The technology enables the treatment of human waste at the source, minimizing the need for transportation and external infrastructure. The system uses a collection of anaerobic bacteria, adapted to operate across a wide temperature range (from -5°C and 50°C), which act as the inoculum (seed material) for the bio-digester. These bacteria convert organic human waste into methane, carbon-dioxide, and treated water.

This anaerobic process effectively inactivates pathogens responsible for waterborne diseases, ensuring the safe treatment of faecal matter without requiring any external energy source. The only by-product of this treatment is pathogen-free water, which is suitable for non-potable use such as gardening and flushing.

Treated water from the reed bed system flows into a storage tank, from which it will be pumped and reused for flushing, gardening and other similar activities. Before reuse, the treated water will pass through simple filters to eliminate odours and any residual suspended particles. The anticipated influent and effluent wastewater quality parameters from Bio-Digesters, as provided by DRDO are presented in **Table 7-15**. The effluent characteristics comply with the CPCB discharge standards for irrigation.

**Table 7-15: Wastewater Quality Parameters (Influent & Effluent)**

S. No	Parameter	Unit	Characteristics	
			Influent	Effluent
1.	pH	-	7.0 - 7.5	7.0 - 7.5
2.	Turbidity	NTU	70 - 90	2 - 5
3.	Total Suspended Solids	mg/l	90 - 120	50 - 80
4.	Total Dissolved Solids	mg/l	350 - 450	100 - 300
5.	Biochemical Oxygen Demand at 5 days and 20°C	mg/l	70 - 120	2-4
6.	Chemical Oxygen Demand	mg/l	250 - 300	15 -25
7.	Coliforms	MPN/100 ml	300 - 350	0 - 12

Source: DRDO Website

## Operation & Maintenance

The inoculum used in the bio-digester system is added only once during commissioning. Care must be taken to minimize exposure to oxygen during inoculum addition, as the microbes' function under strict anaerobic conditions. Inadequate charging of the required inoculum quantity can adversely affect the performance of the bio-digester. Additionally, leakage from the bio-tank must be avoided, as the anaerobic microbial inoculum is the critical component ensuring the system's efficiency.

The sludge generation in this technology is minimal due to the low biomass yield associated with anaerobic digestion. However, the small amount of bio-sludge produced will require periodic removal every 10-15 years. This will be carried out by machines and the sludge will be handed over to the sludge treatment facility for proper treatment and disposal under MCG.

Currently, Gurugram has 16 operational STPs with a capacity of 434 MLD. Additionally, one STP with a capacity of 25 MLD is under construction and four new STPs are proposed with a capacity of 340 MLD.

#### **7.4.16 Impacts due to Depot**

One depot has been proposed at Sector 33 for the GMRP. The depot will have following facilities:

- Washing Lines,
- Operation and Maintenance Lines,
- Workshop, and
- Offices

The depot area will be levelled through cut and fill method within the depot. Impacts anticipated at depot sites are:

##### **i. Water Supply**

Water supply will be required for different purposes in the depot. Water quantity considered in the depot for train wash is 300 litre per car in every 3 days. 80% of water requirement for car wash should be recycled and reused. For different uses about 31.34 KLD of water will be required for Depot. Other water requirement for cleaning the depot, horticulture, flushing urinals and closet will be met from recycled water (which shall confirm with the standards expected for such use). The water requirement will be met from supply water by Municipal Corporation.

##### **ii. Treatment Plants**

ETP: About 19.47 KLD of wastewater will be generated at the Depot, which will be treated through ETP of capacity 20 KLD. The treated wastewater shall be recycled and reused for Car Washing (and other uses above). A lumpsum amount of Rs. 15 Lakh has been kept for ETP.

Bio-digester: Sewage generation at the proposed Depot is about 5.6 KLD, which will be treated through Bio-digester with Reed Bed System of capacity 10 KLD with an approximate area of 40 sq. m. Effluent from bio-digester will be pumped into the reedbed. Treated wastewater from the reed bed flows into a storage tank. Before reuse, the treated wastewater passes filters to remove smell and any particles. The treated wastewater shall be reused for horticulture and flushing purpose. A lumpsum amount of Rs. 2.5 Lakh has been kept for Biodigester.

##### **iii. Oil Pollution**

Oil spillage during change of lubricants, cleaning, and repair processes for maintenance of rolling stock, is very common. The spilled oil should be trapped in oil and grease trap. The collected oil would be stored appropriately and disposed of to authorised collectors, to avoid any underground/ surface water and soil contamination. The sludge will be dewatered and transported to designated landfill sites of Gurugram Municipal Corporation.

**iv. Noise Pollution**

The main source of noise from depot is the operation of workshop. The roughness of the contact surfaces of rail and wheel and train speed is the factors, which influence the magnitude of rail - wheel noise. Use of ballast-less track with elastic and absorbent fittings is a standard provision for noise control. Use of green belt of thick foliage helps to reduce noise impact at Depot.

**v. Surface Drainage**

The surface drainage pattern may change due to levelling of the Depot Site. Suitable drainage measures will be adopted to drain off the area suitably in the nearby water body or drains.

**vi. Rainwater Harvesting**

To augment storage of groundwater, it is proposed to construct roof top rainwater harvesting structure of suitable capacity in the depots. Annual Rainwater harvesting potential of depot will be 14.31 thousand cum. A lumpsum amount of Rs. 40.00 lakh has been kept for rainwater harvesting structures consisting of Gutters, Downpipes, Filtration Units, Storage Tanks, Piping and Pumps and Recharge Structures at depot.

**vii. Solid Waste Generation**

The solid waste generation at depot location is estimated to be 30 kg/day. The waste generated from the Depot shall be collected and kept in the designated bins for biodegradable and non-biodegradable waste for onward disposal. Non-biodegradable waste shall be recycled and shall be disposed of through authorized recyclers.

**viii. Loss of Trees and Green Belt Development**

About 259 trees are to be removed at the proposed Depot. It is proposed to plant ten saplings for each tree to be cut. Compensatory afforestation cost at depot area is included in the **Section 7.7.1**.

The greenbelt development / plantation in the depot area harmonizes the depot with surrounding environment and acts as pollution sink / noise barrier. The estimated cost for green belt development at Depot shall be about Rs. 11.85 Lakh.

**7.4.17 Carbon Credits for Gurugram Metro Rail Project**

The measures used to calculate Carbon Credit for the projects are classified into the following categories:

- A. Emissions due to Energy requirement
- B. Emissions due to reduction in Modal Shift

**A. Emissions due to Energy requirement**

The GMRP is designed to operate low GHG emitting rolling stock, equipped with a regenerative braking system. This system enables the recovery of electrical energy during braking, which is then fed back into the traction system, thereby reducing the net energy demand from the grid. This reduction in grid electricity usage results in energy conservation and contributes to GHG emission reduction.

The gross annual energy requirement for traction and auxiliary power for GMRP is presented in **Table 7-16**. The proposed rolling stock will feature regenerative braking, and it is estimated that 20% of the total traction energy will be recovered through regeneration. Based on this, the projected regenerated energy is 68,530 MWh in the year 2026 and 1,55,510 MWh in the year 2041.

**Table 7-16 Energy Requirement**

S. No	Item	Unit	MCC to Cybercity		
			Yr: 2026	Yr: 2031	Yr: 2041
1.	Total Energy required per Year (Traction +Auxiliary) <b>(A)</b>	MWh	81,783	1,50,939	1,86,016
2.	Regeneration Energy (20% of total Traction Energy) per Year <b>(B)</b>	MWh	13,253	24,719	30,506
Net Annual Energy consumption <b>(A-B)</b>		MWh	68,530	1,26,220	1,55,510

Source: DPR

CO<sub>2</sub> emissions due to energy consumption (including both traction and auxiliary power) and the reduction through regenerative energy have been estimated using the CO<sub>2</sub> emission intensity of grid electricity as provided in the CMP Toolkit, 2014. The results of the estimation are presented in **Table 7-17**.

**Table 7-17 CO<sub>2</sub> Emissions from Energy Requirement (Ton/Year)**

Item	Yr: 2026	Yr: 2031	Yr: 2041
CO <sub>2</sub> emissions due to Total Energy Consumption (Traction & Auxiliary) of Metro Operations	40,074	51,319	35,343
Reduction in CO <sub>2</sub> Emissions due to Regeneration Energy (20% of total Traction Energy)	6,494	8,404	5,796

## B. Reduce Emission per unit Transported Modal Shift from Two, Three and Four wheelers

The daily reduction in vehicle km travelled on road due to implementation of GMRP is presented in **Table 7-18**.

**Table 7-18 Daily Reduced Vehicle KM**

Mode	Yr: 2026	Yr: 2031	Yr: 2041
Car+Taxi	14,38,266	16,09,250	21,52,158
2W	1,82,060	2,80,203	3,19,508
Auto Rickshaw	1,98,540	3,15,509	3,55,900
Bus	25,557	34,375	46,039

The implementation of GMRP is expected to result in a reduction in road traffic, which in turn lead to reduction in CO<sub>2</sub> emissions. The estimated reduction in CO<sub>2</sub> emissions is presented in **Table 7-19**. These estimates are based on emission factors outlined in the MoUD Policy, 2017.

**Table 7-19 Reduction in CO<sub>2</sub> Emissions (Ton/Year)**

Mode	Yr: 2026	Yr: 2031	Yr: 2041
Car+Taxi	9,271	14,269	16,271
2W	15,004	16,787	22,451
Auto Rickshaw	5,644	8,970	10,118
Bus	7,348	9,883	13,237

Mode	Yr: 2026	Yr: 2031	Yr: 2041
<b>Total</b>	37,267	49,910	62,077

Details of the carbon credits accruing from modal shift, gross energy consumption and regenerative braking system for year 2031 are summarised in **Table 7-20**.

**Table 7-20 Carbon Credits due to Metro Operations**

S. No	Item	Carbon Credits (tCO <sub>2</sub> e/Year)		
		Yr: 2026	Yr: 2031	Yr: 2041
a)	Reduction in CO <sub>2</sub> emissions due to Modal Shift	37,267	49,910	62,077
b)	Reduction in CO <sub>2</sub> Emissions due to Regeneration Energy (30% of total Traction Energy)	6,494	8,404	5,796
c)	CO <sub>2</sub> emissions due to Gross Energy Consumption (Traction & Auxiliary) of Metro Operations	40,074	51,319	35,343
Carbon Credits tCO <sub>2</sub> e/year: (a)+(b)-(c)		3,688	6,995	32,530

Source: RITES Study

#### 7.4.18 Soil Erosion

Construction activities pose a heightened risk of soil erosion, especially in areas with involving extensive excavation and earthmoving operations. For this project, the primary areas of impact are road verges, with minimal disturbance to virgin land.

##### Mitigation Measures:

Prior to the start of construction, the contractor shall submit schedules to GMRL outlining both temporary and permanent erosion and sedimentation control measures. These measures will apply to activities such as clearing and grubbing, roadway and drainage excavation, and embankment/subgrade construction especially in open and low-lying areas, near or across water bodies, areas prone to flooding, and sloping terrain. The Contractor shall also submit an erosion and sedimentation control plan, including strategies for the disposal of waste materials.

Visual monitoring shall be carried out during construction, which will include photographic records and site description records. The contractor shall conduct daily inspections, in consultation with GC, to ensure compliance. No construction work shall commence until the erosion/sedimentation control schedules and methods of operations for the relevant construction sections are approved by GMRL. Topsoil from construction areas shall be stripped and stockpiled separately for reuse in landscaping and site restoration. All roads and work areas must be to be kept clean and free of soil, sand, tools, materials and equipment during and after construction activities.

The Contractor shall be responsible for the integration of all approved permanent and temporary erosion and sedimentation control measures throughout the construction period.

### 7.4.19 Impact on Waterbodies

The major water bodies which are falling within 10 km radius of the alignment are:

- Sultanpur National Park (Wetland) (Distance from alignment - 8.2 km)
- Najafgarh Jheel (Distance from alignment - 4.7 km)
- Basai Pond (adjacent to alignment & Basai village metro station)
- KBA/IBA in Sector 101, Basai (Spur is at the edge of this area)

No significant impact on water quality is anticipated for Sultanpur National Park and Najafgarh Jheel, as both are located at a considerable distance from the proposed GMRP corridor. Furthermore, a high-density urban buffer, including multiple high-rises buildings, exists between these water bodies and the metro alignment, significantly reducing any potential direct or indirect impact.

The Basai pond is located adjacent to the Basai Village Metro Station. The Basai Village Metro Station is proposed near Basai Pond and the GMRP alignment passing near the pond (Ch. 11690 to Ch. 11789). The total area of Basai Pond is approximately 14,500 sqm. A permanent area of approximately 9.4 sqm may be required within the pond for the installation of three piers, each with a 2-metre diameter.

Construction activities near Basai Pond and KBA/IBA in Sector 101, Basai, may result in:

- Temporary deterioration of water quality
- Increased turbidity and reduction in pond area
- Disruption of natural drainage patterns
- Temporary restriction of cattle access to one side of the pond
- Soil erosion due to excavation, especially during the monsoon
- Potential fuel spills and disposal of construction waste
- Utility bursts (e.g., sewer or drainage lines) near the alignment, causing accidental discharge into the pond

Gurugram experiences four distinct seasons, as outlined in the meteorology section. During the monsoon and winter, sunlight is generally limited, and even in the remaining months. The viaduct is located on the eastern side of the Basai Pond, and as the sun rises in the east, its shadow falls on the pond only during early morning hours, typically for 3–4 hours per day, depending on seasonal sun movement. Given that the width of the viaduct is only 10m, the shadow impact of viaduct on the pond is negligible.

Mitigation Measures.

- During the detailed design stage, GMRL shall explore the possibility to avoid pillar placement within the pond. If unavoidable, pillars shall be placed only along the outer edge to minimize any impact on water spread.
- To mitigate impacts on the pond, a ramp will be constructed prior to pillar and viaduct works in the pond area, serving as a barricade against project activities.
- A temporary on-site drainage system will be constructed prior to the commencement of construction, particularly planned during the lean season when the pond's water level is minimal.

- The construction site shall be isolated using protective sheeting, earth bunds, or sandbag barriers to prevent sediment runoff into the pond.
- Regular water quality monitoring shall be carried out during the construction phase.
- Geo-textile sediment fences shall be used to control the entry of sediment into the waterbody.
- The contractor shall strictly prohibit the disposal of solid or construction waste into the pond.
- Site grading shall be designed so that runoff water flows away from the pond.
- The contractor shall coordinate with utility agencies, maintain quick response teams, and pre-identification of sensitive areas to manage emergencies effectively.

#### 7.4.20 Rainwater Harvesting

To augment groundwater storage, it is proposed to construct rainwater harvesting structures of suitable capacity at all stations and along the alignment. Each pillar can have inbuilt downpipes to collect rainwater runoff from the viaduct, which will be directed into underground storage tanks. The collected rainwater will percolate into the subsoil through filtration layers consisting of sand and gravel, promoting effective groundwater recharge.

Rainwater harvesting assessment has been done for a corridor length of 29.05 km and 27 elevated stations, for which the design has been finalized. Gurugram receives an average annual rainfall of 505.4 mm. Based on a runoff coefficient of 0.85, the estimated annual rainwater harvesting potential from elevated stations and viaduct sections is approximately 1,36,135 cubic meters per year. The estimated capital cost for implementing rainwater harvesting system is **Rs. 479.90 lakh** for GMRP corridor. In addition, a lump sum amount of **Rs. 40.00 lakh** has been allocated for rainwater harvesting infrastructure at the depot, which will include gutters, downpipes, filtration units, storage tanks, piping, pumps, and recharge structures. If monitoring at any stage indicates a potential risk of chemical leaching, especially toward the end of the lifecycle of structural panels, additional measures such as filtration systems or first-flush diverters shall be integrated into the rainwater harvesting infrastructure at elevated stations to eliminate any traces of toxic substances.

#### 7.4.21 Light and Shadow

Light and shadow are integral elements in the design of elevated metro stations, influencing safety, wayfinding, aesthetics, user comfort and sustainability. The impact of an elevated metro system in terms of light and shadow depends on various factors such as design, location and the surrounding urban context.

Positive Impacts:

- The elevated metro system can create dynamic and visually appealing shadow patterns, enhancing the aesthetic appeal of urban areas.
- Well-designed artificial lighting systems can improve nighttime visibility, enhance ambiance and make stations and adjacent areas feel safer and more inviting.

Negative Impacts:

- The large structures of the metro system can cast long shadows that might reduce natural light in adjacent areas such as roads, curves, public spaces and nearby buildings.
- Reduced sunlight exposure can limit passive solar heating, especially during winter, thereby increasing reliance on artificial heating in adjacent buildings.
- Lower surface temperatures in shaded areas may create cold spots, leading to discomfort for pedestrians and reducing usability of public spaces.
- Excessive or poorly designed lighting may contribute to light pollution, which can have environmental, health and safety impacts.
- Most riders particularly two-wheeler users tend to prefer riding under metro viaducts during sunny or rainy weather, leading to localized congestion in these lanes.

To address and minimize the potential negative effects of light and shadow, the following measures need to be incorporated during the DDC stage:

- **Optimize Structure Height:** Design elevated metro structure to the minimize height required for safe clearance. Lower structures cast shorter shadows, reducing the impact.
- **Architectural Integration:** Ensure the metro infrastructure is visually integrated with the surrounding built environment to reduce discord.
- **Landscape Design:** Incorporate greenery, trees, and landscaping features around stations to soften visual impact, improve microclimate, and enhance aesthetic appeal.
- **Use of transparent or translucent materials:** Integrate glass, polycarbonate, or other light-permeable materials in roofing or side panels to allow natural light penetration and reduce harsh shadows. Emphasize maximum use of natural daylight in station and viaduct design. Where feasible to avoid design in poorly lit or heavily shaded area, to prevent reduction in ambient light
- **Smart Lighting Systems:** Install intelligent lighting solutions that adjust brightness based on time of day, weather conditions, and occupancy, thereby optimizing energy consumption and enhancing visual comfort.

#### 7.4.22 Impacts due to Solar Panel

Reflectance from solar photovoltaic panels can produce glare, may affect local fauna and causing temporary visual discomfort for nearby residents.

To address solar glare from photovoltaic panels in the GMRP, several effective measures can be implemented, including optimizing panel orientation and tilt to reduce glare angles, applying anti-reflective coatings to glass surfaces and installing physical barriers to obstruct reflected light paths

### 7.5 ESS 4: Community Health and Safety

The proposed metro project may have potential health, safety, and security risks, particularly for vulnerable populations residing near the construction sites.

Community health and safety concerns are crucial during the construction phase, as the project corridor runs along high-traffic corridors. Increased risks may arise due to utility

shifting, material transport and storage, and heavy construction activities. It is essential to carefully manage safety hazards and inconvenience during this phase of the project.

Construction activities will primarily occur on existing roads, which may lead to traffic congestion and temporary diversions, affecting nearby settlements and daily mobility patterns. The project includes various activities such as labour engagement, use of heavy machinery use, civil construction, and material transportation. These activities may directly or indirectly impact the surrounding communities, particularly in high density urban and residential areas. While the project will prioritize local employment, the requirement for specialized skills and technologies may necessitate the deployment of migrant labour during the construction phase. It is estimated that approximately 1,200 construction workers will be employed for a period of 4 years, with about 50% accommodated in labour camps and the rest residing in nearby settlements. The influx of workers can lead to the following risks: increase the risk of crimes such as theft and robbery and risks of GBV/SH. Poor waste management within labour camps may pollute the nearby areas, resulting in health issues. Additionally, spread of communicable diseases, as migrant workers may introduce infectious disease, posing a threat to both labour camps and adjacent settlements.

The civil construction phase and associated project activities are expected to contribute to environmental pollution, including air emissions, noise generation, oil and fuel spills, alteration in surface drainage, improper solid waste disposal, and water pollution. These factors may have a direct impact on community health and safety, particularly in densely populated or environmentally sensitive areas.

The project area is located within Zone IV, classified as a high-risk seismic zone under Indian's seismic zoning classification. All metro structures will be designed using appropriate design technology to withstand seismic forces in accordance with relevant Indian Standards. To avoid hindrance for take-off and landing and to ensure Aviation Safety, certain areas of the local airspace are regarded as integral parts of the aerodrome environment. Obtaining NOC for height clearance is a statutory requirement as per Government of India's Gazette Notification G.S.R 751 (E) and its amendments. All project structures height is within the permissible top elevation as prescribed by No Objection Certificate Application System (NOCAS). Hence, permission from Airports Authority of India is not required for the project.

#### **A. Safety Hazards Due to Increased Traffic and Mitigation Measures**

##### **Safety Hazards**

Construction activities may pose safety risks to residents particularly children and the elderly, due to the increased movement of heavy vehicles and construction equipment. This may lead to pedestrian-vehicular conflicts, especially along congested sections such as Hero Honda Chowk to the Start Point of Basai Flyover, Sector 4 & 7 Chowk to Prakash Puri Chowk, Sector 5 Chowk to Ashok Vihar Phase 2 Petrol Pump, Jawala Mill Chowk to the End of Rao Gajraj Singh at NH 48, and Krishna Chowk at Palam Vihar.

Mitigation measures to address traffic-related safety hazards are discussed in Section 7.2.3.

#### **B. Community Exposure to Work Hazards and Communicable Diseases**

Communities residing near the project site may be exposed to various construction-related hazards due to the movement of vehicles transporting materials and equipment, the operation of heavy machinery, the use of chemicals, and other associated construction

activities. In addition, settlements located along the project corridor are particularly susceptible to heavy waterlogging and urban flooding during periods of rainfall.

### **Risks**

1. Pedestrian safety risks during both construction and operational phases, especially near metro stations and during utility shifting.
2. Increased risk of traffic hazards and incidents.
3. Injuries and accidents resulting from unauthorized access or trespassing at construction sites.
4. Injuries, accidents, and property damage caused by waterlogging and urban flooding.
5. Increased risk of respiratory illnesses due to dust and air pollution.
6. Health hazards from poor sanitation and inadequate drainage in labour camps.
7. Risk of spreading or increasing incidence of communicable and vector-borne diseases such as COVID-19, Tuberculosis, Hepatitis C, Dengue, Malaria, and Chikungunya.
8. Personal safety and well-being impacts associated with worker influx.
9. Noise and vibration risks and impacts caused by vehicular movement, construction works, machinery, generators and operational activities.
10. Risk of chemical and sludge spills during transport through or near residential areas.
11. Safety risks associated with poor housekeeping, such as improper storage of materials, tools, and equipment at construction sites.

### **Mitigation Measures**

1. Barricade and fence the work areas using sturdy materials to restrict unauthorised community access to the construction sites.
2. Ensure safe and uninterrupted access to residential and commercial establishments. Where technically and financially feasible, universal access provisions shall be made.
3. Install adequate signage and deploy flagmen to guide the community away from construction zones.
4. Implement a traffic management plan to ensure smooth vehicular and pedestrian movement.
5. Conduct awareness programs on community health and safety, including safe road usage protocols.
6. Organise regular medical check-up camps near settlements.
7. Establish tie-ups with nearby hospitals for routine checkups and emergency services.
8. Integrated Pest Management, including regular monitoring of pest and vector populations, use of non-chemical control methods (biological and cultural practices), and minimal use of chemical treatments. Additionally, measures including eliminating breeding sites, safe insecticide use, and community awareness programs.
9. Conduct awareness camps on the prevention and control of STIs, communicable disease, and vector-borne diseases.
10. Undertake regular cleaning of drains, especially in areas prone to urban flooding and waterlogging.
11. Use of dewatering pumps to effectively remove stagnant water from the affected area.
12. Raise community awareness about preventive measures such as such as keeping doors and windows closed during construction related dust emissions.

13. Implement alternative working hours (e.g. early morning or staggered shifts) to minimize disruption during sensitive times like school hours, prayer times, or community events.
14. Restrict construction activities near residential areas during night-time hours (10:00 PM and 6:00 AM). If noise levels exceed permissible limits, mitigation measures outlined under S. No. 6 of Section 7.3.3 will be implemented.
15. Surface the roads used for transporting materials to the site and implement dust suppression measures, such as regular water spraying or the use of non-toxic dust suppressants, to minimize dust emissions from vehicle movement.
16. Establish mechanisms to receive, acknowledge, and address community grievances and feedback effectively.
17. Include SEA/SH GM into the overall project-level GM.

With the implementation of above mitigation measures, the residual impacts on the community are expected to be minimal.

### **C. Risks & Impacts of Labour Influx and Mitigation Measures**

#### **Risks**

It is estimated that about 1,200 construction workers will be engaged in project related construction activities. The influx of labour can potentially lead to a variety of social risks and impacts. The common risks associated with labour influx are as follows:

1. Risk of conflict between workers and communities
2. Increased risk of illicit behaviour and crime
3. Increased burden on and competition for public service.
4. Increased risk of communicable diseases and burden on local health services
5. Risk of GBV/SH
6. Increased pressure on accommodations and rents

#### **Mitigation Measures:**

1. Prior to the commencement of construction activities, the contractor will prepare a LMP for approval by GMRL.
2. A CoC will be developed to regulate the worker behaviour on site, in labour camps, and within the surrounding communities.
3. The CoC shall include a program to raise awareness among construction workers about respecting local communities.
4. Information on the CoC will be provided in the local languages to ensure accessibility and understanding.
5. Cultural sensitization training will be conducted to guide workers in appropriate engagement with local communities.
6. Establish designated leisure areas within workers' camps to discourage workers from visiting community leisure spots.
7. Strict disciplinary actions (e.g., dismissal) will be enforced for workers found engaging in criminal activities.
8. Enforcement of laws against drug abuse and human trafficking.
9. Awareness sessions will be organized for workers and local communities on issues such as illicit behaviour, substance abuse, prostitution, and GBV.

10. Adequate services and facilities will be provided within the labor camps to minimize reliance on local community infrastructure.
11. Awareness programs shall be conducted for both workers and local community to prevent disease transmission.

With the implementation of the above mitigation measures, the residual impacts associated with labour influx are assessed to be minimal.

#### **D. Risk of Gender-Based Violence and Proactive & Preventive Measures**

##### **Risks**

The construction workers, predominantly composed of young males, often operates away from their families and outside their usual social environments. Such circumstances may increase the risk of GBV/SH, particularly in interaction between workers and the local community, including female residents. During the operational phase, GBV related risks may include harassment or abuse on trains, within stations premises, or in nearby, potentially affecting both passenger and GMRL Staff.

##### **Proactive & Preventive Measures**

- Mandatory training and awareness programs for all construction workers on GBV and SEA/SH issues
- Integration of a clearly defined CoC into all employment contracts.
- Collaboration with local law enforcement agencies to ensure effective response mechanisms.
- Establishment of a GM
- Special safeguards for vulnerable groups, particularly women and children, to be implemented throughout the project lifecycle.
- Incorporation of gender-sensitive design features during the planning and design stages of the metro infrastructure.
- Community sensitization campaigns, especially targeting women and girls, to raise awareness on safety measures and reporting mechanisms.
- Installation of CCTV surveillance systems across metro stations and trains.
- Provision of well-lit station platforms, entrances, and surrounding areas.
- Deployment of trained security personnel, including female staff, to ensure a safe and secure transit environment.

##### **7.5.1 Visual Intrusion**

The alignment and stations of the proposed metro are elevated, which may result in some degree of visual intrusion. However, the use of sleek and modern structural elements in the elevated metro design can contribute to an aesthetically appealing urban landscape. During the DD stage, the viaduct and station structures will be carefully designed to minimize visual intrusion.

##### **7.5.2 Flood Protection**

Construction activities may disrupt the natural drainage system, resulting in localized flooding or the submergence of low-lying areas. Run-off during both construction and operation

phases may become contaminated, impacting the surrounding environment. Measures need to be implemented to integrate the natural drainage features into the project's design.

Addressing storm water stagnation at critical points near the GMRP alignment during both construction and operation phases is crucial to prevent flooding, structural damage, and to ensure public safety.

#### **Mitigation Measures:**

- A. During Design Phase:
  - Rainwater harvesting structures to be designed for alignment, stations and depot.
  - All structures shall be constructed above the high flood level. Adequate flood protection measures shall be provided for all key installations, including electrical systems, labour camps, and storage facilities for materials, chemicals, and fuels.
  - Ensure permeable pavements.
- B. During Construction Phase:
  - Temporary drainage systems, such as cut off storm drains to be installed to divert stormwater away from construction sites.
  - Adequate grading and sloping shall be ensured to facilitate proper stormwater flow.
  - Erosion control measures such as silt fences, sedimentation basins, and erosion control blankets shall be implemented to prevent sedimentation in drainage channels.
  - Exposed soil surfaces shall be stabilized using vegetation or suitable synthetic covers.
  - Portable pumps shall be used to remove stagnant water from low-lying or flood prone areas during heavy rains.
  - Temporary flood protection measures, such as sandbags or water-filled barriers, shall be installed to protect construction zones.
  - The contractor shall prepare and implement a stormwater management plan that includes silt basin, sediment collection mechanisms, and proper disposal systems for construction yards and labour camps.
  - Regular inspections and maintenance of temporary drainage systems and erosion control measures.
- C. During Operation Phase:
  - Trees and vegetation shall be planted to increase absorption and reduce surface runoff at depot location.
  - A regular schedule for maintenance and cleaning of the drainage network shall be established to prevent clogging and ensure effective stormwater flow.
  - Promptly inspect and repair any damage to drainage infrastructure.
  - Coordination with ULB and relevant water management authorities shall be maintained to ensure stormwater management and compliance with regulations.
  - Participate in regional stormwater management initiatives.

#### **7.5.3 Impact on disadvantaged and vulnerable persons**

A census & socio-economic survey have been conducted among the project-affected families for the GMRP. Vulnerable persons identified for this project include families or households headed by women, people with disabilities, families living below the poverty line (extremely poor), widows, and persons above the age of 60 years, irrespective of their title status (ownership). The social survey findings reveal that approximately 82 vulnerable persons are

likely to be affected. This includes four (3.31%) individuals who are differently abled, 56 (46.28%) elderly people, 17 (14.05%) widows, 39 (32.23%) SC, four (3.31%) women-headed households (WHH), and one (0.83%) person living below the poverty line (BPL). Mitigation measures and interventions for impacted vulnerable households are incorporated in the RAP.

Also, vulnerable passengers who will travel by metro may face issues during their journey. To address this, the DDC shall incorporate the following design features into the project to provide support:

- Gently sloped ramps with gradients ranging from 1:15 to 1:17 for wheelchair users.
- Lifts and escalators for persons with disabilities and elderly people.
- Tactile paving to guide visually impaired individuals.
- Women security staff and women helpline number for female passengers.
- Sign language training for frontline staff (Customer Relations Assistants) to assist hearing-impaired and mute (deaf and dumb) passengers.
- A public address system and CCTV for all users, with a particular focus on aiding the visually impaired.
- Toilets for physically challenged at all stations and Depot
- Provision of Stretchers at Stations to assist those who are sick/unwell/got injured.

#### 7.5.4 Dark Spots

##### Safety Concerns

- **Crime and Security:** Poorly lit or unmonitored areas can become hotspots for criminal activities such as theft, vandalism, and assault.
- **Tripping Hazards:** Inadequate lighting at stations and platforms increases the risk of trips, slips, falls, and collisions, particularly during nighttime or low-visibility conditions.
- **User Experience:** Dark and poorly lit areas can create a perception of insecurity and discomfort, affecting passenger confidence and ridership experience.
- **Accessibility:** Inadequate lighting can affect the accessibility of metro facilities for passengers with visual impairments.

##### Operational Challenges

- **Maintenance Issues:** Dark spots may hide maintenance issues, structural damage, or safety hazards, making it difficult for maintenance teams to identify and address problems promptly.
- **Emergency Response:** In the event of emergency such as fire, health incidents, or security threats, dark spots can impede rapid response and safe evacuation.

Following measures shall be implemented to reduce and mitigate the impacts due to dark spots:

- Ensure uniform and adequate smart lighting system throughout metro stations, platforms, access points, and surrounding areas to eliminate dark spots, especially during evening and night hours.
- Utilize energy-efficient lighting fixtures with occupancy sensors, timers, and daylight responsive controls to optimize lighting levels while conserving energy and ensuring safety.

- Incorporate backup lighting systems, illuminated signage and uninterrupted power supplies to support safe evacuation and emergency response operations.
- Install and maintain security cameras, emergency call boxes, and alarm systems to deter crime, monitor passenger safety, and facilitate rapid response to incidents.
- Implement regular security patrols, provide training for security personnel and community engagement initiatives to enhance the perception of safety and vigilance among metro users.

### 7.5.5 Seismicity

If seismic risks are not adequately addressed during the design and subsequent operations of the metro project corridor in Gurugram City (Zone IV), the potential impacts could be severe. Failure to incorporate seismic consideration can increase the vulnerability of infrastructure to earthquake induced damage, compromising structural integrity and endangering public safety. Additionally, there is potential for soil liquefaction and landslides during seismic events, which may further impact construction and operations. The key potential impacts are:

1. **Structural Failure:** Increased risk of collapse or severe damage to metro structures during earthquakes, endangering the safety of passengers and staff.
2. **Injury and Loss of Life:** Higher likelihood of fatalities and injuries due to insufficient seismic resilience.
3. **Service Disruption:** Prolonged interruptions in metro operations, leading to increased traffic congestion and reliance on alternative transportation modes.
4. **Economic Consequences:** Significant financial losses resulting from repairs, compensation claims, and decreased ridership in the aftermath of seismic events.

These risks highlight the critical need for incorporating robust seismic engineering practices to ensure the safety, reliability, and continued community confidence in the metro system.

#### Mitigation Measures:

- **Seismic Design Standards:** DDC, GC and Contractor shall implement robust seismic design standards in compliance with IS 1893 to enhance structural resilience.
- **Regular Inspections:** GMRL should conduct regular inspections and maintenance of infrastructure to identify and rectify vulnerabilities.
- **Emergency Preparedness:** Contractor shall develop and implement comprehensive emergency response plans to ensure swift action during seismic events.
- **Design layouts** should also integrate designated open spaces or refuge areas for safe evacuation.
- **Retrofitting Strategies:** GMRL should plan for future retrofitting of existing structures.

## 7.6 ESS 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement

The project will require acquisition and transfer of land (permanent and temporary) for the construction of the proposed corridor, stations and depot. The cut-off date for legal title holders will be the date of Notification under GMRL Policy for Direct Purchase of Private Land/Property through Mutual Negotiations. For non- titleholders, the cut-off date has been

set as the completion date i.e. 14.02.2024 of the survey which has been done from December 2023 to February 2024. Cut-off date details of survey have been provided in the Resettlement Action Plan (RAP). This was communicated to the affected people during the survey and consultation process. People moving into the project area after the cut-off date will not be entitled to any assistance. A total of 121 NTH are likely to be affected by the project, of which 22 NTH were not available during the survey despite multiple attempts to cover them. However, some flexibility will be considered during implementation to take into account any non-titled-holders who were identified but unavailable during the survey and owned assets within the project footprint prior to the cut-off-date.

#### A. Permanent Land Requirement

The proposed metro project requires 24.84 ha. of land which includes 23.44 ha state government land, 0.08 ha central government land and 1.32 ha of private land. The details of land requirement are provided in **Table 7-21**.

**Table 7-21 Details of Permanent Land Requirement (in ha)**

Ownership	Station & Viaduct	Maintenance Depot	Total
Central Govt	0.08	0.00	0.08
State Govt	1.71	21.73	23.44
Private	0.68	0.64	1.32
<b>Total</b>	<b>2.47</b>	<b>22.37</b>	<b>24.84</b>

Wherever land or permanent structures are required to be purchased or acquired for metro construction, land or property will be purchased through the provisions of the GMRL Policy for Direct Purchase of Private Land/Property through Mutual Negotiations. The entitlement provisions under the RFCTLARR Act, 2013, in lined with ESS5 are outlined in the RAP.

Although the number of affected titleholders is low, there remains a significant risk of grievances being raised, which could potentially cause delays in the project's construction schedule. Therefore, the impact of land and property acquisition during the construction phase is considered major.

#### B. Impact on Structures

The findings of census and socio-economic survey revealed that 210 structures are likely to be affected in project corridor. Among these structures, there are 14 title-holder structures, two informal settlers' structures, 91 informal occupiers' structures, 44 are those with licenses issued by MCG, one holding Excise & Taxation Department License for Wine Shop, one trust structure, 52 government structures, one religious' structures, and four community structures. The affected structures are mostly small in size, and extent of impact has been assessed based on the percentage of the area affected. Accordingly, where the impact exceeds 10%, the structures are deemed no longer viable for use and are therefore considered fully affected. A detailed representation of the typology of affected structure and extent of the impact is presented in **Table 7-22**.

Table 7-22 Details of Affected Structures

Affected Properties	Typology of Impacted Structure			Extent of Impact*						No. of Impacted Properties
	K	P	S-P	<10%	11-20%	21-40%	41-60%	61-70%	>71%	
Title Holders (TH)	0	13	1	2	1	3	3	1	4	14
Informal Settlers	1	-	1	1	-	-	-	-	1	2
Informal Occupiers	73	15	3	-	2	3	8	-	78	91
License issued by MCG	43	-	1	-	-	-	-	-	44	44
License issued by Excise & Taxation Department, Haryana	-	-	1	-	-	1	-	-	-	1
Trust	-	1	-	1	-	-	-	-	-	1
Government	10	17	25	2	-	1	-	-	49	52
Religious	-	1	-	-	-	-	-	1	-	1
Community	-	3	-	1*	-	-	-	-	3	4
<b>Total</b>									<b>210</b>	

Source: RITES Field Studies

(K: Kutch, P: Pucca, & SP: Semi-Pucca)

\*Basai pond is not considered in the typology of affected structures

Among the 210 affected structures, 20 are residential comprising five houses belonging to TH, three houses and 12 huts resided by NTH. There are 126 commercial structures, including 24 shops (06 TH and 18 NTH), one TH office (political party office), one wine shop license issued by Excise & Taxation Department, Haryana and 101 kiosks operated by NTH, which consist of one informal settler (encroacher), 56 informal occupiers (squatters) and 44 licensed from MCG. Additionally, four NTH structures serve both residential and commercial purposes and three other structures (two are boundary walls and one under construction).

Furthermore, 57 other structure comprising government, community and religious will also be impacted by the project. Of these, 52 are government structures, including 32 bus stops, eight boundary walls, and 12 other structures. In addition, one religious structure (temple) and four community properties (one pond and three water tanks/ATMs) are likely to be affected.

As per the DPR, a Stabling Depot was initially proposed at Sector 101, Gurugram, covering an area of 5.50 hectares. However, since this location is a low-lying area and part of the KBA/IBA in Sector 101, Basai, a new depot with improved facilities has been proposed at Sector 33, near the proposed Sector 72A Metro Station, covering an area of 22.37 ha. (21.73 ha government and 0.64 ha private). About 20% part of the land is occupied by marble merchants. Before the commencement of the census and socio-economic survey, leaflets were distributed to inform them about the project. The survey team also briefed the merchants about the project and the depot, and initially, they were willing to participate in the survey. However, when the survey team visited the depot location to conduct the survey, the merchants refused to cooperate due to an ongoing legal dispute between the Marble

Merchants and HSVP. They stated that they would not participate in any study related to the Metro Project until the Hon'ble Court delivers its verdict.

A consultation was held with the Marble Merchants as detailed in Section 6.2 and 6.3, during which they shared a revised layout and demarcation plan of the marble market in Sector 33 and 34 (DRG. No D.T.P. (a) 1273/04 dated 30.06.04). According to this layout plan, a total of 71 plots are marked in Sector 33. They informed that around 50-60 marble shops are located in Sector 33; however, only 28 of these shops fall within the depot area. Additionally, they conveyed that, as per Memo No. 13088 dated August 14, 2014, approved by the Chief Administrator, an affidavit was submitted to the Hon'ble Court in 2014. This affidavit confirmed that the marble merchants would be relocated from Sector 33 to Sector 34. The RAP shall present an assessment of the resettlement site at Sector 34 and the arrangements for relocation once they are finalized by HSVP.

The chief administrator also issued directions at the meeting held on November 11 to superintending engineer-I, HSVP, Gurugram to prepare and submit a tentative estimate for laying out of development works in Sector 34, Gurugram, as per the approved layout plan in case allottees of Marble Market Sector 33 are accommodated in Sector 34.

As communicated by GMRL, HSVP is currently in discussions with these merchants to resolve the matter by offering them with an alternative place on within the same area, specifically along the front side of the road from Subhash Chowk to Hero Honda Chowk.

On December 29, 2025, HSVP demolished marble shops in Sector 33 Marble Market. Currently, new market construction is underway and upon completion, affected shops will be relocated to this developed facility. Therefore, the affected marble merchants are not considered as PAPs.

An agency has been appointed to support the implementation of RAP activities. The agency will enumerate the impacted properties and affected persons within the depot area and along the project corridor and update the RAP accordingly. Compensation for impacted properties will be paid in accordance with the approved Entitlement Matrix and GMRL Policy for Direct Purchase of Land & Property through mutual negotiations developed for the GMRP.

### **C. Verdict of Court Case at Depot Location**

Verdict 1: In the case of Vinod Kumar and Others vs. State of Haryana and Others (CWP-23543-2015), the petitioners challenged the acquisition of their land, seeking de-notification or release on the grounds that the acquisition proceedings had lapsed under Section 24(2) of the RFLTLARR Act, 2013. The land was originally acquired through notifications dated 27.11.2003 and 24.11.2004 under the Land Acquisition Act, 1894, followed by an award on 22.11.2006. Although the High Court initially allowed the writ petition in 2018, the Supreme Court overturned the order in 2024 and remanded the matter for reconsideration. Upon review, the High Court held that possession had been lawfully taken through Rapat No.170 dated 22.11.2006 and Rapat No.55 dated 29.09.2009, and that part of the compensation (₹2.93 crore out of ₹15.58 crore) had already been accepted, with the rest tendered and deposited in the LAC account. Since these events occurred prior to the enactment of the 2013 Act, the Court ruled that the acquisition had not lapsed. The petitioners' claim of continued possession and allegations of discrimination were rejected. It was also noted that the land, specifically

Khasra Nos. 233 (0-11-0) and 234 (0-9-0) of village Islampur, Gurugram, formed part of an approved development plan involving a 30-meter-wide green belt and a 12-meter service road. The Court concluded that the land was acquired for a valid public purpose and dismissed the writ petition, affirming the validity of the acquisition.

#### D. Mitigation Measures

A Resettlement Action Plan (RAP) is prepared to address and mitigate the impacts on the affected households. The RAP shall be disclosed on the GMRL Website for all stakeholders. The objective of the plan is to improve or at least restore the income and livelihood conditions of the people to at least the pre-project level. The households affected will not only receive cash compensation for land and other assets at prevailing rates for full replacement cost but also additional assistance will be given for relocation and livelihood restoration. Overall, the RAP presents (a) the socio-economic profile of the affected settlements; (b) the type and extent of loss of assets; including land, structures, and trees; (c) principles and legal framework applicable for mitigation of these losses; (d) the entitlement matrix; (e) income and livelihood restoration program; (f) relocation and resettlement budget; (g) the institutional framework for the implementation of the plan, including monitoring and evaluation.

The gap filling measures between GoI policies and WB ESS5 are outlined below:

- **Replacement Cost of Affected Structures:** The RFCTLARR act calculates compensation for structures based on the market value of the building and other immovable properties or assets attached, along with a 100% solatium on the final award amount. In contrast, ESS 5 mandates replacement compensation for structures without accounting for depreciation.
- **Recognition of Non-Titleholders:** The Act does not recognize informal settlers (encroachers) and informal occupiers (squatters) as affected persons. In contrast, the ESS5 recognizes informal settlers and informal occupiers as affected families.

These gaps have been addressed by aligning with the requirements of ESS5 to ensure affected persons receive compensation at full replacement value and by including non-titleholders in the project's entitlement matrix.

#### E. Avoidance of Displacement through Alternative Design Solutions

WB's ESF mitigation hierarchy was adopted to minimize adverse impacts through careful project design, guided by the findings of the social study conducted as part of the ESIA. In line with the avoidance principle under this hierarchy, the initial identification of 261 properties likely to be affected by the development of the viaduct, station and entry/exit locations was reviewed. As a result of design modifications, 79 properties were saved, although a few additional properties were identified due to further refinement of the project design. The details of the saved properties are provided below **Table 7-23**:

**Table 7-23 Impact avoided through alternative design solution**

S. No.	Chainage	No. of Structures Saved	Remarks
1	6+000 to 7+000	1	Change in alignment
2	7+000 to 8+000	1	

S. No.	Chainage	No. of Structures Saved	Remarks
3	8+000 to 9+000	3	
4	9+000 to 10+000	19	
5	10+000 to 11+000	3	
6	16+000 to 17+000	11	Change in entry/exit points
7	18+000 to 19+000	1	Change in alignment
8	22+000 to 23+000	3	Change in entry/exit points
9	23+000 to 24+000	16	Change in alignment
10	24+000 to 25+000	6	
11	25+000 to 26+000	14	

## 7.7 ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

### 7.7.1 Loss of Trees

The proposed GMRP corridor passes through an urban area of Gurugram City. An inventory of trees along the corridor was carried out, and approximately 1,660 tree are likely to be affected, as presented in **Table 7-24**, with detailed information provided in **Annexure 7.7**. Most of the trees likely to be affected located along the median of the road, on either side of the road at metro stations, and within depot boundary.

**Table 7-24 Number of Trees along the Corridor and Depot**

S. No	Section / Station	Number of Trees
1.	Millenium City Centre to Cyber City	1401
2.	Depot at Sector-33	259
<b>Total</b>		1660

It is proposed to plant ten saplings for each tree to be cut. Hence, total 16,600 samplings need to be planted. The cost of afforestation is estimated at Rs.7,50,000/- per ha. Accordingly, compensatory afforestation cost is estimated to be about Rs 113.18 Lakh. Native and miscellaneous indigenous tree species are recommended for afforestation. The list of proposed tree species for plantation is provided in **Table 7-25**.

**Table 7-25 List of Trees for Plantation**

S. No	Botanical Name	Common Name
1.	<i>Alstonia scholaris</i>	Alstonia
2.	<i>Azadirachta indica</i>	Neem
3.	<i>Ficus virens</i>	Pakad
4.	<i>Acacia nilotica</i>	Babul
5.	<i>Cassia fistula</i>	Amaltas
6.	<i>Alianthus excelsa</i>	Aadu
7.	<i>Holopteleaintegrifolia</i>	Papdi
8.	<i>Dalbergia sisoo</i>	Shisham
9.	<i>Delonix regia</i>	Gulmohar
10.	<i>Albizialebbeck</i>	Siris
11.	<i>Albiziaamara</i>	Krishna siris
12.	<i>Kigeliapinnata</i>	Balamkheera
13.	<i>Ficusbengalensis</i>	Bargad

S. No	Botanical Name	Common Name
14.	<i>Ziziphus mauritiana</i>	Beri
15.	<i>Ficus racemosa</i>	Gular
16.	<i>Morus alba</i>	Shahtoot
17.	<i>Ficus religiosa</i>	Pipal
18.	<i>Terminalia arjuna</i>	Arjuna
19.	<i>Casearia graveolens</i>	Chila
20.	<i>Melia azadirach</i>	Bakan

Source: Working Plan Gurgaon Forest Division 2009-10 to 2023-24.

The location for afforestation will be decided by GMRL in consultation with the MCG and the Department of Forest.

### 7.7.2 Aravalli Range

The Aravalli Range is located about 3 km away from the GMRP alignment. A dense urban settlement exists between the alignment and the Aravalli Range, which acts as a buffer. Therefore, no impact is anticipated on the Aravalli Range

### 7.7.3 Impact on Avifauna

Considering the ecological aspects, the waterbodies lying within 10 km radius of the proposed alignment are:

- KBA/IBA in Sector 101, Basai
- Sultanpur National Park
- Najafgarh Jheel
- Basai Pond

#### 7.7.3.1 KBA/IBA in Sector 101, Basai

KBA/IBA in Sector 101, Basai was identified as an Important Bird Area as per the Birdlife International assessment conducted in year 2004. As per this assessment, the primary water source for the site was a breached water channel carrying wastewater and partially treated sewage from the Gurgaon Water and Sewage Works. Historically, it served as a wintering site for local migratory bird's species. The area is currently surrounded by urban infrastructure, including the Dwarka Expressway (with an elevation of 9–10m) located approximately 300m to the northwest, an operational railway line nearby, a railway overbridge (8–9m high) and several few high-rise residential buildings are in the vicinity of this area. The proposed metro alignment will have a similar elevation, approximately 10m. A pictorial representation of the area, existing infrastructure and the proposed metro alignment is shown in **Figure 7-2**. It is anticipated that existing elevated structures/height barriers such as Elevated Dwarka Exp, Rail Over Bridge, High Rise Buildings have been in place for a considerable duration. Additionally, the Gurugram-Rewari Railway line is located near the area, has not disrupted the flying path of avifaunal species in past. Over time, local and migratory bird species have adapted their flight paths accordingly to accommodate these existing structures.

The proposed GMRP corridor will adopt the third rail traction system, which is ground-based. This system maintains open airspace, reduces the risk of electrocution and bird collisions, and helps preserve natural flight paths. Therefore, no adverse impacts are anticipated on the

flying paths of avifauna species due to the GMRP. Furthermore, the bird resting area is located approximately 308ms from the proposed spur alignment. Given this distance, and considering the operation of an electric metro system, no significant noise or vibration impacts on avifauna are expected during the operational phase.

As per the baseline study conducted in the area, the primary source of water was treated wastewater discharged from a nearby STP, which led to ponding and consequently supported avifaunal activity, particularly among local and migratory bird species. Recently, the unintentional effluent discharge was halted due to the repair of a damaged drain. Subsequently, local residents have filled the land with soil and resumed agricultural activities.

The general impact due to construction activities are noise generation, dust emissions, material storage, vibrations, affect water quality and aquatic habitats and unauthorized activities by workers, such as hunting of birds or disturbing wildlife, habitat degradation and light pollution at night.

Although the site holds historical ecological sensitivity as documented through bird sightings, any future seasonal ponding in the area may be impacted by metro construction and operations activities. Therefore, the biodiversity of the KBA/IBA in Sector 101, Basai, will be re-examined during the rainy season. Based on this, conduct an Integrated Biodiversity Assessment (with critical habitat assessment) to prepare a biodiversity management plan and bird friendly design guidelines for implementation).

Material storage areas will be sited away from the KBA/IBA in Sector 101, Basai with proper containment systems to prevent runoff. Strict guidelines shall be enforced to prohibit hunting or disturbance of wildlife by workers, supported by regular monitoring and awareness programs. Fly camps and site facilities shall be managed with controlled waste disposal systems, adequate sanitation, and minimal footprint designs. Buffer zones shall be maintained between construction activities and the waterbody to preserve ecological integrity.

Figure 7-2 KBA/IBA in Sector 101, Basai



Source: RITES Study

### 7.7.3.2 Sultanpur National Park

The Sultanpur National Park is located approximately 8.2 km away from the GMRP and the ESZ notified for Sultanpur National Park is 5 km from its boundary. There is an existing railway line (Gurugram-Farukhnagar), located about 200-300m from national park's boundary operates regularly without reported impacts on the avifauna frequenting the park. Therefore, no adverse impact on Sultanpur National Park is anticipated due to the proposed metro project.

### 7.7.3.3 Najafgarh Jheel

Najafgarh Jheel is located approximately 4.7 km from the proposed metro corridor. Given this distance, it is anticipated that noise, vibration, and other operational disturbances generated during the construction and operation phases of the GMRP are not expected to propagate to the Jheel. and will have no impact on Najafgarh Jheel and its avifauna. Therefore, no adverse impact on Najafgarh Jheel and its avifaunal population is expected.

### 7.7.3.4 Basai pond

No avifauna was observed at Basai Pond during the baseline study; therefore, no impact on avifaunal species is anticipated.

## 7.7.4 Impact due to Pigeons

Pigeons pose significant challenges within metro networks, including issues related to excreta and nesting in inaccessible areas such as the undersides and crevices of overhead tracks. Eggs laid in such locations often fall onto roads, creating hazards for both vehicular traffic and pedestrians. The accumulation of droppings and nesting materials can disrupt metro operations and compromise hygiene and safety, necessitating effective management to mitigate their impact on the transportation system. Combating/Controlling the nuisance and menace caused by Blue Rock Pigeon (*Columba livia*) at metro stations can be challenging; however, several effective and sustainable measures can be implemented to mitigate their impact:

**Structural Design Implementation/Application:** Blue Rock Pigeons, commonly known as *Kabootar*, tend to perch and nest on flat surfaces. They are prolific breeders and often remain at the same breeding sites for generations, thereby creating a persistent nuisance. Their presence contributes to environment contamination through the spread of viruses and bacteria, which can lead to serious respiratory illnesses such as *Hypersensitive pneumonitis* (a form of Interstitial Lung Disease - ILD). A single pigeon produces about 12 kg of excreta annually, which is acidic in nature and my contribute to material corrosion. Additionally, pigeon droppings are known to carry salmonella and other pathogens posing significant health risks. Continuous exposure to such contaminated environments can endanger the health of metro commuters and staff.

The following measures shall be adopted to manage pigeons related concerns at stations:

1. Incorporation into Detailed Design: Structural design interventions shall be integrated during the detailed design phase to deter pigeons from perching and establishing breeding colonies. Some of the suggestion for structural design for protection from pigeon nuisance is given in **Figure 7-3**.

**Figure 7-3 Suggested Structural Design for Protection from Pigeon Nuisance**

2. **Netting and Barriers:** Install physical barriers such as pigeon spikes or wire mesh nets to prevent pigeons roosting and nesting in areas such as under eaves, ledges, and rafters. These measures help reduce pigeon colonization and minimization nuisance to the metro commuters.
3. **Deterrents:** Use of visual deterrents such as twisted metal ribbons or high reflective coloured surface, which are effective in scaring birds away. This method has been widely used in agriculture, can be adapted for GMRP. Additionally, install bird repellent discs and incorporate natural deterrents like marigold, basil, and lavender plants around metro stations. These not only discourage pigeons from nesting and roosting but also enhance the station's aesthetic. Regular pest control at identified hotspots shall also be carried out.
4. **Regular Cleaning:** Keep the station and surrounding areas clean by promptly removing any food waste, spills, and garbage. Eliminating these food source reduces the station's attractiveness to pigeons.
5. **Habitat Modification:** Modify the station environment to make it less conducive for pigeons nesting and roosting. This includes sealing off entry points to buildings, removal of stagnant water, and installing nets in specific areas to block access to potential nesting sites at stations.
6. **Public Awareness and Education:** Conduct awareness campaigns to discourage the public from feeding pigeons near metro premises. Artificial feeding grounds lead to overpopulation and increased nuisance. Educating commuters about the impacts of overfeeding can significantly reduce pigeon congregation in and around stations.
7. **Slanted Surfaces:** Introduce sloped sheathing and slant surface on window panes, ledges, and structural beams of metro stations to discourage pigeons from perching.

By adopting this integrated approach, metro stations can effectively manage pigeon-related issues, thereby ensuring a cleaner, safer, and more commuter-friendly environment.

## **7.8 ESS 7: Indigenous People**

The GMRP is located in Gurugram District, which does not fall under Schedule V area of the Indian Constitution. Furthermore, the affected population does not meet the four key

characteristics required to trigger the provisions of ESS 7<sup>13</sup>. Therefore, the specific requirements safeguards mandated under ESS 7 pertaining to indigenous peoples, their rights, cultural heritage and traditional knowledge are not applicable to this project.

## 7.9 ESS 8: Cultural Heritage

Tangible cultural heritage includes objects, sites, structures, and landscapes that hold cultural, historical, or aesthetic significance, while intangible heritage includes the practices, expressions, and knowledge passed down and continuously adapted by communities. Both forms are integral to cultural identity and legacy.

Tangible cultural heritage within the project area includes cultural assets, archaeological monuments, and structures listed by INTACH, which are detailed in the subsequent sections. No intangible cultural heritage sites or practices have been identified within the project influence area.

### 7.9.1 Impact on Cultural Assets

**Impact:** One cultural heritage asset (temple) is likely to be impacted by the GMRP. The extent of impact is full on the temple (**Figure 5-16**).

**Mitigation:** GMRL shall reconstruct the affected temple with complete coordination and participation of the affected community and in a culturally and socially acceptable manner.

### 7.9.2 Impact on Archaeological Monuments

One archaeological site is falling within 10 km radius of GMRP corridor i.e. Mosque of Ala Vardi Khan. The mosque is located approximately 490m from the GMRP alignment, near Bajghera Road metro station. As per the Ancient Monuments and Archaeological Sites and Remains (Amendment) Act, 2010, public and other works are prohibited within 100m and regulated within 200m (totaling 300 m) from any protected monument. Since the GMRP alignment lies outside the regulated zone, at a distance of approximately 490m from the monument, no adverse impact is anticipated on the site due to the project.

### 7.9.3 Indian National Trust for Art and Cultural Heritage (INTACH) listed Structures

The INTACH-listed structures located within 10 km on either side of the GMRP alignment are as follows:

- Water Body: Bhim Kund

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<sup>13</sup> (a) Self-identification as members of a distinct indigenous social and cultural group and recognition of this identity by others; and (b) Collective attachment to geographically distinct habitats, ancestral territories, or areas of seasonal use or occupation, as well as to the natural resources in these areas; and (c) Customary cultural, economic, social, or political institutions that are distinct or separate from those of the mainstream society or culture; and (d) A distinct language or dialect, often different from the official language or languages of the country or region in which they reside.

- Temples: Sita Ram Temple, Sheetla Mata Devi Temple, Dronacharya Temple, and Eklavya Temple
- Mosques: Sarai Allawardi Mosque, Eidgah Mosque, Shahi Jama Mosque and Jama Masjid
- Church: Church of Epiphany

All these structures are located outside 100m but within a 10 km on either side of the alignment. These structures are at a distance more than the tolerance distance of 12.2 m from centre of alignment, no mitigation measures are required, and no adverse impact is anticipated on these structures.

#### 7.9.4 Chance finds

There is a possibility that chance finds may occur during the construction phase of the metro project. These findings may include the discovery of a single artifact, an artifact indicating the presence of a buried archaeological site, human remains, fossilized plant or animal remains or animal tracks, or natural features that appears to indicate the presence of archaeological material.

In such instances, the contractor will follow the chance-finds procedures to ensure proper handling and compliance with applicable laws. Any chance finds discovered during excavation are to be dealt in accordance with Indian Treasure Trove Act, 1878. The key steps involved in dealing with chance finds are as follows:

- a. Notice by finder of treasure to Collector.
- b. Notification by Collector requiring claimants to appear.
- c. When treasure may be declared ownerless, such treasure shall either be delivered to the finder or be divided between him and the owner of the place in which it has been found. When no other person claims as owner of place, treasure to be given to finder.
- d. The Collector, may, at any time before delivering or dividing the treasure declare his intention to acquire on behalf of the Government the treasure or any specified portion thereof, by payment to the persons entitled thereto and thereupon such treasure or portion shall be deemed to the property of the Government.
- e. The Collector's decision in such matters shall be considered final.

## Chapter 8: Sexual Exploitation & Abuse (SEA) and Sexual Harassment (SH) Action Plan

### 8.1 Proposed SEA/SH Action Plan

Gurugram's rapid urbanization and metro infrastructure expansion have led to increased interaction between diverse populations, including substantial labor influx and growing daily movement of women as transport users. These dynamics elevate the risks of Gender-Based Violence (GBV) and Sexual Exploitation and Abuse (SEA) affecting women both as commuters and residents impacted by construction activities.

Gurugram district and Haryana state continue to experience significant challenges related to Gender-Based Violence (GBV) predominantly affecting women and girls. According to 2024 NCRB data, Gurugram recorded 1,727 cases of crimes against women, including 722 cases of domestic violence and 235 cases of sexual harassment. Women traveling in public and last-mile transport hubs such as Sikandarpur, MG Road and IFFCO Chowk stations often face heightened vulnerability to harassment due to inadequate safety measures, poor lighting, overcrowding and lack of dedicated women's security personnel. During stakeholder consultations conducted as part of the ESIA study with women police officials, it was revealed that the police department has identified five key hotspots for such incidents Gurugram Bus Stand, Devi Lal Park (falling along the GMRP alignment), Sector-14, Choma Gaon Park and IFFCO Chowk.

The influx of construction laborers during metro construction work further increases SEA/SH risks, especially for women living near or working at construction sites. The presence of large, predominantly male workforces without adequate oversight can lead to increased incidents of harassment, exploitation and vulnerabilities to GBV for community women, children and female labourers.

Risk mitigation must therefore prioritize the safety of women transport users by improving lighting, CCTV coverage and presence of security personnel at metro stations and transit routes. Construction sites must enforce strict codes of conduct, deliver sensitization training for laborers and maintain grievance redressal mechanisms accessible to nearby communities. Multi-stakeholder coordination with police, local governance and civil society is vital to create safer spaces and reduce GBV risks related to Gurugram's metro development.

### 8.2 Legal Frameworks

1. Protection of Women from Domestic Violence Act, 2005
  - Provides civil remedies and protection to women from all forms of domestic violence including physical, sexual, verbal, emotional and economic abuse.
2. Dowry Prohibition Act, 1961
  - Criminalizes giving or taking of dowry before, during or after marriage.

3. Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 (POSH Act)
  - Mandates proactive steps and Internal Committees in workplaces to prevent and redress sexual harassment.
4. Indian Penal Code (as amended by the Criminal Law (Amendment) Acts, 2013, 2018; also updated as Bharatiya Nyaya Sanhita 2023):
  - Section 354: Assault or criminal force to woman with intent to outrage her modesty
  - Section 354A: Sexual harassment
  - Section 376: Rape
  - Section 498A: Cruelty by husband or relatives
  - Section 509: Word, gesture, or act intended to insult the modesty of a woman

These sections criminalize various forms of violence, abuse, and harassment.
5. Protection of Children from Sexual Offences (POCSO) Act, 2012
  - Special law for child protection from sexual abuse and exploitation.
6. Haryana State Amendments and Schemes
  - Haryana Victim Compensation Scheme for Women Victims/Survivors of Sexual Assault/other Crimes, 2020: Provides financial aid and rehabilitation for GBV survivors.
  - Haryana State Commission for Women Act, 2012: Constitutes a dedicated commission for women's rights, protection, and policy advocacy in Haryana.
  - Rules on Night Shift and Workplace Safety for Women (2025 Amendment): Mandates consent, enhanced CCTV/security, safe transport, and PoSH Act compliance for women working night shifts in shops, establishments, or industry.
  - Women Safety Cell and Standard Operating Procedures by Haryana Police: Includes Women Helpline, special investigators, and field protocols for GBV.

These legal provisions and guidelines provide the mandatory legal framework and best practice standards required to address SEA/SH in India.

**Table 8-1: SEA/SH Risk Prevention and Response Action Plan**

<b>Key Risks</b>	<b>Actions to Address SEA/SH Risks</b>	<b>Indicators</b>	<b>Timing for Action</b>	<b>Responsibilities</b>
Increased SEA/SH risks due to influx of workers and contractors at Construction Site	<ul style="list-style-type: none"> <li>• Conduct risk assessment and mapping of hotspots at sites</li> <li>• Develop &amp; disseminate SEA/SH code of conduct for all workers and contractors</li> <li>• Conduct mandatory SEA/SH awareness and sensitization training for workers and supervisors</li> </ul>	<ul style="list-style-type: none"> <li>• Risk assessment/mapping done</li> <li>• Codes of conduct signed by all workers</li> <li>• % of workers trained on SEA/SH</li> </ul>	Before and During construction	<ol style="list-style-type: none"> <li>1. Social-cum-R&amp;R-Gender Expert, GMRL</li> <li>2. Social Safeguard Expert, GC</li> <li>3. Contractors</li> </ol>
SEA/SH risks associated with construction activities and project	<ul style="list-style-type: none"> <li>• SEAH/SH training for GMRL staff and specialists</li> <li>• Designate site-level SEAH/SH focal point</li> <li>• Awareness for technical teams</li> </ul>	<ul style="list-style-type: none"> <li>• Training of GMRL Officials on SEA/SH</li> </ul>	Before and During construction	<ol style="list-style-type: none"> <li>1. Social-cum-R&amp;R-Gender Expert, GMRL</li> </ol>
Lack of safe, accessible and confidential grievance redressal mechanisms at project sites	<ul style="list-style-type: none"> <li>• Establish confidential grievance redressal mechanisms (GRM)</li> <li>• Publicize grievance channels with signage and awareness</li> <li>• Set up a SEA/SH committee or focal point at site level</li> </ul>	<ul style="list-style-type: none"> <li>• Number of grievances received and timely addressed</li> <li>• Grievance mechanism awareness among workers and community</li> </ul>	Throughout construction and implementation	<ol style="list-style-type: none"> <li>1. Grievance Officer, GMRL</li> </ol>
Limited survivor support services (medical, psychosocial, legal) in vicinity of project sites	<ul style="list-style-type: none"> <li>• Develop referral pathways and MOUs with local hospitals, counseling and legal aid providers</li> <li>• Provide information to workers and communities on support services</li> </ul>	<ul style="list-style-type: none"> <li>• Referral agreements signed</li> <li>• Number of survivors assisted through referral pathways</li> </ul>	Before construction and throughout implementation	<ol style="list-style-type: none"> <li>1. Grievance Officer, GMRL</li> </ol>

Risks of SEA/SH during metro operation	<ul style="list-style-type: none"> <li>• Include safety measures in design and operation (lighting, CCTV, security personnel)</li> <li>• Conduct public awareness campaigns on zero tolerance for SEA/SH</li> <li>• Ensure safe transport options for workers and women users</li> </ul>	<ul style="list-style-type: none"> <li>• Safety audits findings</li> <li>• Public awareness campaign reach</li> <li>• Number of safe transport options available</li> </ul>	Construction and Operation	<ol style="list-style-type: none"> <li>1. Grievance Officer, GMRL during Operations,</li> <li>2. Security Team</li> </ol>
Retaliation or stigma against SEA/SH survivors or complainants	<ul style="list-style-type: none"> <li>• Ensure confidentiality protocols</li> <li>• Provide training to staff on victim-sensitive handling</li> <li>• Monitor for retaliation cases and act promptly</li> </ul>	<ul style="list-style-type: none"> <li>• Confidentiality breaches reported</li> <li>• Training sessions held</li> <li>• Retaliation cases recorded and resolved</li> </ul>	Throughout project lifecycle	<ol style="list-style-type: none"> <li>1. Grievance Officer, GMRL during Operations,</li> </ol>
Female staff and commuters face harassment risks in metro stations, trains, and maintenance depots	<ul style="list-style-type: none"> <li>• Establish Metro SEA/SH Policy</li> <li>• CCTV coverage</li> <li>• Safety signage</li> <li>• Designated complaints system</li> </ul>	<ul style="list-style-type: none"> <li>• No. of complaints received/resolved</li> <li>• % stations with safety features</li> </ul>	Continuous during operation	<ol style="list-style-type: none"> <li>1. GMRL Operation Team, POSH Committee</li> </ol>
Lack of awareness among metro staff	<ul style="list-style-type: none"> <li>• Annual SEA/SH trainings/workshops on prevention, response and survivor-centred handling</li> </ul>	<ul style="list-style-type: none"> <li>• No. of trainings/workshop held</li> <li>• % staff trained/attended</li> </ul>	Annual	<ol style="list-style-type: none"> <li>2. POSH Committee</li> </ol>

## Chapter 9: Environmental and Social Management Plan (ESMP)

### 9.1 Proposed ESMP

The negative environmental impacts stemming out of the proposed project can be mitigated with simple set of measures, with careful planning and designing of the metro alignment and structures. Adequate provision of environmental clauses in work contracts and efficient contract management will eliminate or reduce significantly all possible impacts. A common problem encountered during implementation of environmental management plans of such projects is lack of environmental awareness among engineers and managers concerned with day-to-day construction activities, which can be solved through regular environmental training programs. ESMP is presented in **Table 9-1**, which defines actions to be undertaken during design, pre-construction, construction and operation stage of the project. The effectiveness of environmental considerations will, however, depend on appropriate inclusion of these in the work contracts, commitment to implement, and implementation, supervision and reporting well. These are very important for the Project, and by adoption if this ESIA, there is expected to be full commitment and adherence to the mitigation, management measures herein. Contractors also has to ensure updating of the ESMP based on finalized 'as-built' plans and implement the revised plan to ensure compliance.

The major concern during the construction stage is that the contractors, due to lack of enforcement, do not practice good environmental sanitation (housekeeping), safety standards, and may intend to get unauthorized use of the easily available natural resources and other available infrastructure like roads and water resources. This would result in degradation of ambient air quality, water resources and land environment around the construction sites and labour camp. Improper management of earthwork activities would disrupt the natural drainage and increase soil erosion. Additionally, the implementation of the mitigation actions requires that the project implementation unit would record an end-of-construction mitigation checklist, before releasing the final payment of any work contract.

In addition to that GMRL shall develop and establish Safety, Health and Environmental (SHE) Policy and Procedures and that should become an integral part of contract document.

Operational phase mitigation would involve good environmental sanitation (housekeeping) practice at metro establishments including effective solid waste collection and disposal, wastewater disposal, upkeep of the plantations and green area. During the operation period, the metro operating unit will be required to confirm receipt of the construction period mitigation report through the GMRL and prepare and follow on timetable of corrective actions including for any incidents.

**Table 9-1 ESMP**

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
<b>Design Phase</b>				
1.	Visual intrusion	<ul style="list-style-type: none"> <li>Design aesthetic structures of viaduct and stations to minimize visual intrusion.</li> </ul>	DDC	GMRL
2.	Flood Protection	<ul style="list-style-type: none"> <li>Rainwater harvesting structures to be provided along the alignment, at stations locations and within the depot area.</li> <li>The DDC will analyse flood data and propose appropriate flood mitigation measures particularly at interfaces points and thresholds between proposed grade levels, stations and ancillary facilities.</li> </ul>	DDC	GMRL
3.	Disadvantaged and Vulnerable Person	<ul style="list-style-type: none"> <li>The DDC should consider universal accessibility features in design, including gently sloped ramps with gradient of 1:12 for wheelchair users, provisions of lifts and escalators for PWD, tactile paving to guide visually impaired individuals, and a public address system to assist all users particular the visually impaired.</li> </ul>	DDC	GMRL
4.	Light and Shadow	<ul style="list-style-type: none"> <li>Key design measures to be considered during DDC stage include optimization of structural heights, architectural integration, , landscape design, etc. in consultation with concerned public authorities including fire and town planning departments.</li> <li>During the DDC stage, appropriate setback distances to be integrated into the design to ensure adequate natural lighting, ventilation, minimise noise intrusion, facilitate access for fire and emergency vehicles, and enhance overall safety.</li> <li>Shadow and wind analysis will be conducted during the DDC stage to evaluate shadow impacts, optimize the use of natural light and ensure proper ventilation and airflow.</li> </ul>	DDC	GMRL
5.	Traffic Management	<ul style="list-style-type: none"> <li>The DDC will propose appropriate conceptual traffic diversions plans within construction zones to ensure smooth traffic operations and the safety of both construction workers and road users.</li> <li>During the DDC stage, widening of footpaths at metro stations and the provisions of designated pedestrian zones shall be proposed to minimize conflicts with passersby. Separate vehicle bays shall be planned to ensure safe drop-off and pick-up, thereby preventing pedestrian-vehicle conflicts. The design shall ensure no disturbance to pedestrian movement through footpaths and parking.</li> </ul>	DDC	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
6.	Green Buildings	<ul style="list-style-type: none"> <li>All stations and depot buildings will be designed as green buildings as per IGBC rating system.</li> </ul>	DDC	GMRL
7.	Energy & Water Efficiency	<ul style="list-style-type: none"> <li>During DDC stage, the integration of energy and water efficient systems will be planned.</li> <li>Wherever feasible, permeable pavement shall be incorporated into the design for access roads leading to stations, depots and service areas to facilitate water infiltration.</li> <li>Wherever feasible, incorporation of renewable energy sources such as solar panels with anti-reflective coatings at stations and depot.</li> </ul>	DDC	GMRL
8.	Impact on residential and commercial establishments	<ul style="list-style-type: none"> <li>During DDC stage, the alignment are/will be refined to mitigate or minimize social impacts associated with the viaduct and station locations.</li> </ul>	DDC	GMRL
9.	Noise and Vibration	<ul style="list-style-type: none"> <li>During DDC stage, the alignment will be refined to mitigate or minimize E&amp;S impacts associated with the viaduct and station locations.</li> <li>Dynamic analysis should be carried out by DDC to assess and mitigate the effects of dynamic forces generated by moving trains, wind and other external factors.</li> <li>Lower vibration levels will be achieved by incorporating bolster-less bogies equipped with secondary air springs.</li> <li>To prevent the development of surface irregularities on the rails, a heavy rail section of 60 kg/m (90 UTS) supported at 60 cms intervals to be incorporated into design.</li> </ul>	DDC	GMRL
10.	Loss of trees and water bodies	<ul style="list-style-type: none"> <li>Alignment will be refined to avoid or minimize impacts on trees and water bodies.</li> <li>The design of the temporary on-site drainage system will be undertaken during DDC stage prior to the commencement of construction.</li> <li>During the detailed design stage, GMRL shall explore the possibility to avoid pillar placement within the pond. If unavoidable, pillars shall be placed only along the outer edge to minimize any impact on water spread.</li> <li>To mitigate impacts on the pond, a ramp will be constructed prior to pillar and viaduct works in the pond area, serving as a barricade against project activities.</li> <li>The depot should be designed to minimize tree removal and preserve existing trees to the extent possible.</li> </ul>	DDC	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>A temporary on-site drainage system will be constructed prior to the commencement of construction, particularly planned during the lean season when the pond's water level is minimal</li> </ul>		
11.	Management of Pigeons	<ul style="list-style-type: none"> <li>DDC should design in consultation with a qualified ecological expert.</li> <li>Potential pigeon nesting locations will be closed or covered.</li> <li>To deter pigeons at stations areas, structural design modifications such as slanted surfaces on windowpanes and other beam structures of metro station can be incorporated.</li> <li>Identification and planning of netting areas at metro station.</li> <li>Planning for deterrents like anti-bird spikes.</li> </ul>	DDC	GMRL
12.	Safety of Structures	<ul style="list-style-type: none"> <li>Design provisions to ensure structural safety against earthquakes, fire, etc. will be done in accordance with IS codes &amp; other standards.</li> </ul>	DDC	GMRL
13.	Cultural Heritage	<ul style="list-style-type: none"> <li>There is one temple which is located within the RoW. During the DDC stage, the alignment will be refined to avoid any impact on this temple.</li> <li>If avoidance is not feasible, the temple will be reconstructed in a culturally and socially acceptable appropriate manner with coordination and participation of the local communities and other concerned stakeholders.</li> </ul>	DDC	GMRL
14.	Access points to Establishments	<ul style="list-style-type: none"> <li>DDC will assess the feasibility of station entry/exit locations and other project facilities.</li> <li>Permanent structures planned for the project must be designed to ensure that they do not obstruct access to residential, commercial, and community establishments.</li> <li>Platform Screen Door (PSD) to be considered in design phase.</li> </ul>	DDC	GMRL
15.	Parking Space	<ul style="list-style-type: none"> <li>GMRL will assess and plan the parking requirements based on projected demand and land availability for the development of designated parking area.</li> </ul>	DDC	GMRL
16.	Last-mile connectivity	<ul style="list-style-type: none"> <li>GMRL will plan to allocate designated spaces for autos, taxis, e-rickshaws and other modes of transport to facilitate efficient last mile connectivity.</li> </ul>	DDC	GMRL
17.	Risk of exclusion of Households in design phase	<ul style="list-style-type: none"> <li>Undertake consultations in accordance with the SEP.</li> <li>Special attention for ensuring the inclusion of vulnerable groups in project benefits, with continuous stakeholder engagement to promote and sustain such inclusion.</li> </ul>	DDC	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
18.	Accident, breakdown or failure of Metro	<ul style="list-style-type: none"> <li>Alarm systems should be integrated into the design of metro coaches and stations for emergency preparedness.</li> </ul>	DDC	GMRL
19.	Gender-Based Violence	<ul style="list-style-type: none"> <li>Gender-sensitive design features such as well-lit stations, information booths, police presence, safe and accessible feeder transportation, etc. should be incorporated at the design stage to proactively address and minimize risks related to SEA/SH.</li> <li>Additional provisions may include Sanitary Pad Vending Machines, Transparent Elevators, Gender Neutral Toilets, Dedicated Women Coaches and App for Online Complaint.</li> </ul>	DDC	GMRL
<b>Pre-Construction Phase</b>				
1.	ESMP Implementation	<p>The Contractor will prepare the Environment, Health &amp; Safety Manual covering following site-specific management plans:</p> <ul style="list-style-type: none"> <li>Occupational Health and Safety Management Plan (OHSMP)</li> <li>Borrow Area Management Plan (with locations of borrow sites and licenses obtained from the Mines and Minerals department)</li> <li>Community Health and Safety Management Plan</li> <li>Camp Management Plan (with location map and design of camp facilities)</li> <li>Waste Management Plan (with locations of waste disposal sites and details of waste contractors, maximizing recycling efforts.) It will include SOPs/ Plan for segregation of waste at source, segregated storage, collection, transportation, treatment &amp; disposal of wastes, slurry, sludge of different types for Construction &amp; O&amp;M stages</li> <li>Wastewater Discharges Management Plan (with locations and designs of wastewater treatment plants)</li> <li>Traffic Management Plan</li> <li>Training Plan for ESHS risks including HIV/AIDS, GBV and SEA/SH</li> <li>Grievance Mechanism for Workers</li> <li>Demobilization Plan (to be implemented upon completion of works)</li> <li>Stormwater Management Plan</li> <li>Emergency Preparedness and Response Plan</li> <li>GBV Code of Conduct</li> <li>Labour Influx Management Plan</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
2.	Mobilization of ESHS staff	<ul style="list-style-type: none"> <li>• Qualified and experienced ESHS specialists should be deployed at site throughout the construction period.</li> <li>• Implementation of ESMP, including OHSMP, by the ESHS Staff.</li> <li>• Daily monitoring and preparation of monthly reports.</li> </ul>	Contractor	GMRL
3.	Consents/ Permits/ Approvals/ Compliances	<ul style="list-style-type: none"> <li>• The Contractor must obtain permissions for all construction activities such as establishing and operating batching/ hot-mix plants/ labour camps, PUCs, labour licenses, tree cutting permissions, (and all other permits, clearances as applicable) etc.</li> </ul>	Contractor	GMRL
		<ul style="list-style-type: none"> <li>• Forest clearance will be obtained from forest department for urban forest located at Sector-10 Metro Station.</li> </ul>	GMRL	GMRL
4.	Flood Protection	<ul style="list-style-type: none"> <li>• The Contractor will develop a comprehensive stormwater management plan, integrating it with the overall construction schedule.</li> </ul>	Contractor	GMRL
5.	Vibration	<ul style="list-style-type: none"> <li>• Detailed geotechnical investigation should be carried out prior to construction.</li> <li>• Vibration impact study shall be carried out during the construction phase based on detailed geotechnical investigations.</li> </ul>	Contractor	GMRL
6.	Loss of Land, Structures, livelihood	<ul style="list-style-type: none"> <li>• Land will be purchased in accordance with the GMRL Policy for Direct Purchase of Private Land/Property through Mutual Negotiations.</li> <li>• Compensation will be paid for the loss of land, structures, livelihood, and other assets. GMRL will ensure that compensation is paid before in full prior to taking possession of the land.</li> <li>• RAP is prepared in line with the RFCTLARR Act, 2013 and WB ESS5 and will be implemented by RAP Support Agency.</li> <li>• RAP is addressing issues associated with physical and economic displacement, loss of community infrastructure and other assets.</li> <li>• A GM will be established by GMRL to allow affected persons to raise concerns related to displacement and other impacts.</li> <li>• Information related to all project activities will be disclosed to affected communities in a transparent and timely manner.</li> <li>• RAP implementation will be monitored until a point whereby it can be demonstrated that the standard of living and livelihoods of displaced households have been at least</li> </ul>	GMRL/ RAP Implementing Agency	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		restored if not improved. Where required, corrective actions will be taken to achieve this outcome.		
7.	Engagement and information disclosure	Project affected persons, other interested parties, and vulnerable groups will be engaged, informed about the project, and their views, suggestions, and grievances will be recorded and addressed. Consultations will be conducted to solicit suggestions on planning and implementing measures to manage risks and impacts associated with project activities during both construction and operation phases.	GMRL	GMRL
8.	Loss of trees	<p>A Compensatory Afforestation Plan will be prepared including establishing nurseries, identifying locations for green belt development, plan for care and maintenance of planted saplings, etc.</p> <p>Approximately 1,660 trees are likely to be affected, which includes 1401 trees along the alignment and 259 trees at depot area.</p> <p><b>Monitoring Frequency:</b> Four times in a year for entire construction period.</p>	Forest Department	GMRL
9.	Site Selection & Set up of Storage Yard, Labour Camps	<p>Identification of suitable land for setting up a storage yard and labour camp.</p> <p>It should be ensured that the selected sites for the labour camp and storage yard are located at a safe distance from residential areas, water bodies, wetlands, forests, schools, hospitals, commercial establishments, heritage sites, etc.</p>	GMRL/ Contractor	GMRL
10.	Site measures	Prepare an Environment, Health and Safety (EHS) Manual and ensure its implementation arrangements.	Contractor	GMRL
11.	Environmental Management and Monitoring	Set up of Environment and Social Monitoring unit	GMRL	GMRL
<b>Construction Phase</b>				
1.	Soil Erosion	<p>Implementation of suitable construction methods as per EHS Manual.</p> <ul style="list-style-type: none"> <li>Prior to the commencement of construction activities, the Contractor will submit schedules to GMRL for carrying out temporary and permanent erosion/sedimentation control works, as applicable to clearing and grubbing, roadway and drainage excavation, embankment/sub-grade construction, pavement courses and shoulder works.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• The Contractor will submit the proposed methodology for erosion and sedimentation control and a plan for the disposal of waste soil.</li> <li>• Careful planning, timing of cut and fill operations, use of geotextiles or other suitable measures, and re-vegetation practices will be adopted to reduce the soil erosion and dust generation.</li> <li>• The Contractor will be required to incorporate all permanent erosion and sedimentation control features into the project at the earliest practicable time, as outlined in the accepted schedule, to minimize reliance on temporary control measures.</li> <li>• Daily visual inspections should be conducted by the contractor in coordination with and in the presence GC.</li> <li>• Temporary erosion, sedimentation and pollution resulting from the Contractor's negligence, carelessness, or failure to implement control measures will be rectified at the Contractor's own expense, as a part of the work as scheduled or ordered by the GMRL.</li> <li>• Temporary erosion, sedimentation and pollution control works not attributed to the Contractor's negligence, carelessness or failure to install permanent controls, will be performed as ordered by the GMRL.</li> <li>• Topsoil if present, will be stripped from constructional areas and stockpiled for reuse in landscaping and restoration activities.</li> <li>• All roads and working areas will be kept clean during &amp; after works, free from soil, sand, aggregates, tools, materials, equipment.</li> <li>• Batching plants will be located away from construction site and human settlements.</li> <li>• Contractor should submit the details to GMRL in accordance with <b>Annexure 9.9</b> of this document.</li> </ul>		
2.	Flood Protection	<ul style="list-style-type: none"> <li>• Installation of temporary drainage system to divert stormwater away from construction sites.</li> <li>• Sediment barriers will be installed at stockpile locations to prevent erosion and runoff of excavated material.</li> <li>• An adequate drainage system will be provided to prevent flooding in excavated areas.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• Proper grading and sloping will be ensured to facilitate proper water flow and minimize waterlogging.</li> <li>• A Stormwater Management Plan will be prepared for construction yards and labour camps.</li> <li>• Portable pumps for removal stagnant water from critical areas during heavy rainfall.</li> <li>• Temporary flood protection measures such as sandbags or water-filled barriers will be employed to protect construction sites.</li> <li>• Regular inspections and maintenance of temporary drainage systems and erosion control measures.</li> <li>• Drainage systems will be regularly maintained and cleaner to prevent blockages and ensure efficient water discharge flow.</li> <li>• In the event of submerged areas or access paths, appropriate measures will be taken to ensure safe movement of pedestrians, avoiding the need to walk through muddy or flooded areas.</li> </ul>		
3.	Waterbodies	<ul style="list-style-type: none"> <li>• KBA/IBA in Sector 101: Conduct an Integrated Biodiversity Assessment (with critical habitat assessment) to prepare a biodiversity management plan and bird friendly design guidelines for implementation.</li> <li>• Basai Pond: The construction site shall be isolated using protective sheeting, earth bunds, or sandbag barriers to prevent sediment runoff into the pond. <ul style="list-style-type: none"> <li>• Regular water quality monitoring shall be carried out during the construction phase.</li> <li>• Geo-textile sediment fences shall be used to control the entry of sediment into the waterbody.</li> <li>• The contractor shall strictly prohibit the disposal of solid or construction waste into the pond.</li> <li>• Site grading shall be designed so that runoff water flows away from the pond.</li> <li>• The contractor shall coordinate with utility agencies, maintain quick response teams, and pre-identification of sensitive areas to manage emergencies effectively.</li> </ul> </li> <li>•</li> </ul>	GMRL Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• Runoff water from the construction site should be prevented from entering nearby waterbodies by preparing appropriate site slopes and diversion channels directed away from these sensitive areas.</li> <li>• The Contractor will take adequate protective measures to ensure that excavation activities do not affect or damage any waterbodies.</li> <li>• Stockpiles will not be provided near waterbodies. In cases where stockpiling near waterbodies is unavoidable, silt fencing and diversion channels will be provided around the stockpiles to direct runoff and sediments away from the sensitive areas.</li> <li>• Construction materials containing fine particles will be stored within enclosed areas to prevent sediment-laden water from draining into nearby watercourses.</li> <li>• Regular monitoring of waterbodies will be carried out and all applicable discharge standards under the Environmental Protection Act, 1986, and its amendments or any other rules, acts or directions (including those issued by courts by courts or NGT), will be strictly followed by the Contractor.</li> <li>• All solid and liquid waste generated from the construction site will be disposed of in an acceptable manner.</li> </ul>		
4.	Utility Shifting	<ul style="list-style-type: none"> <li>• The Contractor will ensure that all utility services remain operational throughout the construction period and after the project is completed. All proposals should ensure the uninterrupted functioning of these services.</li> <li>• The contractor will plan any required utility shifting in coordination with the respective utility providers and users, preferably during dry weather conditions. Alternate arrangements and information dissemination to users will be ensured by the utility provider.</li> <li>• In case major of changes in design EMP shall be updated</li> <li>• Due care will be taken during the construction phase to ensure that no utilities are damaged by project activities. Any accidental damage will be rectified immediately. Temporary access routes will be provided to the establishments where access is obstructed due to construction.</li> <li>• Utilities that may be affected by construction activities will be properly cordoned off to prevent any potential damage.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• Proper barricading and informative signboards will be installed around these utilities during construction activities.</li> <li>• The construction work schedule will be shared in advance with concerned line departments (e.g., water supply, electricity, roads, transport) and affected communities to ensure continuity of essential services.</li> <li>• For any utility shifting, the Contractor will comply with the terms and conditions stipulated by the respective utility authorities.</li> <li>• All excavation works will be safely closed immediately after the completion of activities or upon the departure of workers from the site. Excavated areas will be secured with hard barricading to prevent the entry of pedestrians or vehicles and to avoid accidents.</li> <li>• All necessary utility provisions shall be made, and necessary NOCs will be obtained from the respective utility authorities. The Contractor will provide necessary assistance to these authorities for effective utility management.</li> </ul>		
5.	Traffic Diversion/Management	<ul style="list-style-type: none"> <li>• A Traffic Diversion and Management Plan will be developed and implemented to minimize congestion. This will include measures such as proposing diversions, creating alternate routes, avoiding school peak hours, enforcing speed limits, and hiring licensed drivers. The plan will focus on ensuring safe access to residential areas and minimizing risks near schools, housing and construction zones. It should be prepared in consultation with Traffic Police Department, Municipal Authorities and other relevant stakeholders.</li> <li>• Necessary traffic management measures such as road widening, traffic segregation, one-way movements, traffic diversions and acquisition of service lanes will be implemented as required.</li> <li>• Surrounding roads will be widened to ensure smooth commuter access and traffic flow.</li> <li>• Within work zones, the use of primary traffic control devices will be essential for ensuring safety and effective traffic direction. These devices will include road signage, delineators, hard barricades, cones, pylons, pavement markings, flashing lights, reflectors and full day/night lighting. Large information boards will be placed at least</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<p>200m on both sides of work zones to provide advance guidance to approaching vehicles.</p> <ul style="list-style-type: none"> <li>• Common assembly points will be earmarked at construction sites, labour camps, temporary offices, etc.</li> <li>• Safety and movement of all workers and local communities will be ensured throughout the construction period. All pits within work zones will be promptly closed upon the completion of related works. Where temporary closures are necessary, strong and stable barricades will be installed to prevent collapse and ensure safety for both pedestrians and vehicles.</li> <li>• Traffic marshals will be deployed as required by the traffic department.</li> <li>• A transportation consultant will be engaged to conduct traffic surveys and recommend alternative routes to ensure smooth traffic flow during construction.</li> <li>• All construction workers will be provided with high-visibility jackets with reflective tapes. Additionally, all work areas shall be adequately illuminated at all times both during the day and at night to ensure visibility and safety</li> <li>• Necessary permissions from traffic department, Gurugram, must be obtained. Detailed information regarding barricade locations, enclosed area dimensions, and estimated work durations will be submitted to secure the required approvals.</li> <li>• Drivers engaged in project activities will undergo defensive driving training, hold valid driving licences and trained in handling construction work related traffic operations. Drivers will not be permitted to operate vehicles under the influence of intoxicants and will be provided with adequate rest periods to ensure safe driving practices.</li> </ul>		
6.	Dark Spots	<ul style="list-style-type: none"> <li>• To avoid any safety hazards, adequate lighting will be provided at construction sites. All barricades will be fitted with continuous reflectors that remain clearly visible at all times both day and night.</li> <li>• No pit or work area will be left unlit or poorly illuminated under any circumstances.</li> </ul>	Contractor	GMRL
7.	Child Labour	<ul style="list-style-type: none"> <li>• Workers under the age of 18 years will not be permitted to engage in any project related activities.</li> <li>• Contractual provisions will include clauses to ensure compliance with the minimum age requirement along with penalties for any non-compliance.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• A labour registry of all contracted workers will be maintained with page verification documentation.</li> </ul>		
8.	Labour Influx	<ul style="list-style-type: none"> <li>• Unskilled labour will be recruited from local communities for basic tasks such as excavation, levelling, cleaning, loading/unloading materials, site watering, etc.</li> <li>• All workers will be required to sign and adhere to the safety protocols and a code of conduct addressing the risk of GBV/SH.</li> <li>• Training sessions will be conducted with a focus on expected behaviour, local norms, and raising awareness about GBV/SH.</li> <li>• The LMP, including an accessible Grievance Mechanism, will be implemented in full.</li> </ul>	Contractor	GMRL
9.	Labour camps	<ul style="list-style-type: none"> <li>• Essential facilities will be provided to workers, including liveable accommodation that remains safe and secure in all conditions, including during inclement weather. Proper water supply and sanitation arrangements will be ensured so that neither workers' nor nearby communities' health is impacted. Additional provisions will include first-aid boxes, clean drinking water, separate latrine/bathing/washing facilities for male and female workers with water available at all times, proper drainage systems to prevent stagnation, temporary living accommodations, and childcare rooms, all in line with applicable regulatory standards.</li> <li>• Labor camps will be constructed only after receiving approval of the proposed layout and arrangements from the Authority Engineer/GMRL.</li> <li>• Firewood usage in labour camps will be prohibited. As far as possible, a common kitchen or canteen facility will be provided to eliminate the need for individual room cooking.</li> <li>• LPG cylinders will be supplied at labour camps, along with firefighting equipment and safety measures.</li> <li>• The contractor will ensure that all workers sign CoC. Daily toolbox talks will be conducted each morning, including reminders of dos and don'ts as outlined in the CoC.</li> <li>• Regular site inspection, health check-ups and sensitization sessions will be organised for workers</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• Regular awareness camps and workshops on GBV, STDs (HIV/AIDS), and GM will be conducted.</li> <li>• Regulated movement of the workers to and from work site.</li> <li>• Fire extinguishers, first-aid kits and emergency contact numbers will be installed at strategic locations within the camps areas.</li> <li>• Legal register for project will be formulated and implemented.</li> <li>• Regular anti-dengue and anti-malaria spraying and fogging will be carried out at the worksite and nearby settlements.</li> <li>• Written permissions for construction-related activities will be obtained from all relevant regulatory and statutory authorities.</li> <li>• There will be no water, waste, or wastewater stagnation at or around the camps. Hygienic conditions will be ensured and consistently maintained until project completion or camp closure.</li> <li>• SOP will be developed for various activities, including training, PPE usage, permission request templates, incident recording and reporting, etc.</li> <li>• IEC materials will be prominently displayed at construction sites to raise awareness.</li> <li>• (Labour management plan, Incident management plan, Emergency preparedness plan, Waste management plan, Hazardous management plan)</li> <li>• BOCWA guidelines and WB EHS will be followed for labour camps.</li> <li>• Separate toilets will be provided for female workers and any support staff such as cooks, if hired. In cases where female workers are accommodated outside the labour camps (e.g., in nearby villages), GBV awareness posters will be displayed, and engagement meetings with the local communities will be conducted.</li> </ul>		
10.	Occupational Health & Safety	<ul style="list-style-type: none"> <li>• Comply with OHS aspects of various labour related acts of India, WB EHS and OHS Guidelines. All high energy hazards will be identified, and critical control measures will be implemented to prevent serious injuries and fatalities. The OHS management plan will form part of the EMP</li> <li>• A work permit mechanism will be implemented for specialized tasks.</li> <li>• Measures will be adopted to minimize fugitive dust emissions during construction activities such as excavation, grading, waste disposal and land clearing.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• An EHS supervisor will be engaged during conduction activities.</li> <li>• An EHS Plan will be prepared and implemented, with approval from GMRL. The plan will include measures such as:                             <ul style="list-style-type: none"> <li>a. Restricting public/unauthorized access to worksites;</li> <li>b. Ensuring that all workers are provided with and use PPE (reflectorized vests, footwear, gloves, goggles and masks);</li> <li>c. Providing (H&amp;S) training for construction personnel;</li> <li>d. Documenting standard procedures for all site activities;</li> <li>e. Maintaining records of accident and incident.</li> </ul> </li> <li>• Work at height will be properly planned, supervised and carried out with adequate provisions for emergencies and rescue. Safety nets and harnesses will be mandatory for all work conducted at height over 2m.</li> <li>• SOP will be developed and followed for all construction related activities.</li> <li>• Training sessions will be organized for workers on prevention and treatment of scorpion and snake bites. Anti-venom supplies will be kept onsite or at the nearest healthcare facility.</li> <li>• All workers will be required to wear PPE while on duty.</li> <li>• Steel scaffolding will be tagged and inspected weekly by a qualified engineer. Working platforms for height work will be a minimum of 400 mm wide.</li> <li>• Electrical distribution boards will be installed within closed sheds to prevent exposure to dust and water. CO<sub>2</sub> fire extinguishers will be placed outside these sheds for use in electrical emergencies.</li> <li>• Lifelines will be provided at slab edges, and worker will be required to wear safety harnesses while working at heights.</li> <li>• Ladders of appropriate length will be provided to ensure safe access to elevated work areas.</li> <li>• Safety posters must be prominently displayed across the site to promote a safety culture.</li> <li>• Labour camps will undergo regular cleaning, inspection, and sensitization drives.</li> </ul>		

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• Emergency contact details (police, fire, ambulance, hospital, security, and forest department) will be displayed at multiple prominent locations in languages understood by all workers. Workers will be trained to use these resources when necessary.</li> <li>• Electrical wiring will be regularly inspected. Smaller switches with rain protection covers will be installed to reduce the risk of electrical short circuits.</li> <li>• Housekeeping practices will be maintained, with materials neatly stacked, labelled and records of housekeeping activities kept up to date.</li> <li>• There should be no accumulation of solid, construction, or hazardous waste at the site. A comprehensive waste management plan will be implemented for collection, treatment, and disposal in line with local regulations and SPCB guidelines.</li> <li>• Rest areas with shade, clean drinking water, and sanitation facilities will be provided.</li> <li>• Medical emergency facilities will be arranged, including paramedical staff, first aid, isolation centers (for COVID-19 or other contagious illnesses), ambulance services, and tie-ups with nearby government or private hospitals for emergency care.</li> <li>• The contractor will tie up with nearby hospitals and submit the list to GMRL.</li> <li>• An Internal Complaints Committee (ICC) will be formed by the contractor, in accordance with statutory norms.</li> <li>• The contractor will maintain registers for attendance, wage payments, overtime, penalties, incidents, and accidents to ensure transparency, compliance with labour laws and to maintain transparency and accountability in site safety and labour management.</li> <li>• The Contractor will submit the required data and documentation as per <b>Annexure-9.4 &amp; 9.5</b>.</li> <li>• SOP will be developed for various activities, including training, PPE usage, permission request templates, and recording and reporting, etc.</li> </ul>		
11.	Dust from Construction/Demolition	<p>Implementation of suitable construction methods will be carried out in accordance with EHS Manual.</p> <ul style="list-style-type: none"> <li>• Water sprays or dust suppressants will be used to minimize dust levels.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• Construction materials will be covered with green nets to prevent dust from blowing away.</li> <li>• Material and waste storage areas, as well as transport vehicles, will be covered to prevent waste from getting eroded/carried away by air, rain, flood, etc.</li> <li>• Dust accumulation along service lanes will be minimized through toe dust cleaning, regular water sprinkling and enforcement of vehicle speed restriction.</li> <li>• Awareness will be raised among nearby communities to adopt safe practices, such as keeping windows and doors closed during high dust emissions.</li> <li>• The contractor will submit the details to the GMRL as per <b>Annexure 9.9</b> of this document.</li> </ul>		
12.	Muck disposal	<p>Implementation of suitable construction methods will be carried out in accordance with EHS Manual.</p> <ul style="list-style-type: none"> <li>• The contractor will dispose off the muck/dry soil generated at construction sites at a location mutually agreed upon by GMRL.</li> <li>• Reconciliation of the disposed soil will be carried out by the contractor, and the quantity will be submitted to GMRL on a quarterly basis.</li> <li>• Dry wheel wash facilities will be installed at the exit gates from where soil disposal takes place.</li> <li>• Sufficient staff will be deployed at the site for effective muck/soil disposal, including a supervisor, labours for wheel cleaning, brooms, and a concrete pad with proper drainage for wheel washing.</li> <li>• Dumpers transporting muck/dry soil must be covered while moving on roads to the designated disposal locations.</li> <li>• The contractor will ensure that muck generated during piling activities is not contaminated with any hazardous substances.</li> <li>• Onsite muck will be monitored quarterly at random locations during piling works. If any contaminated muck is identified, it will be handled and disposed of in accordance with the Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016 and subsequent amendments.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>The contractor will submit all relevant details to the GMRL as per <b>Annexure 8.2</b> of this document.</li> </ul>		
13.	Supply and Storage of Construction Material	<ul style="list-style-type: none"> <li>Procedures for the storage, handling, transport, and reuse of construction materials will be outlined in the EHS Guidelines.</li> <li>The SHE Policy should be prepared in line with WB ESS guidelines and National regulations.</li> <li>The contractor will monitor all aspects of construction activities, commencing with the storage and loading of construction materials and equipment.</li> <li>The scheduling of material procurement and transport will be linked with the overall construction schedule of the project.</li> <li>The construction materials should be tested in the Government labs or Government approved labs to ensure their quality prior to use.</li> <li>Construction materials will be stored away from waterbodies to prevent contamination, including during flooding or heavy rainfall events, etc.</li> <li>Stormwater runoff will be properly managed and treated to prevent pollutants from entering nearby water bodies.</li> <li>Wheel-washing facilities will be installed at the exit points of all construction sites and batching plants to prevent soil and debris from being transported outside the site.</li> <li>The Contractor will be responsible for management of construction materials throughout the project lifecycle and will ensure sufficient material quantities and quality tested in approved labs before their usage.</li> </ul>	Contractor	GMRL
14.	Pre-casting yards and Material stockpiling	<ul style="list-style-type: none"> <li>The construction yard will be away from any settlements and notified area such as national park, reserved forests, etc.</li> <li>Proper and safe stacking of materials will be a priority at all construction yards, storage areas and related facilities. The storage area will be systematically planned with adequate access routes, and all materials will be stored or stacked in an organized and secure manner to ensure safety and ease of use.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
15.	Air Pollution	<ul style="list-style-type: none"> <li>• All vehicles and machinery used for construction works will be regularly maintained to comply with emission standards. Periodic inspections will be conducted, and all necessary permits will be renewed as required.</li> <li>• All materials that generate dust during transportation will be adequately covered. Trucks will maintain sufficient freeboard to prevent material spills during transit.</li> <li>• Barriers will be installed around construction sites prior to the commencement of any work.</li> <li>• All vehicles deployed for works will possess valid PUC certificates and will undergo regular checks to ensure compliance with applicable local regulations.</li> <li>• Dust control measures such as water sprinklers, dust screens, etc. will be implemented and continue even during work stoppages or public holidays.</li> <li>• Wash pit or wheel washing or vehicle cleaning facilities will be established at all construction yards, depots and batching plants.</li> <li>• Temporary storage areas will be maintained by the contractor within well-barricaded and illuminated areas. Adequate pollution prevention measures will be implemented until the excavated material is re-utilized for backfilling wherever necessary or as directed by GMRL.</li> <li>• The contractor will submit relevant details to the GMRL as per <b>Annexure 9.1, 9.3, 9.6, and 9.10</b> of this document.</li> </ul>	Contractor	GMRL
		Air Quality Monitoring: 24 hourly monitoring for 2 days, twice in a month at six locations for each package (2 packages for entire corridor)	Contractor	GMRL
16.	Noise Pollution	<ul style="list-style-type: none"> <li>• Periodic check of machinery and vehicles will be performed. Physical barriers will be installed at bulk loading and unloading areas. Machinery will be equipped with noise mufflers and workers will be provided with PPE.</li> <li>• Temporary walls will be erected around elevated station sites and other construction zones, as necessary.</li> <li>• Noise barriers will be installed along construction boundaries, especially near sensitive receptors such as bird nesting or ecological areas, schools, hospitals, religious places, etc.</li> <li>• Truck drivers and equipment operators will minimize the use of horns.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>All construction equipment and vehicles will be fitted with appropriate noise suppression devices, consistent with applicable national and local regulations.</li> <li>Noise from loading and unloading construction materials will be minimized by using cranes and placing materials on sand beds or sandbags to absorb impact.</li> <li>The Contractor should ensure that the work scheduling will be done in such a way that the work with heavy noise will be carried out during daytime and with low noise at nighttime.</li> <li>Ballast-less tracks with elastic and absorbent fittings will be used to reduce rail related noise.</li> <li>The contractor will submit the relevant details to the GMRL as per <b>Annexure 9.1, 9.3, 9.6 and 9.10</b> of this document.</li> </ul>		
17.	Vibration	<ul style="list-style-type: none"> <li>Vibration monitoring and building condition surveys will be conducted at sensitive structures.</li> <li>Information regarding the construction methodology, probable effects, quality control measures and safety precautions will be disseminated to nearby communities.</li> <li>Residents of buildings located close to metro rail alignment will be informed about potential vibration-related effects and the precautions being undertaken.</li> <li>The contractor will submit the relevant details to the GMRL as per <b>Annexure 9.7</b> of this document.</li> </ul> <p>Vibration Monitoring: 24 hourly monitoring for 2 days, twice in a month at six locations for each package (2 packages for entire corridor)</p>	Contractor	GMRL
18.	Management of Solid Waste	<ul style="list-style-type: none"> <li>The contractor will prepare a waste management plan and submit it to the project authority for concurrence.</li> <li>Biodegradable waste generated at labour camps and construction sites will be segregated at the source and handed over to the ULB for appropriate treatment and disposal.</li> <li>Non-biodegradable waste will be handed over to authorized recyclers.</li> <li>No spillage of waste will be permitted during transportation.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>Garbage will be covered in containers, which will be cleaned daily to prevent unhygienic conditions.</li> <li>The contractor will dispose-off non-hazardous solid waste, non-hazardous liquid waste and biomedical waste in accordance with national regulations.</li> <li>Solid Waste will be managed and disposed of in compliance with the Solid Waste Rules, 2016 and its subsequent amendments.</li> </ul>		
19.	Management of Construction & Demolition Waste	<ul style="list-style-type: none"> <li>C&amp;D Waste will be managed in accordance with the provisions of C&amp;D Waste Management Rules, 2016 and its subsequent amendments.</li> <li>C&amp;D waste will not be mixed with other types of waste and will be disposed of separately.</li> <li>All generated C&amp;D waste will be collected at a designated location and stored in a segregated manner based on its potential for reuse or recycling.</li> <li>The waste will be transported and disposed of at an authorised C&amp;D waste processing facility.</li> <li>The contractor will submit relevant details to the GMRL as per <b>Annexure 9.9</b> of this document.</li> </ul>	Contractor	GMRL
20.	Management of Plastic Waste	<ul style="list-style-type: none"> <li>The contractor will prepare a waste management plan and submit it to the project authority for concurrence.</li> <li>Source segregation of plastic waste will be carried out based on its recyclability.</li> <li>Plastic waste generated at the site will be handed over to authorized vendors in compliance with the Plastic Waste Management Rules, 2016 and its subsequent amendments.</li> <li>The contractor will submit the relevant details to the GMRL as per <b>Annexure 9.9</b> of this document.</li> </ul>	Contractor	GMRL
21.	Generation of Hazardous Waste	<ul style="list-style-type: none"> <li>The Contractor will develop a plan for the management of hazardous waste.</li> <li>If asbestos is encountered during utility shifting or demolition activities, it will be handled in accordance with a SOP prepared and approved by the GMRL/AE.</li> <li>The contractor will engage only authorized recyclers for the treatment and disposal of Hazardous Waste, under intimation to the GMRL.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• Hazardous waste will be disposed of in accordance with the provisions of the Hazardous and Other Wastes (Management and Trans Boundary Movement) Rules, 2016 and its subsequent amendments.</li> <li>• The contractor will ensure that hazardous and other wastes are properly labelled, recorded, and stored in impermeable containment for a period not exceeding 90 days, and in a manner suitable for safe handling, storage and transportation.</li> <li>• A record of sale, transfer manifests, and storage of such waste will be maintained and made available for inspection upon request.</li> <li>• In the event of any accident occurring at the contractor’s facility involving hazardous or other wastes, the contractor will take immediate measures to safeguard personnel and property and promptly notify the State Pollution Control Board via telephone and email and subsequently submit a report in Form 11.</li> </ul>		
22.	Water Supply and Sanitation	<ul style="list-style-type: none"> <li>• Arrangements for water supply will be made in accordance with national regulations and the ESF/EHS Manual.</li> <li>• The water requirement for the project will be met through treated water from STPs and municipal supply.</li> <li>• The Contractor will provide essential facilities at labour camps, including access to uncontaminated water for drinking, cooking, washing, latrines and urinals; clean and sufficient bathing and washing areas; and a proper system for the conveyance, treatment, and disposal of sewage and solid waste.</li> </ul>	Contractor	GMRL
23.	Community Health and Safety	<ul style="list-style-type: none"> <li>• The contractor will develop and implement a traffic management plan, including traffic diversions, avoiding peak hours (e.g. school times, market activities and religious activities), adherence to speed limits, and the deployment of licensed drivers, etc. The plan will ensure access to residential areas and enhance safety near schools, residential areas and construction zones</li> <li>• Road signage will be installed at appropriate locations to minimize safety hazards associated with project-related traffic.</li> <li>• Work areas will be barricaded and fenced with sturdy materials to restrict unauthorized community access.</li> </ul>	Contractor GMRL	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• Safety barriers will be provided near trenches, and trenches will be covered with planks during non-working hours.</li> <li>• All drivers deployed to project duties will receive defensive driving training.</li> <li>• Adequate signage, barriers and flag persons will be deployed for effective traffic control.</li> <li>• Cautionary signage and work timings will be displayed prominently at work sites.</li> <li>• Sufficient signboards and flagmen will be placed to direct the public away from construction areas.</li> <li>• Awareness programs on CHS will be conducted, including safe road use procedures.</li> <li>• Regular medical check-up camps will be organised near settlements.</li> <li>• Regular vector borne spraying and fogging (e.g., anti-dengue and anti-malaria) will be carried out regularly in settlements near construction areas.</li> <li>• Awareness camps will be conducted on the prevention and control of STIs, communicable and vector-borne diseases.</li> <li>• Community awareness will be undertaken to promote safe practices among residents, including keeping windows and doors closed during dust-generating construction activities to minimize exposure.</li> <li>• Water sprinkling will be carried on access roads and construction sites for dust suppression.</li> <li>• Grievance registers will be maintained at site gates, and contractors and GMRL staff will be trained in effective grievance redressal procedures.</li> <li>• Prior to the commencement of construction works, the contractor will develop a labour management plan that includes provisions for preventing GBV/SEA/SH.</li> <li>• Incidents of GBV/SEA/SH will be reported to the GM setup by GMRL, while maintaining confidentiality of victim/survivor details.</li> <li>• Awareness campaigns will be organized to inform communities especially women and girls about the risks of GBV/SH and reporting mechanisms for project-related incidents.</li> <li>• Disseminate information on how to use the GM to report SEA/SH cases, CoC violations, and support services for GBV/SH victims.</li> </ul>		

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• Construction activities in congested or high-traffic areas will be prioritized for early completion to minimize public inconvenience.</li> <li>• Contractors must use multi gas analysers and detectors to identify volatile materials and prevent safety hazards.</li> <li>• Contractor will develop and enforce a CoC to regulate worker behaviour at the construction sites, camps and within local communities.</li> <li>• CoC will include an awareness program for workers on respecting the local community and its customs.</li> <li>• CoC-related information will be provided in local languages for better understanding.</li> <li>• Cultural sensitization training for workers to ensure respectful interaction with local residents.</li> <li>• Leisure areas will be established within workers' camps to discourage visits to community leisure spots.</li> <li>• Sanctions, including dismissal, will be enforced against workers involved in criminal activities.</li> <li>• Enforcement of laws against drug abuse and human trafficking.</li> <li>• Sensitization camps on illegal behaviours such as prostitution, substance abuse, and GBV will be held for both workers and local communities.</li> <li>• Adequate services and amenities will be provided in workers' camps to avoid dependency on community facilities.</li> <li>• Concerned police stations will be consulted during construction to identify high-risk areas/hotspots for regular patrolling and CCTV surveillance.</li> <li>• Contact details of designated or focal persons will be displayed at prominent locations along the project corridor, including on barricades.</li> <li>• Integrated Pest Management and vector management will be implemented including pest monitoring, eco-friendly control methods and minimal use of chemicals to safeguard public health and the environment.</li> </ul>		
24.	Tree protection/ Cutting and Disposal	<ul style="list-style-type: none"> <li>• Contractor will prepare an action plan for the management of 1,401 trees to be affected by the project. About 14,010 saplings will be planted as per compensatory afforestation norms</li> </ul>	GMRL for Compensatory	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• The tree species proposed for plantation in the project area include Gulmohar, Siris, Neem, Ashoka, Jamun, Desi Badam, Karanj, Amalataash, etc.</li> <li>• No individual or entity, other than the contractor, will be permitted to cut trees identified within the RoW.</li> <li>• Terms and conditions mentioned in the permission for tree cutting will be followed by the contractor</li> <li>• Biomass will not be stored at the construction site for more than 15 days.</li> </ul> <p>Monitoring Frequency: Four times in a Year for entire construction period</p>	Afforestation; and Contractor	
25.	Cultural Heritage	<ul style="list-style-type: none"> <li>• Chance finds: In the event of any chance finds during construction, GMRL and the contractors will apply measures in accordance with Indian Treasure Trove Act, 1878. The concerned authorities will be informed at the earliest.</li> </ul>	Contractor	GMRL
26.	Water logging	<ul style="list-style-type: none"> <li>• Temporary waterlogging due to construction activities, uneven dumping of construction waste, etc. will be avoided by ensuring that materials are not stored or waste is not dumped near stormwater runoff channels.</li> <li>• It will be ensured that metro construction activities do not lead to waterlogging in the area.</li> <li>• Regular cleaning of drains at waterlogging and urban flooding hotspots.</li> <li>• Dewatering pumps will be used to remove water from affected areas and prevent waterlogging.</li> </ul>	Contractor	GMRL
27.	Water Pollution	<ul style="list-style-type: none"> <li>• Measures such as sedimentation tanks and silt traps will be implemented at batching plants and along site runoff channels to control sedimentation.</li> <li>• Contractor will make efforts to reduce water consumption by using energy efficient water fixtures at construction sites and project offices.</li> <li>• Water leakage through pipes and valves will be strictly avoided.</li> <li>• Reuse of water, especially water used for curing and other uses will be planned and implemented.</li> <li>• Contractor will submit relevant details to the GMRL as per <b>Annexure 9.2, 9.3, 9.10</b> of this document.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		Monitoring Frequency: Four times in a Year at 10 locations for entire construction period.		
28.	Soil Pollution	<ul style="list-style-type: none"> <li>• Implement measures to prevent the ingress of toxic substances, heavy metals, or chemicals. A designated and secured storage area for such materials will be prepared and necessary equipment will be made available for safe handling and emergency response.</li> <li>• Contractor will take all necessary precautions to ensure that construction materials, diesel, grease, waste oil, chemicals, etc. do not spill onto the ground.</li> <li>• Regular monitoring of groundwater and soil leachate will be conducted at muck disposal sites where there is a potential risk of groundwater contamination.</li> <li>• Contractor will submit the required details to the GMRL as per <b>Annexure 9.3 &amp; 9.7</b> of this document.</li> <li>• Fuel and oil will be stored in cement lined storage yards on elevated platforms that are not prone to waterlogging or flooding. These materials will be handled with care to prevent soil contamination due to leakage or spillage.</li> <li>• All fuels and chemicals will be stored in contained facilities and appropriate measures will be taken to prevent any spillage. In case of an emergency spill, suitable containment mechanisms and pollution mitigation measures will be implemented with support from experts.</li> </ul> <p><b>Monitoring Frequency:</b> Four times in a Year at 10 locations for entire construction period</p>	Contractor	GMRL
29.	Incident Management	<ul style="list-style-type: none"> <li>• An Incident Reports Management Plan will be prepared, incorporating reporting formats and aligned with the WB’s Environmental and Social Incident Response Toolkit (ESIRT).</li> <li>• The contractor will promptly notify the GMRL of any incident or accident related to the project that has, or is likely to have, a significant adverse impact on the environment, affected communities, the public, or workers, including, inter alia, cases of SEA/SH, and accidents resulting in death, serious injury or multiple injuries.</li> <li>• GMRL shall immediately inform the Bank and instruct the GC, Supervising Engineer and the contractors to:</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>▪ Prepare a Preliminary Incident Report in line with WB ESIRT</li> <li>▪ Conduct a detailed incident investigation and reporting</li> <li>▪ Prepare a corrective action plan and</li> <li>▪ Implement the corrective measures at the earliest.</li> </ul> <ul style="list-style-type: none"> <li>• In all such cases, the contractor will suspend the ongoing work at the affected site until the identified hazardous conditions have been rectified, and it is safe to resume activities.</li> <li>• Sufficient details must be provided regarding the scope, severity and potential causes of the incident or accident along with the immediate and planned remedial measures taken or proposed to address it, as appropriate.</li> </ul> <p>Part of EHS manual, the contractor will submit the incident related details as per <b>Annexure 9.5.</b></p>		
30.	Environmental Monitoring	<p>Contractor will prepare and implement an environmental monitoring plan for air, noise, soil, water, vibration and ecology</p> <p><b>Monitoring Frequency</b></p> <ul style="list-style-type: none"> <li>• Air: 24 hourly monitoring for 2 days, twice in a month for entire construction</li> <li>• Noise: 24 hourly monitoring for 2 days, twice in a month for entire construction</li> <li>• Soil: Four times in a year for entire construction</li> <li>• Water: Four times in a year for entire construction</li> <li>• Vibration: 24 Hours, once in every month for 1 year</li> <li>• Ecology: Four times in a year for entire construction.</li> </ul>	Contractor	GMRL
31.	Availability of institutional capacity	<ul style="list-style-type: none"> <li>• Contractor will implement training programs and establish an environment unit comprising Environmental Engineers, OHS Experts and Social Experts (refer EHS manual for details)</li> <li>• Training will be conducted for officials and staffs of GMRL, GC, contractors, etc., as per Training Schedule.</li> </ul>	GMRL	GMRL
32.	Energy Management /Conservation	<ul style="list-style-type: none"> <li>• The contractor will use and maintain lighting, tools and equipment that meet appropriate specifications to ensure energy conservation, in accordance with EHS guidelines.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
33.	Construction Material Management and House Keeping	<ul style="list-style-type: none"> <li>• Full height, continuous safe fences, barriers and barricades with reflectors, adequately lit at all times for clear visibility, will be erected around the around the construction sites</li> <li>• All stairways, passageways and gangways will be always maintained free from any blockages or obstructions.</li> <li>• All surplus earth and debris will be removed or disposed of in line with C&amp;D Waste Management Rules, 2016. Recycled materials from C&amp;D waste recycling facilities may be used wherever feasible.</li> </ul>	Contractor	GMRL
34.	Access points to Establishments	<ul style="list-style-type: none"> <li>• Contractor will ensure that safe entry and exit is provided to residents during construction.</li> <li>• Construction activities should not block access points to any residential or commercial establishments. If unavoidable, an alternate access point will be provided in discussion with the concerned property owners.</li> </ul>	Contractor	GMRL
35.	Chance Find Procedure	<ul style="list-style-type: none"> <li>• Chance findings are anticipated at the metro construction site.</li> <li>• Excavation for project related activities may lead to chance finds.</li> <li>• Contractor will prepare and implement a Chance Find Procedure and create awareness among workers, supervisors and engineers regarding chance finds during excavation. In case of any suspected find, work will be stopped immediately to allow further investigation, and the procedure will be followed.</li> <li>• The State Archaeological Department will be informed immediately if a find is suspected, and any required action for removal or protection in situ will be taken as per their instructions.</li> <li>• The contractor will protect the site, report the finding to the Engineer/GMRL and refer the matter to local museums.</li> <li>• All discovered artefacts will be handed over to the museum or cultural management agency.</li> <li>• A review will be undertaken to determine whether excavation activities can continue.</li> <li>• The Department of Art &amp; Cultural Affairs will be responsible for managing the discovered objects.</li> </ul>	Contractor	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
36.	Restoration of Construction Sites	<ul style="list-style-type: none"> <li>For site restoration, the contractor will submit the required information to the GMRL as per <b>Annexure 9.8</b>.</li> </ul>	Contractor	GMRL
37.	Engagement and information disclosure	<ul style="list-style-type: none"> <li>Consultations will be carried out to solicit suggestions and plan appropriate measures for managing risks and impacts arising from the proposed project activities during the construction phase.</li> </ul>	GMRL	GMRL
<b>Operation Phase</b>				
1.	Flood Protection	<ul style="list-style-type: none"> <li>Regular maintenance and cleaning of drainage systems will be ensured to prevent blockages and maintain ensure efficient water flow.</li> <li>Drainage infrastructure will be regular inspected, and any damages will be repaired promptly.</li> <li>Rainwater harvesting structures will be installed along alignment, at stations and in the depot area.</li> <li>Coordination will be maintained with local municipalities and water management authorities to ensure integrated stormwater management and regulatory compliance.</li> <li>Participation in regional stormwater management initiatives will be undertaken, and nature-based solutions will be used wherever feasible.</li> </ul>	GMRL	GMRL
2.	Waterbodies	<ul style="list-style-type: none"> <li>Monitoring of treated wastewater generated from metro stations during the operation phase will be carried out to ensure that it does not contain any harmful pollutants.</li> </ul>	GMRL	GMRL
3.	Dark Spots	<ul style="list-style-type: none"> <li>Adequate lighting levels will be provided throughout metro stations, platforms, access points and surrounding areas to minimize dark spots, especially during evening and nighttime hours.</li> <li>Energy-efficient lighting fixtures, sensors, timers and lighting controls will be used to optimize illumination based on occupancy, time of day and natural light conditions, while maintaining visibility and safety.</li> <li>Emergency lighting systems, backup power sources and clearly visible signage for evacuation routes and emergency response will be incorporated.</li> </ul>	GMRL	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• Safe and security, including CCTV cameras, emergency call boxes, and alarm systems, will be installed and maintained to deter crime, monitor passenger safety, and enable rapid incident response.</li> <li>• Security patrols, personnel training and community engagement initiatives will be implemented to enhance the perception of safety and promote vigilance among metro users.</li> </ul>		
4.	Vulnerable and disadvantaged person	<ul style="list-style-type: none"> <li>• Regular maintenance of ramps, lifts, escalators, tactile paving, etc. will be ensured throughout the metro operations.</li> <li>• Following provisions will be incorporated into the design to enhance accessibility for PwDs:                             <ul style="list-style-type: none"> <li>▪ Extra-wide automatic flap gates at stations for wheelchair access</li> <li>▪ Provision of wheelchairs at stations</li> <li>▪ Reserved spaces for wheelchair in trains.</li> <li>▪ Tactile paths for visually impaired</li> <li>▪ Ramps to address changes in level</li> <li>▪ Handrails alongside staircases</li> <li>▪ Separate and accessible toilets.</li> <li>▪ Lifts equipped with wide access doors, audio-visual indications, telephone buttons, braille-labelled call buttons.</li> <li>▪ Signage at prominent locations for easy navigation.</li> <li>▪ Reserved seating for differently-abled passengers in trains</li> <li>▪ Audio and visual indication during train door operations for safety and awareness.</li> </ul> </li> </ul>	GMRL	GMRL
5.	Noise Pollution	<ul style="list-style-type: none"> <li>• A green belt will be maintained within the depot boundary to enhance environmental aesthetics and mitigate air and noise pollution.</li> <li>• Noise barriers will be installed at sharp curves, near structures located within 20m of the alignment and at identified sensitive receptors.</li> <li>• Screening of noise will be ensured by installing parabolic noise barriers on both sides of the track along curved sections of the viaduct and near sensitive locations during the operation phase.</li> </ul>	GMRL	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>These noise mitigations measures are proposed in accordance with the Noise Pollution (Regulation and Control) Rules, 2000 &amp; its amendment and WB's ESS3.</li> </ul>		
		Noise Barrier are proposed for a total length of 3213 m. <b>Monitoring Frequency:</b> Once (24 hourly monitoring for 2 days continuously) in three months, Four times in a year for 3 years at each station and Depot.	GMRL	GMRL
6.	Vibration	Vibration can be minimized through the following measures: <ul style="list-style-type: none"> <li>Regular maintenance of tracks and rolling stock.</li> <li>Installation of resilient soft base plates and resilient rubber pads between the rail and track slab.</li> <li>Periodic rail grinding using a rail grinding machine and lubrication of rails using vehicle mounted lubricators will be undertaken.</li> <li>Rails will be continuously welded and laid to fine tolerances to reduce noise and vibration caused by track geometry.</li> <li>Regular vibration monitoring will be carried out at identified sensitive receptors during the operation phase.</li> </ul> <b>Monitoring Frequency:</b> 24 Hours monitoring, Four times in a year for 3 years at 10 locations.	GMRL	GMRL
7.	Ecology	<ul style="list-style-type: none"> <li>Maintenance of trees at afforestation sites and within the depot area.</li> <li>The GMRL/GC will develop a biodiversity management plan for the KBA/ IBA in Sector 101, Basai and Basai Pond. This plan will be effectively implemented during the operation phase.</li> </ul>	GMRL	GMRL
8.	Management of Solid Waste	<ul style="list-style-type: none"> <li>A waste management plan will be developed, which will be effectively implemented during the operation phase.</li> <li>During operation, solid waste generated from metro stations and the depot will be collected in designated bins and handed over to the ULB for disposal.</li> <li>Non-biodegradable waste will be handed over to authorized recyclers for proper processing.</li> <li>Garbage storage and transfer points will be covered and cleaned every day to prevent nuisance, vector breeding and unhygienic conditions.</li> </ul>	GMRL	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>Solid waste will be managed in compliance with the Solid Waste Management Rules, 2016 and its subsequent amendments.</li> </ul>		
9.	Management of Plastic Waste	<ul style="list-style-type: none"> <li>Source segregation will be carried out based on the recyclability of the plastic waste.</li> <li>The waste will be handed over to authorised vendors for recycling and co-processing.</li> </ul>	GMRL	GMRL
10.	Management of E-Waste	<ul style="list-style-type: none"> <li>E-waste generated will be handed over to Haryana SPCB-approved e-waste recyclers or authorized management facilities, in accordance with the E-Waste Management Rules, 2022 and its subsequent amendments.</li> </ul>	GMRL	GMRL
11.	Management of Hazardous & Battery Waste	The hazardous and battery waste generated will be disposed of in accordance with the Hazardous Waste Management Rules, 2016 & its subsequent amendments, and the Batteries Waste Management Rules, 2022, respectively.	GMRL	GMRL
12.	Water Supply and Sanitation	<ul style="list-style-type: none"> <li>Water will be treated prior to use in accordance with Indian drinking water standards.</li> <li>Sewage will be treated using biodigester technology.</li> <li>Measures such as wastewater treatment and reuse, along with rainwater harvesting, will be implemented to augment groundwater levels.</li> <li>Organic waste will be segregated and treated using on-site bio-composting technique.</li> </ul> <p>Monitoring Frequency:                      Wastewater: Once in three months, Four times in a year for 3 years at each station and Depot                      Solid Waste: Once in three months, Four times in a year for 3 years at each station and Depot.</p>	GMRL	GMRL
13.	Biodigester	<ul style="list-style-type: none"> <li>Care will be taken to ensure that the inoculum is exposed to minimal oxygen during the addition process.</li> <li>Leakage from the bio-tank will be avoided, as the anaerobic microbial inoculum is main component of this technology.</li> </ul>	GMRL	GMRL
14.	Solar Panel	<ul style="list-style-type: none"> <li>Solar panels will be cleaned biannually as a standard practice. During periods of high dust or pollution, quarterly cleaning will be conducted to maintain optimal efficiency.</li> <li>Measure such as adjusting the panel orientation and tilt to minimize glare angles, applying anti-reflective coatings on the glass surface, installing physical barriers to</li> </ul>	GMRL	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<p>block direct lines of sight, and optimizing indoor lighting placement will be implemented.</p> <ul style="list-style-type: none"> <li>At the end of their service life, solar panels used in the metro project will be disposed of or recycled as per E-Waste (Management) Rules, 2022 and CPCB guidelines.</li> </ul>		
15.	Depot	<ul style="list-style-type: none"> <li>The water requirement will be met through the municipal water supply. Additional requirement for horticulture and flushing of urinals/closets will be fulfilled using recycled water.</li> <li>Treated wastewater from the ETP will be recycled and reused for car washing, in compliance with consent conditions.</li> <li>Treated wastewater generated from the STP will be reused for horticulture and flushing purposes, in accordance with consent conditions. Proper records will be maintained at site.</li> <li>Oil spillage during lubricant changes, cleaning and repair activities for rolling stock maintenance is common. Spilled oil will be captured using oil and grease traps and the collected oil will be disposed of through authorised collectors to prevent contamination of soil and surface and groundwater.</li> <li>For noise control, ballast-less tracks with elastic and absorbent fittings will be used.</li> <li>Thick green belt development will be undertaken to help reduce noise impact.</li> <li>Suitable drainage measures will be adopted, such as providing separate pipelines or channels for stormwater and wastewater, with appropriate slope and alignment to prevent cross contamination and ensure that stormwater and site wastewater remain separate.</li> <li>A stormwater drainage system with silt and oil traps will be installed to ensure that the city's common surface drains do not carry contaminants from the depot.</li> <li>Spill kits, bunded areas and containment barriers will be installed to address accidental chemical or fuel spills effectively.</li> <li>Well-defined emergency response procedures will be established including personnel training for spill management and flood scenarios.</li> </ul>	GMRL	GMRL
16.	Management of Pigeons	<ul style="list-style-type: none"> <li>Deterrents such as bird spikes, reflective materials and similar measures will be installed to prevent bird nesting and related nuisances.</li> </ul>	GMRL	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
17.	Air Pollution	<ul style="list-style-type: none"> <li>Air quality monitoring needs to be carried out at each station and depot</li> </ul> <p><b>Monitoring Frequency:</b> Once (24 hourly monitoring for 2 days continuously) in three months, Four times in a year for 3 years at each station and depot.</p>	GMRL	GMRL
18.	Soil Quality Monitoring	<ul style="list-style-type: none"> <li>Soil quality monitoring to be checked at baseline monitoring locations</li> </ul> <p><b>Monitoring Frequency:</b> Once in three months, four times in a year at 10 baseline monitoring locations for 3 years</p>	GMRL	GMRL
19.	Incident Management	<ul style="list-style-type: none"> <li>An Incident Management Plan will be implemented in accordance with the ESIRT provisions outlined in the EHS Manual</li> </ul>	GMRL	GMRL
20.	Monitoring and Grievances	<ul style="list-style-type: none"> <li>A mechanism will be implemented to monitor the progress of ESMP/EMoP measures and evaluate the results achieved.</li> <li>A project level grievance mechanism will be implemented to address concerns.</li> </ul>	GMRL	GMRL
21.	Gender Based Violence	<ul style="list-style-type: none"> <li>Workshops will be organised on GBV/SEAH and POSH act, 2013 for all GMRL Staff.</li> <li>A clause on GBV/SEAH behavioural obligations will be included in the employment contracts of all employees to strengthen measures aimed at preventing and addressing SEAH at workplace.</li> <li>Female security personnel will be deployed at stations and onboard trains (for random checks) to enhance the safety and comfort of female commuters.</li> <li>Information such as women’s helpline numbers, gender specific messaging (audio &amp; video), emergency buttons and intercom systems will be provided in all coaches and at stations.</li> <li>To address GBV related incidents, a SOP should be developed.</li> </ul>	GMRL	GMRL
22.	Screening of major Crimes	<ul style="list-style-type: none"> <li>Display of information on major GBV related offences and corresponding punishments will be ensured at the metro stations to raise awareness among commuters.</li> </ul>	GMRL	GMRL
23.	Provisions of CCTV	<ul style="list-style-type: none"> <li>Installation of CCTVs at metro stations and nearby locations.</li> <li>Installation of CCTVs at identified GBV hotspots in the vicinity of metro stations.</li> </ul>	GMRL	GMRL
24.	Facilities for Women Commuters	<ul style="list-style-type: none"> <li>Installation of Sanitary Pad Vending Machines,</li> <li>Transparent Elevators,</li> <li>Gender Neutral Toilets,</li> <li>Dedicated Women Coaches</li> </ul>	GMRL	GMRL

S. No.	Environment & Social Aspect	Mitigation Measures	Implementing Entity	Responsible Entity
		<ul style="list-style-type: none"> <li>• Apps for Online Complaint.</li> </ul>		
25.	Street vendors near metro station	<ul style="list-style-type: none"> <li>• To avoid traffic congestion near metro stations caused by street vendors, traffic wardens should be deployed to manage and regulate vehicular movement.</li> </ul>	GMRL	GMRL
26.	Proper and designated space for autos and e-rickshaws to avoid chaos at metro stations.	<ul style="list-style-type: none"> <li>• GMRL will ensure that designated spaces are provided for auto-rickshaws and e-rickshaws.</li> <li>• Traffic Police and traffic wardens should be deployed to manage and regulate traffic movement effectively.</li> </ul>	GMRL	GMRL
27.	Accident, breakdown or failure of Metro	<ul style="list-style-type: none"> <li>• Regular inspections of alarm systems in metro coaches and at metro stations will be conducted to promptly detect emergencies, accidents, breakdowns or power failure.</li> <li>• First aid facilities will be provided at all stations</li> </ul>	GMRL	GMRL
28.	Pedestrian road safety during operation at major metro stations.	<ul style="list-style-type: none"> <li>• Traffic should be managed at and around the metro stations with the assistance of Police Department.</li> </ul>	GMRL	GMRL
29.	Engagement and information disclosure	<ul style="list-style-type: none"> <li>• Consultations will be carried out to solicit suggestions for planning and addressing measures to manage risks and impacts arising from the proposed project activities during the operation phase.</li> </ul>	GMRL	GMRL

## 9.2 Penalty for non-compliance of ESMP

The contractor is required to implement ESMP for all the construction activities. In the event of non-compliance, penalties shall be imposed based on the severity of the unsafe act and or condition. The proposed penalties for ESMP non-compliance by the contractor are outlined in **Table 9-2**.

**Table 9-2 Proposed Penalties for non-compliance of ESMP**

S. No.	Conditions	Penalty in Rs.
1.	Delay in submission of monthly Progress Reports on ESMP	Rs.50,000 per month.
2.	Reports not updated as per the instructions of the GC/GMRL	
3.	Failure to observe important days related to environmental and social awareness among workers.	Rs.10,000 per violation
4.	Posters, as directed by GC/GMRL, not printed and displayed at designated locations.	Rs.10,000 per violation
5.	Non-Compliance of measures as proposed in the ESMP	Rs.1,00,000 per violation
6.	Non-Compliance of Traffic Management	Rs.25,000 per violation
7.	Non-Compliance with Emergency Preparedness Plan	Rs.1,00,000 per month
8.	Non-Compliance with Labour Welfare Measures	Rs.50,000 per month
9.	Environmental Pollution Failure to prevent or contain air, noise, water and soil pollution. Protection of trees Failure in carrying out environmental monitoring	Rs.50,000 per violation
10.	Housekeeping <ul style="list-style-type: none"> <li>• Unhygienic conditions around drinking water tanks/taps.</li> <li>• Poor maintenance and cleanliness of site offices, stores, toilets and urinals</li> <li>• Non-provision or improper maintenance of garbage bins at required locations.</li> <li>• Blocked stairways, gangways, or passageways.</li> <li>• Lumber with protruding nails left unattended.</li> <li>• Unprotected openings at the worksite.</li> <li>• Excavated earth not removed within a reasonable time.</li> <li>• Truck carrying excavated earth not covered and vehicle tyres not cleaned before exit.</li> <li>• Vehicles and equipment not parked at designated place after completion of work.</li> <li>• Surplus cables, steel scrap, wooden scrap and empty wooden drums left scattered.</li> <li>• Water stagnation at the site.</li> </ul>	Rs.50,000 per violation
11.	Non-compliance of management measures at batching plant and casting yard	Rs.10,000 per violation

## 9.3 Emergency/ Disaster Management Plan

A disaster is an unexpected event natural or manmade that may result from sudden failure, external threats, internal disturbances, earthquakes, fire or accidents. According to the Disaster Management Act, 2005 a "disaster" is defined as a catastrophe, mishap, calamity or

grave occurrence in any area, arising from natural or manmade causes, or by accident or negligence, which results in substantial loss of life or human suffering, damage to or destruction of property, or degradation of environment and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area.

The Disaster Management Act, 2005, enacted by the Government of India, provides a framework for the effective management of disasters. It establishes national, state and district-level authorities responsible for formulating and implementing disaster management policies and plans. The Act emphasizes a holistic approach to disaster management including prevention, mitigation, preparedness, response and recovery. It mandates the preparation of disaster management plans, capacity-building initiatives and the establishment of an early warning system. Additionally, the Act promotes community participation and coordination among various agencies aiming to minimize the impact of disasters through a systematic and structured approach.

### 9.3.1 Need for Disaster Management Measures

The effect of any disaster spread over within operational area of the GMRP is likely to be substantial, as GMRL handles with thousands of passengers daily its viaducts and stations. Disaster can cause sudden and immense misery, disrupting normal life and established socio-economic patterns. Additionally, they may result in damage to critical infrastructure, buildings and communication systems within the metro network. Therefore, an efficient disaster management plan is essential for the proposed project.

The first step in disaster preparedness is the identification of potential causes that may pose unexpected risks to the structural integrity during construction and operation. These include excessive load, cracks, failure and malfunctioning of sensing instruments, accident, etc. These factors must be thoroughly investigated and monitored with due care.

The primary objectives of the Disaster Management Plan are as follows:

- Provide timely assistance to stranded passengers and ensure their prompt evacuation.
- Provide accurate information to maintain a sense of security.
- Protect GMRL property from damage.
- Expedite the restoration of train operations following a disruption.

To achieve these objectives, clearly defined staff roles and responsibilities during disaster situations must be outlined to ensure a coordinated and effective response. Training and capacity building of officials and workers should be emphasized to prevent confusion and enable prompt response, fostering alertness and efficiency in fulfilling their duties.

### 9.3.2 Provisions under Disaster Management Plan

GMRL shall prepare a DMP covering all components of the metro project including the corridor, stations, Depot and other facilities. The DMP should include the following provisions.

#### A. Preventive Action

Once there is any indication or suspicion of a potential disaster, immediate preventive measures must be initiated to avoid failure or escalation. Engineers responsible for preventive action should be fully aware of the availability and readiness of repair equipment, materials, trained manpower and technical expertise required during emergencies.

#### B. Reporting Procedures

Clear criteria should be defined to determine the level at which a situation is classified as a disaster. This should also specify the stage at which surveillance and monitoring need to be intensified both in terms of frequency and detail. The Engineer-in-Chief shall notify designated officers with the following critical information:

- Identified outdoor assembly points and emergency exit points for evacuation.
- Details of nearest medical facilities for emergency response.

#### C. Communication System

An efficient and robust communication system is essential for the success of any disaster response operation. The communication framework should be developed in consultation with local authorities. More often the communication system are often disrupted during disasters, it is essential to clearly identify damage prone areas, establish a temporary and foolproof communication system for those areas and ensure redundancy and reliability in all communication channels.

#### D. Emergency Action Committee

To ensure a coordinated and timely response, an Emergency Action Committee should be constituted. The MD, GMRL shall serve as the Chairman of this committee. The committee may comprise of:

- Head of operations
- Head of technical services
- Head of security
- Representatives from fire services
- Representatives from local police
- Representative from NGOs and civil society organisations

Emergency Action Committee will be responsible for preparing the evacuation plan and related procedures, based on local needs and available infrastructure. The evacuation plan should include:

- Demarcation of evacuation zones with prioritization based on risk levels.
- Identification of safe routes and assessment of transport adequacy and traffic control measures.
- Identification of safe shelters and relief areas.
- Security arrangements for protecting property left behind.
- Defined roles and responsibilities for all members of the evacuation and response teams.
- Establishment of a Joint Control Room for coordinated operations.

All personnel involved in the Emergency Action Plan should be thoroughly familiar with all elements of the plan and their roles and responsibilities. Regular training sessions and mock drills must be conducted to ensure readiness and eliminated confusion during actual emergencies. Site staff should be trained to detect early warning signs, assess the severity of the situation, take immediate and effective remedial measures. Specific responsibilities must be assigned to individuals for each segment of the emergency plan.

The success of any emergency plan depends on public participation, their response to warning notifications and timely action. Public must be educated on the hazards and key role in disaster mitigation by helping in the planned evacuation and rescue operations.

It is essential to communicate by whom and how the declared emergency will be terminated. The termination of an emergency must be clearly communicated to the public through officials' de-alert signals. The notification should be clear so that the evacuees know precisely what to do when re-entering or approaching the affected areas.

### 9.3.3 Emergency Measures under Disaster Management Plan

Emergency measures are essential to prevent system failures in critical areas such as lighting, fire protection, escape routes, ventilation shafts, etc. The objective of the Emergency Action Plan is to identify vulnerable areas, structures and population groups that may be affected during a catastrophic event of accident. The EAP should include provisions for preventive actions, notification and warning systems and effective co-ordination among various emergency and relief authorities. These are discussed in following sections.

#### A. Emergency Action Committee

Emergency lighting systems powered by batteries should be installed at all metro stations. The battery backup system should be capable of supplying power to at least 25% of the lighting systems in stations, platforms and viaducts for a minimum duration of 2 hours during a power outage or emergency.

## B. Fire Protection

All materials and construction practices should comply with appropriate fire resistance standards. For surface or elevated structures, the minimum fire resistance period should be two hours. The use of wood should be strictly avoided, except for artificial or treated wood products that are flame resistant and meet fire safety standards. The materials which have zero surface burning characteristics need to be used. The electrical systems should be equipped with automatic circuit breakers that are triggered by both current surges and overloads. The design of a station will include the following provisions:

- Fire prevention measures
- Fire control mechanisms
- Fire detection systems
- Clearly marked means of escape
- Firefighter access routes
- Adequate firefighting equipment

Accumulation of flammable waste materials such as paper and plastic cartons must be strictly prohibited. Smoking strictly prohibited at all designated non-smoking locations. Fire safety planning and implementation shall be undertaken in close coordination with the local fire authority. Smoke control will be achieved by the following means.

- Down stand bulkheads with a minimum depth of 600 mm will be installed around escalator and lift openings to help contain smoke.
- A minimum 30-minute water supply should be assured during fire emergencies. Pumps and overhead tanks should have the capacity to discharge water at 1,100 litres per minute at a head of 21m at the nozzle mouth.
- Water storage in tanks (underground or overhead) shall be divided into dead storage and running storage.
- Firefighting systems should be provided with a diesel pump as a standby in case of power failure.
- In case of fire of electrical origin, water cannot be used until the electric system has been made dead and earthen. For electrical fires, fire extinguishers with non-aqueous agents such as dry chemical powder or CO<sub>2</sub> gas should be installed generously at all static facilities and inside rolling stock
- As smoke inhalation often results in more casualties than direct burns, effective smoke management is critical. This includes ventilation systems that supply fresh air while extracting smoke and combustion gases from the site of the fire.
- All openings including ducts and passages between GMRP property and any adjoining structures that could allow uncontrolled access must be protected using fire doors, fire shutters, fire dampers, or other appropriate systems. Advanced fire detection and alarm systems shall be installed in accordance with the latest technological standards.

## i. Fire Prevention and Safety Measures

Fire prevention measures will be carefully planned and implemented to minimize the risk of fire outbreaks. This will be achieved through the appropriate selection, location and installation of materials and equipment. GMRL shall obtain approval for the firefighting scheme, ensuring compliance with the following statutory requirements:

- The National Building Code of India
- The Disaster Management Act, 2005 (53 of 2005)
- The Factories Act, 1948 (act 63 of 1948)
- The Punjab Factory Rules, 1952

A No Objection Certificate (NOC) shall be obtained in the prescribed format and consultation with the fire safety department will be undertaken to incorporate their inputs regarding procedures and permits. In stations planning, potential sources of fire can be reduced by:

### ➤ Fire Prevention

- Use of non-combustible or smoke retardant materials where feasible.
- Use of fire-retardant materials in rolling stock, including low-smoke, zero halogen type electric cables.
- Design layouts that allow ease of equipment maintenance and cleaning of the station premises.
- Provision of dedicated storage spaces for combustible materials (e.g. paint, oil).
- Strict prohibition of smoking in fire prone areas.
- Ensuring good housekeeping practices at all times.

### ➤ Safety

- Automatic sprinkler and detection system where to floor area exceeds 750 sqm.
- One wet riser-cum-downcomer per 1,000 sqm of floor area, supported by static underground tank, overhead tanks and pumps of suitable capacity. System components include hydrants, first-aid hose reel, etc.
- Provision of portable non-aqueous fire extinguishers (CO<sub>2</sub>, dry chemical powder) at suitable places.
- Installation of automatic smoke venting systems.
- At least two separate exits where more than 10 persons work, and area exceeds 1,400 sqm.
- Installation of fire-resistant doors along escape routes to prevent fire and smoke spread.
- Travel distance to escape routes should not exceed 20m, and may be extended up to 40 m where multiple escape options are available.

## ii. Fire Alarm and Detection System

A comprehensive fire alarm and detection system will be installed across all stations and ancillary buildings including entrance passages and subways in compliance with Gurugram Fire Services standards. Key features include:

- Operation via 24V DC power source.
- Manual call points at every hydrant, hose reel point, station head wall, tail wall and other identified locations.
- Installation of alarm bells at both platform and concourse level and alarms must be clearly audible throughout the area.
- Heat detectors at roof level, ceilings and floor cavities.
- Smoke probe units in compartments and enclosed spaces.
- Automatic activation of the fire pump upon detection of alarm signals.
- A station fire control and indicating panel in the station controller's room to control, monitor and indicate the status of the fire detection and suppression systems.
- Integration with the fire service zone system for compatibility with Gurugram Fire Services.

## iii. Fire Control Measures

Fire and smoke containment will be achieved through:

- Compartmentalization of fire risk areas (excluding public spaces in stations due to operational constraints).
- Provision for smoke extraction and smoke containment systems.
- Openings between compartments must be capable of automatic sealing in the event of a fire.
- Each fire compartment (except public areas) shall not exceed 1,500 sqm
- The fire resistance rating of separated compartments should be at least 3 hours

## iv. Access for Fireman

Provision for secondary access, separate from public evacuation routes, shall be made to facilitate firefighter entry in emergencies. Key requirements:

- The secondary entry point should be directly and easily accessible from the road.
- Firefighter access shall be provided to all station levels.
- Minimum stairway width should be 1.0m and maximum riser height should not exceed 60cm.

### **C. Emergency Door**

The rolling stock should be equipped with emergency doors at both ends of the cab to ensure the direct evacuation of passengers in the event of any emergency, including fire onboard the train.

#### **9.3.4 Reporting to World Bank**

GMRL shall notify the Bank at the earliest possible time, and in any case no later than 48 hours after becoming aware of the incident or accident, providing all available details upon request. Furthermore, GMRL shall submit an investigation report or root cause analysis along with a corrective action plan to the Bank no later than 10 days from the time of the initial notice unless a different timeframe is agreed to in writing by the Bank.

## Chapter 10: Environmental and Social Monitoring Plan

### 10.1 Pre-Construction Phase

The environmental and social monitoring programme serves as an early warning system to identify potential issues arising from the proposed project activities and enables timely implementation of corrective measures. As part of the ESIA, pre-construction phase monitoring was carried out for air, water, noise, soil, and vibration quality. The results of this monitoring are documented in Chapter 4 of this report.

### 10.2 Construction Phase

The environmental monitoring schedule for the entire construction period (4 Years) is summarized in **Table 10-1**. Environmental monitoring during the construction phase will be conducted at the same locations where baseline monitoring was previously carried out or at any other location deemed important during implementation by the GMRL, Contractor or Others. The number and selection of monitoring locations could be modified based on emerging requirements once construction activities begin. Monitoring activities should be undertaken by a NABL Accredited/MoEF&CC recognized agency, whether private or government affiliated. The contractor will be responsible for carrying out the monitoring during the construction phase under the supervision of the GMRL.

**Table 10-1 Construction Stage Monitoring Plan**

Parameter	Locations	Frequency	Reference/ Standard	Implementation by/Approved by
Air Quality	<ul style="list-style-type: none"> <li>Construction Yard</li> <li>Millennium City Center</li> <li>Depot</li> <li>Remaining locations will be variable based on construction activity.</li> </ul>	24 hourly monitoring for 2 days, twice in a month at six locations for each package (2 packages for entire corridor) for 4 years	<ul style="list-style-type: none"> <li>Guidelines for Ambient Air Quality Monitoring, CPCB, 2003</li> <li>National Ambient Air Quality Standards 2009</li> </ul>	Contractor/ GMRL
Noise Quality	<ul style="list-style-type: none"> <li>Millennium City Centre</li> <li>Udyog Vihar Phase 6 Metro station</li> <li>Near Greenwood Public school (Basai Pond)</li> <li>ESIC Hospital</li> </ul>	24 hourly monitoring for 2 days, twice in a month at six locations for each package (2 packages for entire corridor) for 4 years	Protocol for Ambient Level Noise Monitoring, CPCB, May 2015	Contractor/ GMRL

Parameter	Locations	Frequency	Reference/Standard	Implementation by/Approved by
	<ul style="list-style-type: none"> <li>• Near Blossoms Primary School</li> <li>• Infront of GAV International School</li> <li>• Near Presidium School, Palam Vihar</li> <li>• Manipal Hospital, Palam Vihar</li> <li>• Near Rotary Public School</li> <li>• The remaining locations can be selected from sensitive areas near vulnerable receptors and ongoing construction sites.</li> </ul>			
Water (Ground and surface water)	<ul style="list-style-type: none"> <li>• Basai Village</li> <li>• Sector-101</li> <li>• Sector-37</li> <li>• Depot</li> <li>• The remaining locations can be selected at deep excavation sites, stockpile areas and storage yards.</li> </ul>	Four times in a year for 4 years at 10 locations	<ul style="list-style-type: none"> <li>• Guide Manual – Water and wastewater analysis, CPCB</li> <li>• Drinking water – Specifications IS 10500: 2012 and CPHEEO manual 2012</li> </ul>	Contractor/ GMRL
Soil	<ul style="list-style-type: none"> <li>• Basai Village</li> <li>• Sector-23A</li> <li>• Udyog Vihar Phase-V</li> <li>• The remaining locations can be selected at excavation sites, stockpile areas, storage yards, and labour camps.</li> </ul>	Four times in a year for 4 years at 10 locations	US EPA test protocols	Contractor/ GMRL

Parameter	Locations	Frequency	Reference/ Standard	Implementation by/Approved by
Vibration	<ul style="list-style-type: none"> <li>• Fortis Hospital</li> <li>• Manipal Hospital</li> <li>• INOX Mall</li> <li>• Greenwood School</li> <li>• Presidium School</li> <li>• Additional locations for vibration monitoring can be selected in areas where other heavy construction activities are occurring, as they may contribute to the vibrations from metro construction.</li> </ul>	24 Hours, once in every month at 10 locations for 1 year	ISO/ TC 108 vibration	Contractor/ GMRL
Ecology	<ul style="list-style-type: none"> <li>• KBA/IBA in Sector-101, Basai.</li> <li>• Basai pond</li> <li>• Other locations can be selected from Green Areas (Parks and Gardens), Tree Felling and Replantation Zones</li> </ul>	Four times in a year for 4 years (at afforestation locations)	As per Forest authorities & MCG	Contractor/ GMRL, MCG/GMDA & Forest Department

Workers Health and Safety: Epidemiological studies will be conducted at construction sites to monitor the potential spread of diseases among workers. Regular health inspections and medical check-ups should be carried out to ensure effective monitoring of workers' health and safety. Any recurrence of health incidents should be recorded, and appropriate mitigation measures should be implemented promptly. The contractor will be responsible for ensuring the health and safety of workers throughout the construction phase. The project proponent will be responsible for reviewing and auditing the health and safety plans and measures implemented by the contractor.

The estimated environmental and social monitoring cost during the construction phase of the GMRP is Rs. 132.32 Lakh. This cost shall be included as part of the civil construction contract.

### 10.3 Operation Phase

The monitoring schedule for the operation phase is detailed in **Table 10-2**. During this phase, the Environmental and Social Management Unit (ESMU) shall be responsible for submitting monitoring reports bi-annually. These reports will cover: air quality, noise levels, water quality, wastewater management, solid waste disposal, soil quality, vibrations, ecological indicators.

**Table 10-2 Operation Stage Monitoring Schedule Plan**

Parameter	Locations and Frequency	Reference/Standard	Implementation by/Approved by
Air Quality	Once (24 hourly monitoring for 2 days continuously) in three months, Four times in a year for 3 years at each station and Depot.	<ul style="list-style-type: none"> <li>Guidelines for Ambient Air Quality Monitoring, CPCB, 2003</li> <li>National Ambient Air Quality Standards 2009</li> </ul>	GMRL
Noise Quality	Once (24 hourly monitoring for 2 days continuously) in three months, Four times in a year for 3 years at each station and Depot.	Protocol for Ambient Level Noise Monitoring, CPCB, May 2015	GMRL
Water (Ground and surface water)	Once in three months, Four times in a year at 10 baseline monitoring locations for 3 years	<ul style="list-style-type: none"> <li>Guide Manual – Water and wastewater analysis, CPCB</li> <li>Drinking water – Specifications IS 10500: 2012 and CPHEEO manual 2012</li> </ul>	GMRL
Waste Water	Once in three months, Four times in a year for 3 years at each station and Depot.	<ul style="list-style-type: none"> <li>Guide Manual – Water and wastewater analysis, CPCB</li> </ul>	GMRL
Solid Waste	Once in three months, Four times in a year for 3 years at each station and Depot.	<ul style="list-style-type: none"> <li>Solid Waste Management Rules, 2016 and its amendments</li> </ul>	GMRL
Soil	Once in three months, Four times in a year at 10 baseline monitoring locations for 3 years	US EPA test protocols	GMRL
Vibration	24 Hours monitoring, Four times in a year for 3 years	ISO/ TC 108 vibration	GMRL
Ecology	Four times in a year for 3 years at Depot, Afforestation Sites	As per Forest authorities & MCG	GMRL, MCG/GMDA & Forest Department

The environmental and social monitoring cost during the operation phase of GMRP is **Rs 101.22 Lakh**. The estimated cost towards environmental and social monitoring during operation will be the responsibility of GMRL.

## Chapter 11: Institutional Arrangement

### 11.1 Proposed Institutional Arrangement

Supervision involves periodic checking to ensure that project activities are being carried out in accordance with the approved plans. It provides critical feedback to the project management team, enabling timely interventions to keep the project on schedule. During the construction phase, the supervision and reporting process related to the implementation of mitigation measures shall commence at the contractor level. The contractor will report to the GMRL through the GC.

During construction phase, the implementation of the ESMP will comprises of the following key activities:

- Timely implementation of various mitigation and enhancement measures as recommended in the ESMP.
- Overseeing the implementation of these measures and making necessary refinements or recommending additional measures based on evolving site conditions.
- Project level monitoring of key performance indicators at specified intervals to evaluate ESMP implementation.
- Periodic reporting on the status of ESMP implementation, monitoring results and key performance indicators.
- Continuous assessment of the effectiveness of ESMP measures using monitoring data and reports and providing necessary directions or corrective actions.

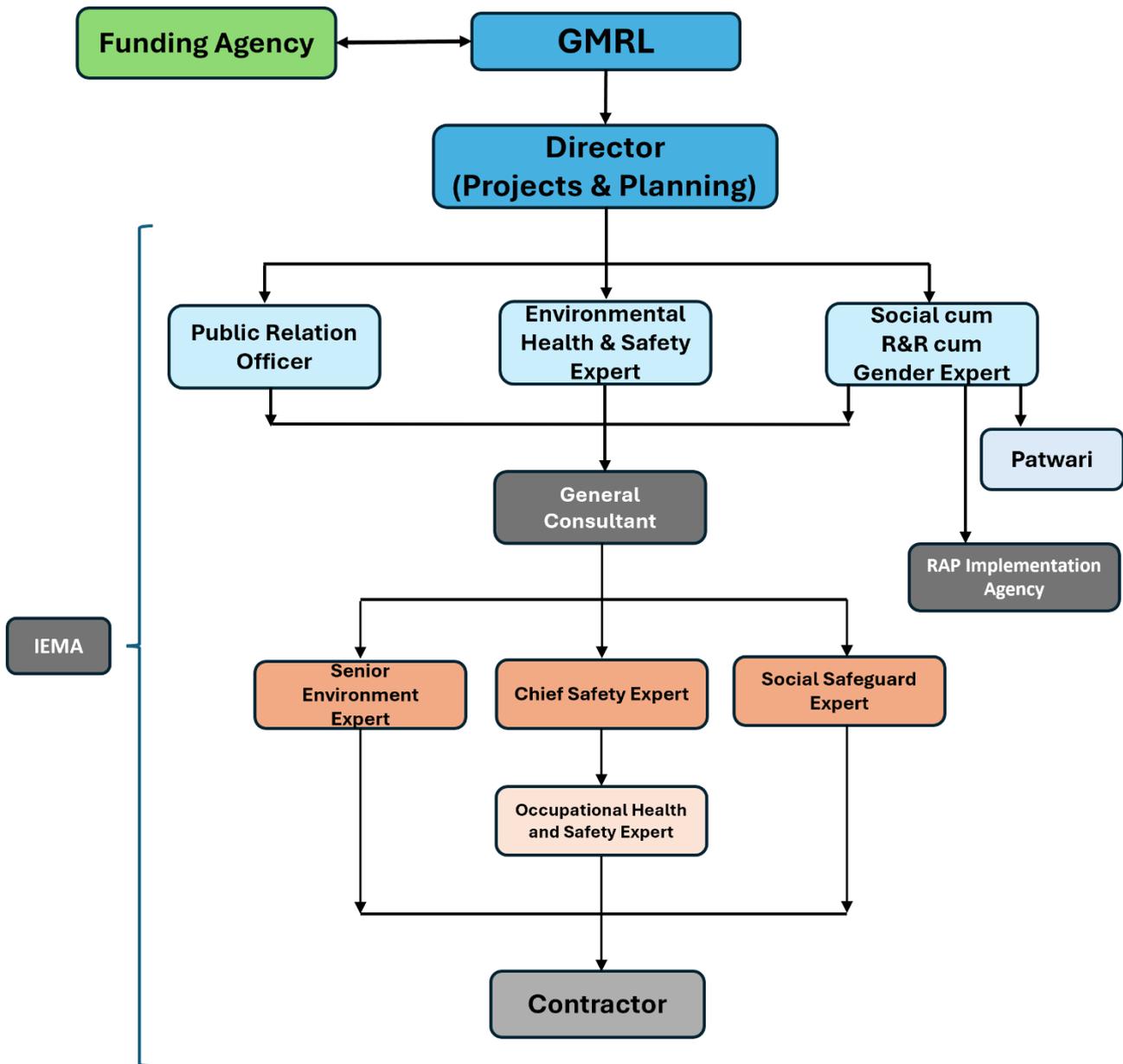
These activities to be carried out by various agencies that will be involved in the implementation of metro project. These activities will be conducted either concurrently or at regular intervals across different location and duration. Therefore, it is essential that all participating agencies function within a well-defined and coordinated framework. The proposed coordination model for the construction and operational phases is presented in **Figure 11-1** and the roles and responsibilities of identified agencies detailed in the subsequent section.

**GMRL:** GMRL will be responsible for the overall planning and implementation of the project. It will be supported by its Directors, officials, consultants, subject-matter experts, and contractual staff to ensure effective coordination and successful project execution. GMRL will also ensure that all project interventions align with the strategies and commitments outlined in the ESCP.

**Director/Project:** The Director/Project holds overall responsibility for planning, execution, monitoring, and evaluation of the project. He will oversee the implementation of the ESMP and coordinate with safeguard specialists for issue resolution. The Director will also conduct periodic reviews, monitor safeguard implementation, recommend improvements as needed,

and liaise with relevant institutions and government departments for necessary support. The Social cum R&R cum Gender Expert and Environmental Health & Safety Expert shall work under Director/Project and are responsible for implementing social, environmental and safety mitigation measures. Their key functions include supervising and monitoring construction activities, facilitating the relocation of affected persons, coordinating with utility departments for service relocation and ensuring overall implementation of the ESMP.

Figure 11-1 Institutional Mechanism for ESMP Implementation



\*IEMA: Independent External Monitoring Agency

**Environmental Health & Safety Expert:** The Environmental Health & Safety Expert at the GMRL will look after environmental, health and safety aspects. Expert will guide the project team on these aspects and support in building safeguard parameters. He/she will also guide the GC, Contractors and monitor their work with regards to ESMP implementation from time to time. In case of requirement, he/ she will prepare a detailed EMP for different activities to be executed by the project.

**Social-cum-R&R-cum-Gender Expert:** The Social-cum-R&R-cum-Gender expert at GMRL will be the responsible person to guide the overall process related to social and gender aspects. The implementing agencies will execute and monitor the social/R&R/gender components in consultation with the expert. He/ she will be associated in the screening process of such activities that require eviction of encroachers/ squatters and/or involvement of women. He/ she will monitor the social processes followed in execution of the planned activities and realisation of the social / gender inclusion parameters. He/ she will be looking after social/ gender aspects of the project, including monitoring of social / gender indicators and coordinating with different agencies / institutions. The expert will be supported by the Patwari for land related issues.

**Public Relation Officer (PRO):** PRO will be responsible for managing all communication activities related to the metro project. This includes preparing press releases, organizing media events, and running public awareness campaigns to keep stakeholders and the public informed about project progress, important milestones and benefits. PRO also monitors news and social media coverage, responds to public questions and ensures regular updates about the GMRP construction and operations activities.

**General Consultant:** GMRL has engaged a consulting firm as the General Consultant (GC) to provide technical support and facilitate project implementation. GC will ensure that the project ESIA, ESMP and E&S Monitoring Plan is effectively followed during project implementation.

The GC will deploy a team comprising a Senior Environment Expert, a Social Safeguard Expert, and a Chief Safety Expert, supported by an Occupational Health and Safety Expert. These experts will assist the GMRL in updating or modifying the ESIA and ESMP, if required. They will work in close coordination with GMRL's E&S experts, facilitating agencies, and relevant line departments. They will ensure that project interventions align with the ESMP and the E&S Monitoring Plan and will support the effective implementation and monitoring of mitigation measures.

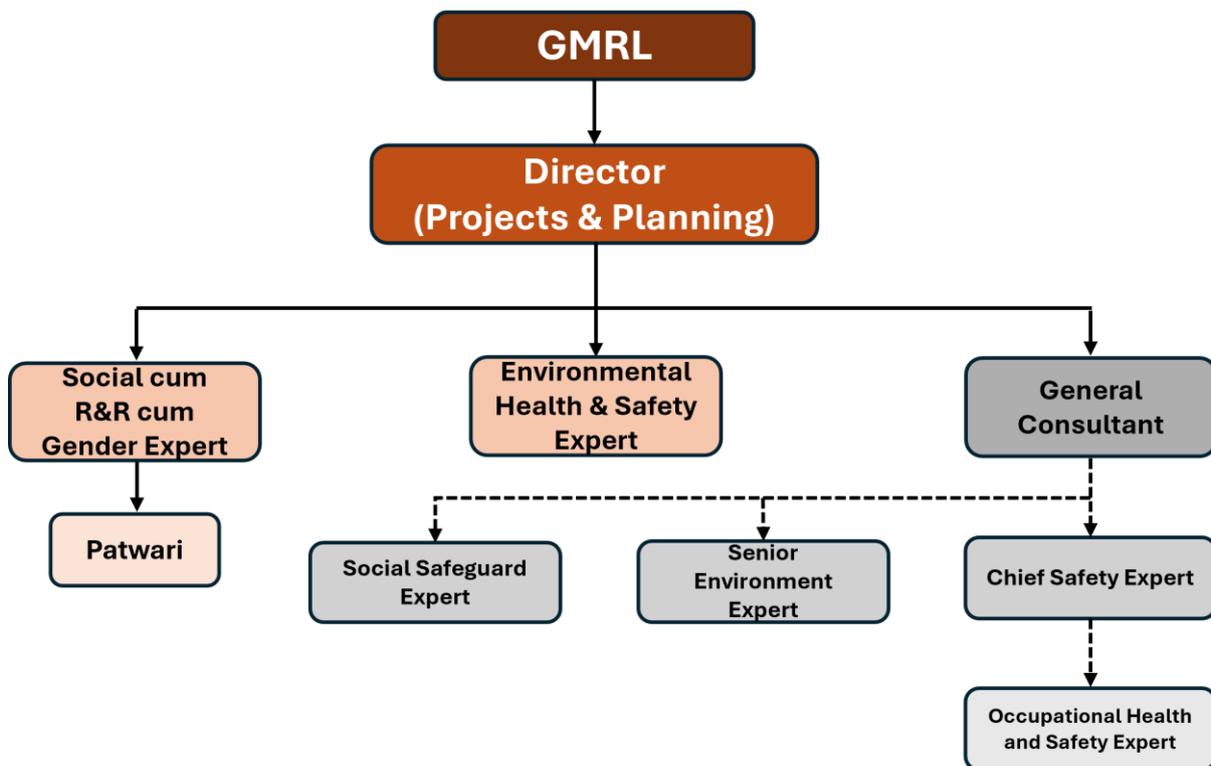
**External Environmental and Social Monitoring (EESM) Agency:** An EESM agency will be engaged to monitor and evaluate the project implementation. ESSM agency will assess the implementation of the ESMP, RAP, SEP and LMP along with other related monitoring activities. The agency will also be responsible for conducting mid-term and end-term evaluations of ESMP implementation.

**RAP Implementation Support Agency:** A RAP Implementation Support Agency has been appointed to facilitate the implementation of the RAP. The agency engaged by GMRL, will act as a facilitator and serve as a link between GMRL and the affected persons and communities, ensuring smooth and effective execution of RAP-related activities.

**Contractor:** Project contractor will implement the ESMP measures, enhancement measures and measures as directed by GMRL and GC. The responsibility to implement the ESMP measures will be built into the contractual agreement.

The Environmental and Social Management Unit (ESMU) needs to be set up by GMRL for the implementation of the ESMP and the EMoP. The organisational structure of ESMU is provided in **Figure 11-2**<sup>14</sup>. The roles and responsibility of ESMU officials are described in the above section.

Figure 11-2 ESMU Structure



<sup>14</sup> Social Safeguard Expert, Chief Safety Expert and Senior Environment Expert indicated by dashed lines in the figure are part of General Consultant

## 11.2 Reporting Structure

The contractor should submit monthly, quarterly and yearly reports on the compliance of environmental mitigation measures including environmental monitoring, to the GMRL.

- GMRL, with support from the GC, shall review the monthly compliance reports submitted by the contractor and provide necessary feedback and recommendations for their finalization and approval. GMRL shall submit quarterly E&S compliance reports to the Bank.
- Photographic monitoring records shall be maintained by the contractor. All key locations including material source points, disposal sites, plant and camp locations, etc. should properly documented through photographs.
- A full record of construction activities shall be maintained as part of the standard contract monitoring system across various stages of construction.
- The GMRL will prepare an online ESMP management tool to enable real time updates from all work sites directly.
- The reporting format for various activities during construction is given at **Annexure 9.1 to 9.10 and Annexure 11.1.**

## 11.3 Record Keeping

Monitoring forms shall be developed and utilized to focus attention on key environmental issues and to provide feedback for continuous improvement. All mitigation and enhancement measures adopted in the final design will be explicitly included in the Bill of Quantities (BOQ), so that performance and completion is readily documented. Project diaries will be maintained to record environmental issues (such as soil erosion, air quality, water quality, noise level, etc.), as well as safety incidents. These records will form part of the accepted environmental management system. GMRL will submit quarterly E&S performance reports to the WB throughout the project implementation period.

An Excel or Google Form-based system will be implemented for managing safeguard information and reporting safety incidents. In addition, the contractor will be required to maintain database/registers for the following:

- Local and migrant labour workforce
- Attendance and wage payment records
- Overtime details
- PPE issuance
- Accident and incident records
- Health check-up and fitness certification
- Safety and induction training sessions.

## 11.4 Grievance Mechanism

### a) Project GM

GMRL will establish a GM to respond to queries, clarifications and complaints related to project. The GM aims to address concerns, grievances and complaint from the PAPs/PAHs and other stakeholders in a timely, transparent and effective manner. It will focus on corrective actions that can be implemented quickly at no cost to the complainant and without fear of retribution.

The GM will address grievances arising from construction related activities, including issues such as loss of access, damage to private or common property, vibration, noise, dust due to excavation, inadequate traffic diversions, traffic mismanagement, community safety concerns and related issues. PAPs/PAHs may also raise grievances during the construction phase.

The GM will function independently in line with mandates and function established under GMRL. Public Relation Officer has been appointed by GMRL and will also serve as the communication expert. The details of GM including institutional arrangements, procedure for lodging complaints and timelines for grievance redressal are outlined in the SEP developed for the GMRP. The contact details of nominated GM Officer is under:

**Table 11-1: Contact Information of GM Officer**

S. No.	Name of GM Officer	Email Id
1	Ms. Shweta Verma	<a href="mailto:grievance@gmrl.org.in">grievance@gmrl.org.in</a>

### b) Contractor GM

Each contractor appointed under the GMRP will be required to establish a GM to address labour related grievances. The GM shall have due representation of GC, Contractor, Workers and at least one-woman representative (from GC/contractor/workers). The GM will function under the supervision of the GMRL. The mandate for GM, Institutional arrangements, procedure for receiving complaints, time limits for redressal of complaints and escalation level for unresolved cases and resolution thereof will be finalised during the approval of C-ESMP by GMRL. GMRL will have an oversight of this labour GM. The GM will be established during the firm's mobilization phase. The minimum requirement for GM will include:

- Complaint/suggestion boxes and grievance registers at work and camp sites.
- Local grievance committee with GMRL and worker (including female) representation.
- Helpline number of GMRL representative for grievance reporting, including anonymous submissions.
- Awareness programs on grievance redressal rights.
- Assurance of non-retribution and timely closure of complaints.

Information about the GM, including its structure, procedures, and assurance of non-retribution, will be regularly shared with all workers through the following channels:

- Induction trainings, toolbox meetings and tailgate sessions.
- Pictorial illustrations and posters in the local language.
- Awareness campaigns focused on workplace safety and Emergency Response Plans
- Briefings on community safety and responsible behaviour while working in or nearby communities.

## Chapter 12: Environmental and Social Costs

### 12.1 Environmental and Social Costs

The estimated environmental and social costs for implementation of ESMP and EMoP during pre-construction, construction and operation phases of the proposed project amount to Rs. 2335.152 Lakh (US\$ 2.79 million), as detailed in **Table 12-1**.

**Table 12-1 Environmental and Social Cost**

S. No.	Item	Cost in Indian Rs. Lakh	Cost in US\$	Responsibility
1.	Compensatory Afforestation			
	for Alignment Section	95.52	114,384.78	GMRL
	for Depot	17.66	21,146.08	GMRL
2.	Environment Monitoring			
	During Construction	132.32	158,448.09	Contractor
	During Operation	101.22	121,207.04	GMRL
3.	Env & Social Management Unit	489.54	586,202.88	GMRL
4.	Rainwater Harvesting	479.90	574,659.32	Contractor
5.	Noise Barrier	522.105	625200.6	GMRL
6.	Bio Digesters with Reed bed at Stations	166.25	199,077.95	GMRL
7.	Depot			
	Effluent Treatment Plant (ETP)	15.00	17,961.92	GMRL
	Biodigester	02.50	2,993.65	GMRL
	Rainwater Harvesting	40.00	47,898.46	GMRL
	Green Belt	11.85	14,189.92	GMRL
	<b>Sub-Total</b>	<b>2122.865</b>	<b>25,42,046.27</b>	
8.	Miscellaneous (10% of Sub-Total)	212.28	249406.10	
	<b>Grand Total</b>	<b>2335.152</b>	<b>2,796250.9</b>	
			<b>2.79 million</b>	

<sup>15</sup>Note: 1 US\$ = 83.51 as on 10.05.2024

<sup>15</sup> In addition to the above environmental cost, the expenditure to implement ESMP measures during design phase, construction phase and operation phase as mentioned in the Table 9-1 will be the responsibility of DDC, Contractor and GMRL respectively.

## Chapter 13: Way Forward

This ESIA report comprehensively addresses all key aspects of the GMRP, including the project background, description, study area, and analysis of alternatives. It thoroughly examines applicable E&S regulations at the international, national, and state levels, and presents detailed baseline information covering VECs.

The ESIA has been identified impacts, which have been evaluated in line with the applicable WB's ESS. The stakeholder views are also considered and incorporated into the report.

All identified mitigation measures are included in the ESMP and RAP, which also details an Environmental Monitoring Plan, which need to be implemented during the pre-construction, construction, and operation phases. Additionally, the ESMP includes associated environmental costs to ensure effective implementation of the proposed measures.

Furthermore, the ESMP outlines the following additional technical studies and activities, which will be undertaken by the GMRL, DDC and contractors as part of continued project development:

- Building Condition Survey
- Chance Finds
- Traffic Management Study
- Light and Shadow Assessment
- Design interventions to eliminate pigeon nuisance
- Station design in accordance with IGBC Green Metro guidelines
- Detailed vibration studies during construction and operation
- Dynamic analysis to ensure structural safety
- Environmental audits related to pollution control, occupational health and safety, and pest management during integration of existing structures
- Updation or preparation of ESIA & RAP to reflect finalized designs and newly identified impacts
- Biodiversity Assessment and Preparation of Biodiversity Management Plan
- Incorporation of stakeholder suggestions during design development, including:
  - Provision of parking at metro stations
  - Refinement of alignment and station access points to minimize social impacts
  - Allocation of space for autos, e-autos, and taxis

**Annexure 1.1****List of Individuals and Organizations Involved in the ESIA**

<b>S. No.</b>	<b>Name of Individual / Organization</b>	<b>Role / Contribution</b>
1	M/s Arihant Analytical Laboratory Pvt. Ltd	Environmental Monitoring (Air, Noise, Water, Soil)
2	N-Dimensional GIS Solution	GIS Studies
3	M/s IADEPT Marketing	Vibration Monitoring
4	M/s Bernard Gruppe	Census and Socio-Economic Study

## Annexure 2.1

## Key Applicable Legislations

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
1.	Environment (Protection) Act, 1986 and amended in 1991; Environment (Protection) Rules, 1986	To protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures. <b>Section 5 of Chapter-II:</b> Power to issue directions. (a) the closure, prohibition or regulation of any industry, operation, or process; or (b) stoppage or regulation of the supply of electricity or water or any other service. <b>Section 7 of Chapter III:</b> Not to allow emission or discharge of environmental pollutants in excess of the standards. <b>Section 8 of Chapter-III:</b> Handling hazardous substances to comply with procedural safeguards.	The various environmental quality standards notified under this act are applicable to this project. <ul style="list-style-type: none"> <li>• Compliance to general standards for discharge of environmental pollutants</li> <li>• Overall Environmental Protection</li> </ul>	Applicable
2.	EIA Notification, 2006, and subsequent amendments	Environment Clearance required for new, modernization and expansion projects listed under 39 categories of Schedule of the notification.	Metro rail projects are not listed in the prescribed categories. However, construction of building for commercial purposes (shopping complex, offices etc) having built area equal to or more than 20,000 sqm shall require prior EC from SEIAA.	Applicable if the stations are planned for commercial development or if depots are more than area threshold
3.	Metro Rail Transit System, Guidelines for Noise and Vibrations, RDSO, Ministry of Railways, September 2015	To minimise the impacts of noise and vibration, during construction and operations of metro corridor.	Recommended norms and precautionary measures for noise and vibrations for metro corridor in India.	Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
4.	Forest (Conservation) Act 1980 amended in 2023; Forest (Conservation) Rules 2003	To protect and manage forest, to check deforestation by restricting conversion of forest areas into non-forest areas. Section 2, Restriction on the use of forest land for non-forest purpose.	Entry/exit of Sector-10 metro station falls in forest area, which is unclassified Forest area. During field visits, the flora observed in the area is only Kikar; and surrounding area is fully developed residential area.	Applicable
5.	Haryana Forest Policy, 2006	To conserve and protect forest ecosystems, including biodiversity, wildlife habitats, and fragile ecosystems, from degradation and destruction.		Applicable
6.	The Wildlife (Protection) Act (WPA), 1972, amended in 2022	Protection of animals and specified plants. Section 27 - Restriction on entry in sanctuary; Section 28 - Grant of permit; Section 33 - Control of sanctuaries.	Sultanpur National Park is located within 10 km of the proposed project. The notified Eco Sensitive Zone (ESZ) of the National Park is up to 5 kms from the boundary of the protected area of the park. The proposed metro corridor is not passing through boundary of the National Park and its notified ESZ. Therefore, the wildlife clearance is not required for this project.	Not Applicable
7.	The Biological Diversity Act, 2002 and its Rules, 2004	For conservation and sustainable use of Biodiversity. As per the provision of Act, certain areas which are rich in biodiversity and encompass unique and representative ecosystems are identified and designated as biosphere reserve to facilitate its conservation.	The water bodies which lie in 10 km on either side of the alignment are: <ul style="list-style-type: none"> <li>• Sultanpur National Park: 8.2 km</li> <li>• Najafgarh Jheel: 4.7 km</li> <li>• KBA/IBA in Sector 101, Basai: 50 m</li> <li>• Basai Pond: adjacent to metro alignment.</li> </ul>	Not Applicable
8.	Wetland (Conservation and Management Rules), 2017	To conserve, manage and maintain the ecological character of the wetlands without restricting wise use.  Section 3 clause (a): wetlands categorized as 'wetlands of international importance' under the Ramsar Convention. Section 4, clause (2): Activities shall be prohibited within the wetlands.	Out of the above, Sultanpur National Park is notified, and the proposed metro corridor is not passing through boundary of the National Park and its notified ESZ.	Not Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
		<p>Sub clause (i): Conversion for non-wetland uses including encroachment of any kind.</p> <p>Sub clause (vi): Any construction of a permanent nature except for boat jetties within fifty metres from the mean high flood level observed in the past ten years calculated from the date of commencement of these rules.</p>	<p>Najafgarh Jheel and KBA/IBA in Sector 101, Basai are not notified till date by Central/State Government.</p> <p>The alignment crossing streams/nalas as detailed in <b>Table 5-9</b>.</p>	
9.	The Ancient Monuments and Archaeological Sites and Remains Act, 2010	Preservation of ancient and historical monuments and archaeological sites and remains of national importance. To regulate the archaeological excavations and protection of sculptures, carvings etc.	One archaeological site is falling within 10 km radius of the proposed metro corridor i.e. Mosque of Ala Vardi Khan. The location of the mosque is 490 m away from the alignment (near to Bajghera road metro station). No impact is anticipated due to the proposed metro project.	Not Applicable
10.	The Treasure Trove Act, 1878	To regulate the ownership and disposition of treasure troves discovered in India. A treasure trove typically refers to any valuable items such as coins, bullion, jewellery, or artifacts that are found hidden or concealed in the ground or in structures, with no known owner.	Applicable to the project if during construction or excavation for metro projects, any valuable historical artifacts or objects of archaeological significance are discovered.	Applicable if any chance find occurs.
11.	The Antiquities and Art Treasures Act, 1972 and its rules	To regulate the export, import, and ownership of antiquities and art treasures in the country and to prevent the illegal trafficking of cultural heritage items, protect national treasures, and promote their preservation for future generations.	Protection and preservation of cultural heritage could apply if archaeological artifacts are discovered during construction activities of the project.	Applicable if any archaeological artifacts are discovered.
12.	Aircraft Act 1934 with Aircraft (Amendment) Act, 2007 (44 of 2007) & Ministry of Civil Aviation (Height Restrictions for	Sub Rule 3 of Height restrictions for safeguarding of aircraft rules: No structure higher than the height specified within the 20 km of Aerodrome Reference Point of the civil and defence aerodromes	Indira Gandhi International Airport, Delhi is situated within 10 km on either side from the proposed alignment.	Not Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
	Safeguarding of Aircraft Operations) Rules, 2015 and its amendment	Rule 4: No structure shall be constructed or erected, or any tree planted or grown on any land.	The height of all proposed structures of the metro project are lower than the permissible height. So, Sub rule 3 is not applicable.	
13.	Water (Prevention and Control of Pollution) Act, 1974 amended in 1988; Water (Prevention and Control of Pollution) Rules, 1975 amended in 2011 The Water (Prevention and Control of Pollution) Cess Act, 1977 amended in 2003	<p>To manage water quality standards (Link at <b>Annexure 2.4</b>) and effluent standards (Link at <b>Annexure 2.4</b>), as well as monitoring water quality (Link at <b>Annexure 2.4</b>), prosecuting offenders and issuing licenses for construction and operation of certain facilities.</p> <p>Cess Act 1977 is for the levy and collection of a cess on water consumed by persons operating and carrying on certain types of industrial activities. This cess is collected with a view to augment the resources of the Central Board and the State Board for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974.</p> <ul style="list-style-type: none"> <li>• Section-19 3(a): alters any water pollution, prevention and control area whether by way of extension or reduction.</li> <li>• Section-19 3(b): define a new water pollution, prevention and control area in which may be merged one or more water pollution, prevention and control areas, or any part or parts thereof.</li> <li>• Section 24: Prohibition on use of stream or well for disposal of polluting matter.</li> <li>• Section 25 &amp; 26: Require consent to establish or operation of any industry from the board.</li> </ul>	<p>Applicability to proposed metro corridor and proposed stations for</p> <ul style="list-style-type: none"> <li>• Stormwater Management</li> <li>• Wastewater Discharge</li> <li>• Protection of Water Bodies</li> </ul> <p>Consent to establish and operate to be obtained for operation of Depot.</p>	Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
14.	<p>Air (Prevention and Control of Pollution) Act, 1981 amended in 1987;</p> <p>Air (Prevention and Control of Pollution) Rules, 1982.</p>	<p>To control the Air polluting activities and when the emissions of any air pollutants into the air exceed the standards set by Central and State boards.</p> <ul style="list-style-type: none"> <li>• Section-16 2(b): plan and cause to be executed a nation-wide programme for the prevention, control or abatement of air pollution.</li> <li>• Section 17(a) to plan a comprehensive programme for the prevention, control or abatement of air pollution and to secure the execution thereof.</li> <li>• Section 21: Restriction on use of certain industrial plant requires consent to establish or operate any plant from the board.</li> <li>• Section 22: Persons carrying on industry etc not to allow emission of air pollutants in excess of the standards laid down by the board under Section 17(1)(19).</li> </ul>	<p>The project activities emit air pollutants during construction and operation phases.</p> <p>Consent to establish and operate to be obtained by contractor for operation of DG sets, and ready-mix plant etc.</p> <p>Consent to establish and operate to be obtained for operation of Depot.</p>	Applicable
15.	<p>National Ambient Air Quality Standard - CPCB order Dated 18<sup>th</sup> November, 2009</p>	<p>The regulation sets limits for air quality parameters for Residential, Commercial, ecologically sensitive area (Link at <b>Annexure 2.4</b>).</p> <p>Industry not to allow emission of air pollutants in excess of the standards laid down under section 17(1)(19) of Air act.</p>	<p>The project generates pollutants during construction and operation phases.</p>	Applicable
16.	<p>Graded Response Action Plan (GRAP)</p>	<p>GRAP is a framework to combat air pollution in Delhi and surrounding areas. It defines different stages of air quality (Poor, Very Poor, Severe, Severe+) based on the Air Quality Index (AQI) and outlines corresponding actions to be taken by authorities and citizens to reduce pollution. The GRAP for the NCR under 4 stages:</p>	<p>Under GRAP, Construction activities permitted for metro projects up to stage – III (AQI &lt; 450).</p>	Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
		Stage - I 'Poor'(AQI 201 - 300), Stage - II 'Very Poor (AOI 301-400), Stage - III 'Severe' (AOI 401-450) Stage - IV 'Severe +' (AQI >450)	The activities are not permitted during stage – IV (AQI > 450).	
17.	Noise Pollution (Regulation and Control) Rules, 2000	To enforce noise pollution control measures <ul style="list-style-type: none"> <li>• According to the provisions of the rules, a person could make a complaint to the designated authority if the actual noise levels exceed the ambient noise standards by 10 dB (A) or more as compared to the standards prescribed. The equipment used during the construction should have acoustic enclosure. Rule 3: Ambient air quality standards link is given at <b>Annexure 2.4</b>. The rules specify maximum permissible noise levels for different times of the day (daytime and nighttime) in each category of area.</li> <li>• Sub rule 5 A of Rule 5: Restriction on the use of horns, sound emitting construction equipment’s during nighttime in the residential area and silence zones.</li> </ul>	Noise generated during construction and operation phase of the project. The noise levels shall be controlled to avoid disturbances to nearby sensitive receptors.	Applicable
18.	Solid Waste Management Rules, 2016 amended in 2020	Management (Collection, Handling, Storage, Treatment and Disposal) of solid waste.  Section 4: Segregate and store the waste generated in three separate streams namely bio-degradable, non-biodegradable and domestic hazardous wastes in suitable bins and handover segregated wastes to authorised waste pickers or waste collectors as per the direction or notification by the local authorities from time to time.	Applicable at all stages throughout the project.	Applicable
19.	Hazardous and Other Wastes (Management	To ensure the protection of the environment and human health from the adverse effects of hazardous and other	Applicable at all stages throughout the project.	Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
	and Transboundary Movement) 2016 and its amendments	wastes. To control the import and export of hazardous and other wastes to prevent illegal trafficking.		
20.	Plastic Waste Management Rules 2016 and its amendments	Management of Plastic waste. <ul style="list-style-type: none"> <li>• Rule 8, Responsibility of the waste generators. Storage of waste at source and handover the segregated waste to urban local body, Extended Producer Responsibility (EPR) agencies, aggregators, recyclers.</li> </ul>	Applicable at all stages throughout the project.	Applicable
21.	E-waste (Management) Rules 2022 and its amendments	Management of E waste including solar panel, cells, batteries etc. <ul style="list-style-type: none"> <li>• Rule 8, Responsibility of consumer or Bulk Consumer.</li> </ul>	Applicable at all stages throughout the project.	Applicable
22.	Battery Waste Management Rules 2022	To ensure environmentally sound management of batteries. The rules cover all types of batteries, viz. Electric Vehicle batteries, portable batteries, automotive batteries and industrial batteries. The rules function based on the concept of Extended Producer Responsibility (EPR) where the producers (including importers) of batteries are responsible for collection and recycling/ refurbishment of waste batteries and use of recovered materials from wastes into new batteries.	Portable batteries and EVs can have roles in supporting metro systems indirectly like emergency power, service vehicles, station mobility.	Applicable
23.	Construction and Demolition Waste Management Rules, 2016	Management of waste resulting from waste from construction, re-modelling, repair and demolition of any civil structure. Section 4, Clause 3 and 5: Duties of the waste generator. Waste generators who generate more than 20 tons or more in one day or 300 tons per project in a month shall have to segregate the waste, submit waste management plan.	The project will generate C&D waste during construction phase.	Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
24.	Categorization of industries - CPCB Order Dated 7th March 2016	The purpose is to categorize industries based on their potential to cause pollution. (Red, Orange, Green, and White - with Red being the most polluting and White being non-polluting)	The project requires Ready Mix Concrete (RMC) plant during construction phase, which is categorized as Green Category.	Applicable
25.	National Building Code, 2016	Provides guidelines for regulating the building construction activities across the country.	Stations and depot structures need to be designed as per the code provisions and fire codes.	Applicable
26.	Town and Country Planning Notification, Government of Haryana, Sep 2012	Land use definition and allocation for various purposes.	Change in Land Use	Applicable
27.	Central Motor Vehicle Act, 1988 and Central Motor Vehicle Rules, 1989	To check vehicular air and noise pollution. Chapter V: Construction Equipment and maintenance of Motor Vehicle.	Construction Equipment & vehicles during construction.	Applicable
28.	Energy Conservation Act, 2001	To conserve natural resources and enhance energy security by minimizing energy wastage.	By integrating energy-efficient design, technologies, and management practices, can minimize energy consumption, reduce operational costs.	Applicable
29.	Disaster Management Act, 2005	To establish institutional mechanisms at the national, state, and district levels for disaster management.	The project areas fall under the seismic (earthquake prone) zone IV and hence any construction activities/ interventions will be under purview of this act.	Applicable
30.	The Haryana State Disaster Management Rules, 2010	To enhance the state's preparedness to effectively manage and respond to disasters of all kinds, including natural and man-made disasters.		
31.	The Ozone Depleting Substances (Regulation and Control) Rules, 2000 and its amendment	To control and manage the production, import, export, and use of substances known to deplete the ozone layer.	The instruments, equipment's etc, which are free from Ozone Depleting Substances (ODS) may be used in the project.	Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
32.	The Manufacture, Storage and Import of Hazardous Chemical Rules 1989 and its amendments	To ensure the safe handling, storage, transportation, and disposal of hazardous chemicals.	Applicable for hazardous chemicals that shall be used in the project as per the list in schedule of rules.	Applicable
33.	Haryana Water Resources (Conservation, Regulation and Management) Authority Act, 2020 and its amendment 2022 and Haryana Water Resources Authority (HWRA), Notification dated 23.12.2020	For conservation, management and regulation of water resources i.e. ground water and surface water within the State of Haryana for ensuring the judicious, equitable and sustainable utilization, management and regulation.	For groundwater extraction in over-exploited assessment units, NOC for infrastructure projects need to be obtained from HWRA subjected to non-availability of treated sewage within 10 km radius.	Applicable
34.	Private Security Agencies (Regulation) Act, 2005	The act regulates private security agencies and their personnel. It mandates that private security agencies must obtain a license and comply with certain training and operational standards.	If the project employs private security agencies to protect the site, the personnel, and the assets, these agencies must comply with the PSARA requirements. This includes obtaining a PSARA license and adhering to the guidelines.	Applicable
<b>Social Regulations</b>				
1.	The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act, 2013	The act provides for a transparent process and fair compensation in land acquisition for public purpose and provides for rehabilitation and resettlement of landowners and those affected by land acquisition. It comprises four schedules that provide the minimum applicable norms for compensation based on market value, multiplier and solatium; Resettlement and Rehabilitation (R&R) entitlements to landowners and livelihood losers; and facilities at resettlement sites for displaced persons,	This act has several provisions that are highly relevant for the development of metro corridor, as it affects the acquisition of land for infrastructure projects like metro rail systems. The relevance of this act for the development of metro corridor are: 1. Fair compensation	Applicable to this project when private land to be acquired on an involuntary basis.

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
		besides providing flexibility to states and implementing agencies to provide higher norms for compensation and R&R. This act is applicable for supporting the continuous business activities during the works or livelihood restoration.	2. Consent of affected families 3. Rehabilitation and Resettlement 4. Social Impact Assessment (SIA) 5. Transparency and Public Consultation	
2.	The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (Haryana Amendment) Act, 2017	The Haryana-specific amendment allows the state government to de-notify land acquired under the Land Acquisition Act, 1894 if the public purpose becomes unviable or unnecessary. Section 101(A) empowers this, ensuring compensation including alternative land and damages for landowners if the acquired land has been utilized or constraints created.	The project requires acquisition of private land. The act applicable to all sub- projects when private land is required to acquired involuntary basis for Haryana State.	Applicable when private land to be acquired on an involuntary basis.
3.	GMRL Policy for Direct Purchase of Private Land/Property through Mutual Negotiations	This policy facilitates land or property purchase through mutual Negotiation/Direct Purchase.	This policy shall be applied in cases where private land acquisition is required to be purchased for the project.	Applicable when private land to be acquired on a voluntary basis.
4.	Street Vendor Act, 2014	The Act mandates town vending committees (TVC) to survey all local street vendors at least once in every five years. A TVC must accommodate all surveyed vendors subject to the holding capacity of the vending zones. Until a survey is complete, no street vendor is to be evicted. The state is to specify the manner of conducting the survey in the scheme.	Relocation of squatters, kiosk etc. during the project implementation.	Applicable
<b>Other Relevant Acts and Policies</b>				
1.	Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013	It aims to set out effective measures to avoid & to eliminate & if necessary to impose punishment for any sexual harassment in the workplace.	It places responsibilities on employers and the management of metro construction projects to take measures to prevent and address sexual harassment.	Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
2.	Bonded Labour System (Abolition) Act, 1976 along with Rules, 1976	To prevent the economic and physical exploitation of the weaker sections of the people and for matters connected therewith or incidental thereto.	To protect the rights and well-being of the labor .	Applicable
3.	The Child Labour (Prohibition and Regulation) Act, 1986 and 2016 amendment	The act lays out: <ul style="list-style-type: none"> <li>• Complete Ban on Child Labor</li> <li>• Adolescent labour regulations</li> <li>• Safety and Welfare Measures</li> <li>• Education and Awareness</li> <li>• Prohibition on Bonded Labor</li> </ul>	It is crucial for metro development authorities, contractors, and relevant government agencies to aware and adhere to these provisions to ensure the protection and well-being of children and adolescents and to comply with the law.	Applicable
4.	Contract Labour (Regulation and Abolition) Act 1970 and rules	To prevent exploitation of contract labour and also to introduce better conditions of work.	as there will be labor invovled in construction, this act ensures that labour contractors comply with the legal provisions and obligations. The contractors require to obtain licenses for employing contract labour.	Applicable
5.	Employees Provident Funds and Miscellaneous Provisions Acts 1952 along with EPF Scheme Rules and Forms	It is a beneficent piece of social welfare legislation aimed at promoting and securing the well-being of the employees. It ensures that workers receive provident fund benefits, which can provide financial security and retirement savings, and it places obligations on employers to make contributions and maintain records.	This legislation is vital in safeguarding the interests of employees in the construction industry, including those involved in metro corridor construction.	Applicable
6.	Employees State Insurance Act 1948 along with Rules and Regulations	Protect the interest of workers in contingencies such as sickness, maternity, temporary or permanent physical disablement, death due to employment injury resulting in loss of wages or earning capacity. Act also guarantees reasonably good medical care.	During Construction and Operation phases, employees have access to healthcare and various benefits in case of sickness, injury, or other contingencies while working in the construction industry.	Applicable
7.	Equal Remuneration Act, 1976 along with allied Rules	Payment of equal remuneration to men and women workers and for the prevention of discrimination, on the ground of sex, against women in the matter of	Relevant as it addresses the issue of pay equity and non-discrimination in remuneration based on gender. This	Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
		employment and for matters, connected therewith or incidental thereto.	includes the following: 1. Equal Pay for Equal Work 2. Non-Discrimination 3. Provisions for Maternity Benefits 4. Registration and Filing of Returns etc.	
8.	Inter State Migrant Workmen (Regulation of Employment and Conditions Service) Act, 1979	To protect workers whose services are requisitioned outside their native states in India. Whenever an employer faces shortage of skills among the locally available workers, the act creates provision to employ better skilled workers available outside the state. It is designed to protect the rights and welfare of inter-state migrant workmen by regulating their employment, working conditions, and ensuring their proper accommodation and transportation.	This legislation is essential in safeguarding the interests and well-being of labourers who migrate from one state to another to work on construction projects like metro corridor.	Applicable
9.	Minimum Wages Act 1948 along with Central Rules 1950	To ensure that workman gets at least minimum wages as fixed by Govt. Minimum wages sets the lowest limit below which wages cannot be allowed to sink. The Minimum Wages Act empowers appropriate governments (both central and state governments) to fix and revise minimum rates of wages for different scheduled employments.	To ensure that workers receive fair wages is crucial in the construction industry, where labor can be physically demanding and may involve hazardous conditions.	Applicable
10.	Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participations) Act, 1995 along with Rules, 1996 and National Trust for Welfare of Persons with Disabilities Act,1999 with rules 2000	It gives effect to the proclamation on the full participation and equality of the persons with disabilities in the Asian & Pacific Region and provides for their education, employment, creation of barrier free environment, social security, etc.	To ensure that infrastructure is accessible, that the rights of persons with disabilities are protected, and that opportunities for their participation in the workforce and society are promoted within the construction industry and public transportation systems.	Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
11.	The Rights of Persons with Disabilities Act, 2016	To ensure equality, non-discrimination, and full participation of PWDs in society by providing them with legal safeguards, entitlements, and opportunities for empowerment.	Applicable for PWD are present and affected in the project.	Applicable
12.	Guidelines and space Standards for Barrier Free Built Environment for Disabled and Elderly persons, 1998	To ensure accessibility and inclusivity in architectural design and urban planning for disabled and elderly persons.	Adherence to guidelines is crucial for ensuring equitable access to public transportation, which will promote independence and mobility for individuals with disabilities and the elderly persons. All metro stations are planned in compliance to these guidelines.	Applicable
13.	Workmen’s Compensation Act, 1923 & its rules and amendments	It provides compensation to employees or their dependents in case of injuries or death arising out of and in the course of employment. The Act is aimed at ensuring financial protection for workers and their families in the event of accidents or injuries at the workplace.	In the case of metro corridor construction, the employers (employer, contractors, construction companies, etc.) are responsible for providing compensation to the affected workers or their dependents in case of accidents or injuries at the workplace.	Applicable
14.	Right to Information Act, 2005	Empower the citizens, promote transparency and accountability in working of public authority.	To promote transparency, accountability, and citizen engagement in government projects, including the construction of metro corridor. It empowers citizens to access critical information, participate in decision-making processes, and hold public authorities responsible for their actions, contributing to good governance and public interest.	Applicable
15.	The Building and Other construction Workers (Regulation of Employment and	To regulate the employment and conditions of service of building and other construction workers and to provide for their safety, health, and welfare measures.	All construction-related activities, including incidents, the deployment of OHS personnel, worker’s camp, construction camp, etc.	Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
	conditions of Services) Act, 1996	Chapter VI: Hours of Work, Welfare Measures and other condition of Service of Building Workers. Chapter VII: Safety and Health Measures.		
16.	The Building and Other Construction Workers Welfare Cess Act, 1996	Provides for levy and collection of a cess on the cost of construction incurred by employers to augmenting the resources of the Building and Other construction Workers' welfare Board constituted under Building and Other construction workers (Regulation of employment and conditions of service) Act, 1996	Provides for their safety, health and welfare measures and other matters connected therewith or incidental thereto	Applicable
17.	The Payment of Wages Act, 1936	Lays down as to by what date, wages are to be paid, when it will be paid and what deductions be made from the wages of the workers, if any.	Intended to protect employees from unlawful employer deductions and/or unjustifiable salary delays	Applicable
18.	The Payment of Gratuity Act, 1972	Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation, if an employee has completed 5 years of service with employer.	Provides payment of gratuity at the rate of 15 days wages for each completed year of service subject to a maximum of Rs. ten lakhs.	Applicable
19.	The Maternity Benefit Act, 1961	Protects the employment of women during the time of her maternity and entitles her of a 'maternity benefit' - i.e., full paid absence from work - to take care for her child. The act is applicable to all establishments employing 10 or more persons.	Act regulates employment of women in certain establishments for a certain period before and after childbirth and provides for maternity and other benefits.	Applicable
20.	Haryana Maternity Benefit Rules, 1967	To provide maternity benefits to women employees working in various establishments in the state of Haryana.	Applicable to the project for women employees for provisions related to maternity leave, payment of maternity benefits, and other related matters to ensure the welfare of women employees during pregnancy and childbirth.	Applicable
21.	The Payment of Bonus Act, 1965	Provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages.	Provides for a minimum bonus of 8.33 percent of wages	Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
22.	The Trade Union Act, 1926	Lays down the procedure for registration of trade union of workers and employers. The trade unions registered under the Act have been given certain immunities for civil and criminal liabilities.	Provide opportunities to constitutes unions.	Applicable
<b>Labor Codes</b>				
1.	The Code on Wages, 2019	Code on Wages, 2019, serves as a comprehensive legal framework that addresses various aspects of wage regulation and workers' rights, with the ultimate goal of promoting fairness and justice in employment relationships while simplifying compliance for employers.	It is essential for employers, contractors, and relevant authorities to ensure that all labour laws and regulations are followed to safeguard the rights and well-being of workers, including their wages and working conditions.	Details are given at end of table.
2.	The Occupational Safety, Health and Working Conditions Code, 2020	To promote the safety, health, and well-being of workers and regulating working conditions in India.	This code is designed to ensure the safety and well-being of workers and regulate working conditions, making it crucial for construction projects, including metro corridor development.	
3.	The Code of Social Security, 2020	It is a comprehensive piece of legislation with the overarching goal of extending social security benefits to a wider range of workers and promoting their welfare and economic security. It provides a legal framework to ensure that workers receive the social security benefits during various life stages and challenging situations.	The act mandates the imposition of a cess for the welfare and social security of building workers involved in metro corridor construction. The cess rate should range from one to two percent of the construction cost incurred by the employer, as determined by government notifications.	
4.	The Industrial Relations Code, 2020	The Industrial Relations Code, 2020 is part of a broader labour law reform agenda in India and is aimed at balancing the interests of employers and employees while fostering a more conducive environment for industrial growth.	It is part of the broader labour law framework in India and can indirectly impact labour practices and employment conditions in various sectors, including the construction industry. Employers and employees should be aware of the code's provisions and ensure compliance with	

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
			relevant labour laws to maintain healthy labour relations and minimize labour-related disputes on construction sites.	
<b>International Conventions</b>				
1.	Forced Labour Convention, 1930 (No. 29)	Prohibits all forms of forced or compulsory labour, which is defined as “all work or service which is exacted from any person under the menace of any penalty and for which the said person has not offered him voluntarily.” The convention also requires that the illegal extraction of forced or compulsory labour is punishable as a penal offence and that ratifying states ensure that the relevant penalties imposed by law are adequate and strictly enforced.	Construction of any infrastructure project, the Forced Labour Convention (No. 29) is highly relevant because it addresses issues related to labour rights, fair employment practices, and the prevention of exploitation.	Applicable
2.	Abolition of Forced Labour Convention, 1957 (No. 105)	Prohibits forced or compulsory labour as a means of political coercion or education or as a punishment for holding or expressing political views or views ideologically opposed to the established political, social, or economic system; as a method of mobilizing and using labour for economic development; as a means of labour discipline; as a punishment for having participated in strikes; and as a means of racial, social, national, or religious discrimination	Construction of a metro corridor or any infrastructure project, the Abolition of Forced Labour Convention (No. 105) is relevant for the same reasons as Convention No. 29. Both conventions are aimed at eradicating forced labour, and they share many key provisions.	Applicable
3.	Equal Remuneration Convention, 1951 (No. 100)	Lays out the principles for equal remuneration for work of equal value and addresses gender discrimination. This convention aims to promote and ensure equal remuneration for men and women workers for work of equal value.	It is relevant to the construction industry and infrastructure projects for several reasons: 1. Gender Equality 2. Work of equal value 3. Non – Discrimination 4. Promoting women in the construction industry 5. Legal framework	Applicable

S. No	Legislation	Purpose	Relevant to Development of Metro Corridor	Applicability
4.	Discrimination (Employment and Occupation) Convention, 1958 (No. 111)	Prohibits all discrimination and exclusion on any basis including of race or colour, sex, religion, political opinion, national or social origin in employment and repeal legislation that is not based on equal opportunities.	It is relevant, as it addresses the issue of discrimination in employment and occupation, ensuring that workers are treated fairly and without discrimination in all aspects of employment.	Applicable
5.	Minimum Age Convention, 1973 (No. 138)	To ensure the effective abolition of child labour and to rise progressively the minimum age for admission to employment or work. India has ratified this convention with minimum age at 14 years	As the convention sets guidelines for the minimum age at which individuals can be employed and the types of work that are prohibited for individuals under a certain age.	Applicable
6.	Convention concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour, 1999 (No. 182)	Prohibition and elimination of the worst forms of child labour, including slavery, forced labour and trafficking in human beings. It prohibits the use of children in armed conflicts, prostitution and pornography, illegal activities such as drug trafficking and dangerous work.	It is relevant as it is applicable to all types of construction projects.	Applicable

Note: Labour Codes Applicability: The rules prepared by States (including Haryana) and Union Territories, in accordance with the four labour codes established by the Central Government, aimed at consolidating 29 central labour laws covering wages, industrial relations, social security, occupational safety, welfare, and working conditions, have not been enforced yet. These codes will come into effect from a date to be notified by the Central Government, except for provisions already enforced. For instance, certain sections under the Code on Wages, 2019, related to the Central Advisory Board, and provisions under the Code on Social Security, 2020, relating to establishing employees' and their family members' or dependents' identities through respective Aadhaar numbers, have already been enforced.

**Annexure 2.2**

**Applicability of World Bank ESS**

ESS Standards	ESS Objectives	Applicability	Remarks
<p>ESS-1 Assessment &amp; Management of Environmental and Social Risks and Impacts</p>	<p>Identify, assess, evaluate, and manage environment and social risks and impacts in a manner consistent with the Environment. Adopt differentiated measures so that adverse impacts do not fall disproportionately on the disadvantaged or vulnerable, and they are not disadvantaged in sharing development benefits and opportunities.</p>	<p>The Project activities will have environmental and social impacts during project life cycle. Therefore, ESS 1 is applicable to the Project.</p>	<ul style="list-style-type: none"> <li>• Development of environmental and social action plans as appropriate.</li> <li>• Identification of project impacts.</li> <li>• Suggest environmental and social management plans appropriate to project impact.</li> <li>• Strengthening of organizational capacity.</li> <li>• Suggest training for security and safety workers.</li> <li>• Prepare emergency preparedness and response, Stakeholder engagement and grievance redressal plans.</li> <li>• Identify monitoring, reporting requirements for the Project.</li> </ul>
<p>ESS-2 Labor and Working Conditions</p>	<p>The ESS 2 applies to workers (construction and operation) directly engaged by the borrower (direct workers), workers engaged through third parties (contracted workers), as well as workers engaged by the client’s primary suppliers &amp; Contractor (supply chain workers). ESS 2 promotes safety and health at work. Promote the fair treatment, non-discrimination, and equal opportunity of project workers. Protect project workers, with particular emphasis on vulnerable</p>	<p>The Project will involve employment of direct and contractual workers during construction and operation phases. The labour hired during the Project life cycle need to be managed based on the requirement of WB ESS-2 of the Environmental and Social Framework.</p>	<ul style="list-style-type: none"> <li>• Identification of labour related impacts and occupational hazards.</li> <li>• Suggest mitigations and prepare Labour Management Plan (LMP) and project Grievance Redressal Mechanism (GRM).</li> </ul>

ESS Standards	ESS Objectives	Applicability	Remarks
	workers. Prevent the use of all forms of forced labor and child labour. Support the principles of freedom of association and collective bargaining of project workers in a manner consistent with national law. Provide project workers with accessible means to raise workplace concerns.		
ESS-3 Resource Efficiency and Pollution Prevention and Management	ESS-3 promote the sustainable use of resources, including energy, water, and raw materials. Avoid or minimize adverse impacts on human health and the environment caused by pollution from project activities. Avoid or minimize project-related emissions of short and long-lived climate pollutants. Avoid or minimize generation of hazardous and non-hazardous waste. Minimize and manage the risks and impacts associated with pesticide use.	Environmental impacts due air and noise emissions generated from DG sets, site preparation work, material handling and transportation is anticipated. The Project activities will need to comply with pollution prevention measures of WB ESS-3 of the Environmental and Social Framework.	<ul style="list-style-type: none"> <li>• Conduct primary surveys to gather information of baseline data on environmental parameters of the Project study area.</li> <li>• Identify project impacts on the environmental parameters.</li> <li>• Suggest mitigation, management, and monitoring plans.</li> </ul>
ESS-4: Community Health and Safety	Anticipate or avoid adverse impacts on the health and safety of project-affected communities during project life cycle from routine and non-routine circumstances. Promote quality, safety, and climate change considerations in infrastructure design and construction, including dams. Avoid or minimize community exposure to project-related traffic and road safety risks, diseases, and hazardous materials. Have in place effective measures to address emergency events. Ensure that safeguarding of personnel and property is	<p>This Standard is applicable to projects which entail potential risks and impacts to the health and safety of the host communities from project activities. The major community health and safety risks associated with the Project are mainly limited to the construction phase only.</p> <p>The major safety and risk involved in the Project are foreseen during excavation works and elevated structures. The other risks may include during movement of heavy machinery and vehicles carrying</p>	<ul style="list-style-type: none"> <li>• Conduct community interactions and discussion.</li> <li>• Identify risk involved on community due to construction and implementation of the Project.</li> <li>• Suggest mitigation, management plans.</li> <li>• Sensitisation of the community with respect to project benefit, impacts and grievance mechanism.</li> </ul>

ESS Standards	ESS Objectives	Applicability	Remarks
	carried out in a manner that avoids or minimizes risks to the Project-affected communities.	construction equipment on public access road.	
ESS 5: Land Acquisition, Restrictions on Land-use, and Involuntary Resettlement	Avoid or minimize involuntary resettlement by exploring project design alternatives. Avoid forced eviction. Mitigate unavoidable adverse impacts from land acquisition or restrictions on land use by providing compensation at replacement cost and assisting affected persons in their efforts to improve, or at least restore, livelihoods and living standards to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. Improve living conditions of poor or vulnerable persons who are physically displaced, through provision of adequate housing, access to services and facilities, and security of tenure. Conceive and execute resettlement activities as sustainable development programs.	The corridor is passing through areas of settlements in Gurugram City. Land for the Project will be required for elevated station, entry and exit, depot, casting yard etc.	<ul style="list-style-type: none"> <li>• Identification of the requirements of final alignment with Land Acquisition for both station and proposed route, as well as all other facilities.</li> <li>• Conduct a detailed social survey for collection of information on affected population, properties/structures, likely impact on land, type of ownership and social groups etc.</li> <li>• Enumeration of Community Property Resources (CPRs)</li> <li>• Prepare Resettlement Action Plan (RAP) to assess the feasibility and effectiveness of income restoration strategies.</li> </ul>
ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	Protect and conserve biodiversity and habitats. Apply the mitigation hierarchy and the precautionary approach in the design and implementation of projects that could have an impact on biodiversity. To promote the sustainable management of living natural resources.	The proposed project alignment is planned within the RoW of existing roads. However, there will be number of trees planted either side of roads to be either cut or transplanted for which necessary permission will be required from the Forest Department. The roadside plantations in the State have been notified as Protected Forests.	<ul style="list-style-type: none"> <li>• Conduct primary ecology and wildlife surveys to gather information on ecology of the Project study area.</li> <li>• Identify project impacts on the ecology.</li> <li>• Suggest specific mitigation, management, and monitoring plans.</li> </ul>

ESS Standards	ESS Objectives	Applicability	Remarks
<p>ESS 7: Indigenous People/ Sub Saharan African Historically Underserved Traditional Local Communities</p>	<p>Ensure that the development process fosters full respect for affected parties' human rights, dignity, aspirations, identity, culture, and natural resource-based livelihoods. Promote sustainable development benefits and opportunities in a manner that is accessible, culturally appropriate, and inclusive. Improve project design and promote local support by establishing and maintaining an ongoing relationship based on meaningful consultation with affected parties. Obtain the Free, Prior, and Informed Consent (FPIC) of affected parties in three circumstances. Recognize, respect, and preserve the culture, knowledge, and practices of Indigenous Peoples, and to provide them with an opportunity to adapt to changing conditions in a manner and in a timeframe acceptable to them.</p>	<p><b>Not applicable for this Project</b></p>	<p><b>Not applicable for this Project</b></p>
<p>ESS-8 Cultural Heritage</p>	<p>Protect cultural heritage from the adverse impacts of project activities and support its preservation. Address cultural heritage as an integral aspect of sustainable development. Promote meaningful consultation with stakeholders regarding cultural heritage. Promote the equitable sharing of benefits from the use of cultural heritage.</p>	<p>The alignment of the project road has ancient monuments and/or archaeological site(s), protected and few religious structures/shrines of local importance that are expected to be partially impacted by the proposed project</p>	<ul style="list-style-type: none"> <li>• Conduct primary surveys for identification of existing Private and Community Property Resources (CPRs) on both sides of the proposed Project alignment.</li> <li>• Identify any potential conflict and impacts on cultural and religious structure due to the Project.</li> <li>• Suggest mitigation, measures.</li> </ul>
<p>ESS-9 Financial Intermediaries</p>	<p>Sets out how Financial Intermediaries (FI) will assess and manage environmental and social risks and impacts associated with the</p>	<p>GMRL is not a Financial Intermediary (FI), thus WB ESS-9 is not applicable on the Project.</p>	<p><b>Not applicable</b></p>

ESS Standards	ESS Objectives	Applicability	Remarks
	<p>sub-projects it finances. Promote good environmental and social management practices in the sub-projects finance (FI). Promote good environmental and sound human resources management within the FI.</p>		
<p>ESS-10 Stakeholder Engagement and Information Disclosure</p>	<p>Establish a systematic approach to stakeholder engagement that helps Borrowers identify stakeholders and maintain a constructive relationship with them. Assess stakeholder interest and support for the Project and enable stakeholders' views to be considered in project design. Promote and provide means for effective and inclusive engagement with project-affected parties throughout the Project life cycle. Ensure that appropriate project information is disclosed to stakeholders in a timely, understandable, accessible, and appropriate manner.</p>	<p>Relevant as the Project will involve a wide variety of stakeholders throughout the Project cycle.</p>	<ul style="list-style-type: none"> <li>• Public Consultation and Focus Group Discussions and In-depth Interviews with stakeholders.</li> <li>• Identification of key stakeholders and preparation of Stakeholder Engagement Plan (SEP).</li> </ul>

## Annexure 2.3

## Clearances/Permissions required for the Proposed Project

S. No.	Clearance/Authorization	Act/ Rules/ Notifications	Competent Authority	Responsibility <sup>16</sup>
1.	Tree Cutting Permission	Forest Conservation Act, 1980	State Forest Department/ Municipal Corporation	GMRL
2.	Location/ layout of workers camp, equipment, and storage yards	Environment Protection Act, 1986 Manufacturing, Storage and Import of Hazardous Chemicals Rules, 1989	Haryana State Pollution Control Board (HSPCB)/ Municipal Corporation	Contractor
3.	Discharges from Labour Camp	Water (Prevention and Control of Pollution) Act, 1974 The Air (Prevention and Control of Pollution) Act, 1981	HPSCB	Contractor
4.	Permission for mining minerals (stones, aggregates, sand, earth, etc.) from quarries	Environment Protection Act, 1986	Mines and Geology Department	Contractor through authorised vendors/dealers
5.	Pollution Under Control certificate for vehicles	Central Motor Vehicle Act, 1988	Transport Department	GMRL & Contractor
6.	Employing Labour/ Workers	The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996	Labour Department	Contractor
7.	Fire Safety Clearance	National Building Code State Fire Prevention and Fire Safety Act/Rules Public Safety Standards of India	State Fire Department	Contractor
8.	Electrical Safety	Indian Electricity Act, 1910 re- enacted in 2003. Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010	Chief Electrical Inspector Department	GMRL/HMRYC Contractor

<sup>16</sup> The details provided in the above table are indicative. All subcontractors, GMRL, and other relevant parties must obtain all necessary permits and comply with all applicable regulations for their respective subprojects.

S. No.	Clearance/Authorization	Act/ Rules/ Notifications	Competent Authority	Responsibility <sup>16</sup>
9.	Environmental Clearance	EIA Notification 2006 & further amendments for Metro/ Railway	Not Required	-
10.		Construction of building for commercial purposes (Shopping Complex, offices etc) having built area equal to or more than 20,000 sqm shall require Environmental Clearance from SEIAA as per the EIA notification 2006. The GMRL holds the responsibility engage NABET accredited environmental consultants to prepare Environmental Impact Assessment (EIA) reports and manage the clearance.	Required if the stations are proposed for commercial purposes.	GMRL
11.	Forest Clearance	Forest (Conservation) Act 1980	MoEF&CC	GMRL
12.	NOC for using Existing utility provision (Land Use Change)	Haryana Municipal Corporation Act, 1994 and Section 203 E of Haryana Municipal Act, 1973	GMDA	GMRL
13.	Consent to Establish (CTE) and Consent to Operate (CTO) for Depots, hot mix plant, crushers, batching plant.	Water (Prevention and Control of Pollution) Act 1974, Air (Prevention and Control of Pollution) Act 1981	HSPCB	GMRL Contractor
14.	Factory License / Registration	The Factories Act, 1948	Directorate of Industrial Safety & Health (DISH), Haryana	
15.	Permission for disposal of Construction and Demolition Waste	Construction and Demolition Waste Management Rules, 2016	HSPCB/ Municipal Corporation	GMRL Contractor
16.	Authorization for Disposal of Hazardous Waste	Hazardous and Other Wastes (Management, and Transboundary Movement) Rules, 2016	HSPCB/ Municipal Corporation	GMRL Contractor
17.	Municipal Solid Waste Authorization	Solid Waste Management Rules, 2016	HSPCB/ Municipal Corporation	GMRL Contractor
18.	Consent for disposal of sewage from labour camps	Consent from SPCB	HSPCB/ Municipal Corporation	Contractor
19.	Permission for Muck disposal	Environment (Protection) Act, 1986	HSPCB/ Municipal Corporation	GMRL Contractor

S. No.	Clearance/Authorization	Act/ Rules/ Notifications	Competent Authority	Responsibility <sup>16</sup>
20.	Chance Finds, if any	<ul style="list-style-type: none"> <li>The Treasure Trove Act, 1878</li> <li>The Ancient Monuments and Archaeological sites and Remains Act, 2010</li> </ul> The Antiquities and Art Treasures Act, 1972 and its rules	Art & Cultural Affairs Department	GMRL
21.	Pollution under control certificate for project vehicles	Central Motor and Vehicle Act, 1988	Department of Transport, Govt. of Haryana authorised testing centres	Contractor
22.	Employing Labour/ workers and labour related license and insurance	The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996  The Contract labour (Regulation and Abolition) Act, 1970 and Rules.  Employees State Insurance Act, 1948.  Interstate Migrant workmen (Regulation of employment and condition of service) Act, 1979,  Factories Act, 1948	District Labour Commissioner	GMRL Contractor
23.	Authorization for Disposal of E-waste Waste	E- Waste Management Rules, 2022	HSPCB	GMRL Contractor
24.	Authorization for Disposal of Plastic Waste	Plastic Waste Management Rules, 2016	HSPCB	GMRL Contractor
25.	Railway Department (permission as per section 16 of the act if required)	Railway Act, 1989 and amendment (Construction near Railway tracks)	Northern Railway zone, North Western Railway zone and North Central Railway zone	GMRL
26.	Safety Certification and Technical clearance of Metro Systems	Amendment to Metro Railway (Operation and Maintenance) Act, 2009	Research Designs & Standards Organisation	GMRL

S. No.	Clearance/Authorization	Act/ Rules/ Notifications	Competent Authority	Responsibility <sup>16</sup>
			(RDSO), Ministry of Railways	
27.	Approval for Traffic Diversion	The Motor Vehicle Act, 1988	Concerned Traffic Department	Contractor

**Annexure 2.4**

The table below provides links to the relevant standards issued by the Central Pollution Control Board (CPCB), IFC and WHO. These standards outline the permissible limits and regulatory requirements for a range of environmental parameters that must be adhered to during both the construction and operational phases of a project.

S. No.	Parameters	Link for the standards
1.	Drinking Water Quality Standards (IS 10500:2012)	<a href="https://cpcb.nic.in/wqm/BIS_Drinking_Water_Specification.pdf">https://cpcb.nic.in/wqm/BIS_Drinking_Water_Specification.pdf</a>
2.	Effluent Discharge Standards (Inland Surface Water)	<a href="https://cpcb.nic.in/displaypdf.php?id=R2VuZXJhbFN0YW5kYXJkcy5wZGY=">https://cpcb.nic.in/displaypdf.php?id=R2VuZXJhbFN0YW5kYXJkcy5wZGY=</a> <a href="https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-wastewater-and-ambient-water-quality-en.pdf">https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-wastewater-and-ambient-water-quality-en.pdf</a>
3.	Tolerance Limits for Inland Surface Water Quality	<a href="#">Designated_Best_Use_Water_Quality_Criteria.pdf</a>
4.	National Ambient Air Quality Standards	<a href="https://cpcb.nic.in/uploads/National_Ambient_Air_Quality_Standards.pdf">https://cpcb.nic.in/uploads/National_Ambient_Air_Quality_Standards.pdf</a> <a href="https://www.who.int/tools/air-quality-standards">https://www.who.int/tools/air-quality-standards</a>
5.	National Ambient Noise Standards	<a href="#">displaypdf.php</a> <a href="https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-noise-en.pdf">https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-noise-en.pdf</a>

## Annexure 2.5

## Comparison of ESF and National Regulation – Gaps and Remedies

World Bank Standards	Government of India Regulations	Gaps and Action
<p><b>ESS1:</b> Assessment and Management of Environmental and Social Risks and Impacts</p>	<ul style="list-style-type: none"> <li>• EIA notification 2006 and Its Amendments</li> <li>• RFTCLARR Act, 2013 Water (Prevention and Control of Pollution) Rules, 1975 amended in 2011 Air (Prevention and Control of Pollution) Act, 1981 amended in 1987</li> </ul>	<p>Gap Exists.</p> <p>As per the EIA notification, metro projects do not require Environmental Clearance (EC). However, as per EIA notification S.O.1533(E) dated 14.09.2006 construction of building for commercial purposes (Shopping Complex, offices etc) having built area equal to or more than 20,000 sqm falls under category B thus shall require prior EC from State Level Environment Impact Assessment Authority (SEIAA). As per ESS1, considering the construction activities, impacts on Environmental and Social components, and pollution discharge expected, the proposed project requires ESIA as per World Bank ESF. Accordingly, ESIA and other reports are prepared in accordance with World Bank ESF.</p> <p>For railway depot having discharge less than 100 KLD falls under orange category and shall require STP &amp; ETP.</p> <p>For railway depot having discharge more than 100 KLD falls under red category and shall require STP &amp; ETP.</p>
<p><b>ESS 2:</b> Labour and Working Conditions</p>	<ul style="list-style-type: none"> <li>• The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996</li> <li>• The Workmen's Compensation Act, 1923 &amp; its rules and amendments</li> <li>• The Inter State Migrant Workmen (Regulation of Employment and Conditions Service) Act, 1979</li> <li>• The Equal Remuneration Act, 1976 along with allied Rules</li> <li>• The Child Labour (Prohibition &amp; Regulation) Act, 1986 and 2016 amendment</li> </ul>	<p>Gaps exist in respect of i) need for labour GRM and ii) provision of some form of contract/MOU to informal workers.</p> <p>The national and state legal provisions meet the ESS2 requirements.</p>

World Bank Standards	Government of India Regulations	Gaps and Action
	<ul style="list-style-type: none"> <li>• The Building and Other Construction Workers Welfare Cess Act, 1996</li> <li>• The Sexual Harassment of Women at the Workplace (Prevention, Prohibition and Redressal) Act, 2013 (POSH Act)</li> <li>• The Contract Labour (Regulation &amp; Abolition) Act 1970 and rules</li> <li>• The Payment of Wages Act, 1936</li> <li>• The Minimum Wages Act 1948 and its Rules</li> <li>• The Payment of Gratuity Act, 1972</li> <li>• The Payment of Gratuity Rules Haryana 1972</li> <li>• The Employees Provident Fund and Miscellaneous Provision Act, 1952 and its rules</li> <li>• The Maternity Benefit Act, 1961</li> <li>• Haryana Maternity benefit Rules 1967</li> <li>• The Payment of Bonus Act, 1965 and its rules</li> <li>• The Bonded Labour (Abolition) Act, 1976 and its rules</li> <li>• Employees State Insurance Act, 1948</li> <li>• The Trade Union Act, 1926</li> </ul> <p>The New Labour Codes<sup>17</sup> of India</p>	

<sup>17</sup> Labour Codes Applicability: The rules prepared by States (including Haryana) and Union Territories, in accordance with the four labour codes established by the Central Government, aimed at consolidating 29 central labour laws covering wages, industrial relations, social security, occupational safety, welfare, and working conditions, have not been enforced yet. These codes will come into effect from a date to be notified by the Central Government, except for provisions already enforced. For instance, certain sections under the Code on

World Bank Standards	Government of India Regulations	Gaps and Action
	<ul style="list-style-type: none"> <li>• Code on Social Security, 2020</li> <li>• Code on Wages, 2019</li> <li>• Industrial Relation Code, 2020</li> <li>• Occupational Safety, Health, and Working Conditions Code, 2020</li> </ul>	
<p><b>ESS3:</b> Resource Efficiency and Pollution Prevention and Management</p>	<ul style="list-style-type: none"> <li>• In India, there are several statutes (Acts and Rules) which are enforced with respect to the pollution abatement. These include: <ul style="list-style-type: none"> <li>• The Environment (Protection) Act, 1986 and its rules and amendments</li> <li>• The EIA Notification, 2006, and subsequent amendments</li> <li>• The Metro Rail Transit System, Guidelines for Noise and Vibrations, RDSO, Ministry of Railways, September 2015</li> <li>• The Forest (Conservation) Act 1980 and its rules and amendments</li> <li>• The Biological Diversity Act, 2002 and its Rules, 2004</li> <li>• The Air (Prevention and Control of Pollution) Act, 1981 and its rules and amendments</li> <li>• National Building Code, 2016</li> <li>• Town and Country Planning Notification, Government of Haryana, Sep 2012</li> <li>• The Water (Prevention and Control of Pollution) Act,</li> </ul> </li> </ul>	<p>The majority of ESS3 requirements are addressed directly by existing regulations and indirectly for resource efficiency, pollution prevention, and management aspects</p>

Wages, 2019, related to the Central Advisory Board, and provisions under the Code on Social Security, 2020, relating to establishing employees' and their family members' or dependents' identities through respective Aadhaar numbers, have already been enforced.

World Bank Standards	Government of India Regulations	Gaps and Action
	1974 and its rules and amendments <ul style="list-style-type: none"> <li>• The Motor Vehicle Act, 1988</li> <li>• The Central Motor Vehicles Rules, 1989</li> <li>• The Energy Conservation Act, 2001</li> <li>• The Ozone Depleting Substances (Regulation and Control) Rules, 2000 and its amendment.</li> <li>• National Resource Efficiency Policy, 2019 (Draft)</li> <li>• The Manufacture, Storage and Import of Hazardous Chemical Rules 1989 and its amendments.</li> </ul>	
<b>ESS 4:</b> Community Health and Safety	<ul style="list-style-type: none"> <li>• The Environmental Protection Act, 1986 and its rules and amendments</li> <li>• The Disaster Management Act, 2005</li> <li>• The Haryana State Disaster Management Rules, 2010</li> <li>• The Rights of Persons with Disabilities Act, 2016</li> <li>• The Air (Prevention and Control of Pollution) Act, 1981 and its rules and amendments</li> <li>• The Water (Prevention and Control of Pollution) Act, 1974 and its rules and amendments</li> <li>• The Manufacture, Storage &amp; imports of Hazardous Chemicals (MSIHC) Rules, 1989 and its amendment</li> <li>• The Motor Vehicle Act, 1988</li> <li>• The Central Motor Vehicle Rules, 1989</li> <li>• Bureau of Indian Standards (BIS)</li> <li>• National Building Codes</li> </ul>	No Gap Exists. These existing laws and rules fulfil the community health and safety requirements.
<b>ESS 5:</b> LA, Restrictions on Land	<ul style="list-style-type: none"> <li>• The Right to Fair Compensation and</li> </ul>	Gap Exists between RFCTLARR Act, 2013 and ESS5.

World Bank Standards	Government of India Regulations	Gaps and Action
Use and Involuntary Resettlement	<p>Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013</p> <ul style="list-style-type: none"> <li>• The Right to Fair Compensation and Transparency in Land Acquisition Rehabilitation and Resettlement (Haryana Amendment) Act, 2017</li> <li>• GMRL Policy for Direct Purchase of Private Land/ Property Through Mutual Negotiations .<sup>18</sup></li> </ul>	<p>Gap exists specifically related a) to aspects such as the identification of non-titleholders (encroachers and squatters) as PAPs and cut off dates for non-titleholders; b) Act considers depreciation in asset whereas Bank ESS 5 requires that assets be valued without depreciation. The gaps are addressed with suitable provisions in EM.</p> <p>GMRL Policy: The compensation will be paid to all parties post-negotiation and will include 100% solatium on the cost of land and structures, along with an additional 25% above of the estimated value after applying the 100% solatium and shall be inclusive of R&amp;R entitlements in accordance with the Second Schedule of the RFCTLARR Act, 2013..</p>
<b>ESS 6:</b> Biodiversity Conservation and Sustainable Management of Living Natural Resources	<p>There are number of act and Rules enforced with respect to the Biodiversity and Habitat. These are as follows:</p> <ul style="list-style-type: none"> <li>• The Biological Diversity Act, 2002</li> <li>• The Forest (Conservation) Act, 1980 and its rules and amendment</li> <li>• The Wildlife (Protection) Act, 1972, and its amendments</li> <li>• The Wetlands (Conservation and Management) Rules, 2017</li> <li>• Haryana Forest Policy, 2006</li> </ul>	<p>No specific Gaps to be addressed as policy/regulations support biodiversity conservation, and livelihoods based on these exist in case of recognised sensitive features. However. Non-designated wetlands, ponds and other features are not protected directly by regulations (even though various Pollution prevention regulations indirectly address upkeep of these). Hence, assessment of biodiversity of non-designated habitats that may be impacted by the proposed development shall be conducted as part of this ESIA and measures incorporated to avoid, mitigate, manage impacts and risks on these</p>
<b>ESS 7:</b> Indigenous Peoples/Sub Saharan African Historically Underserved Traditional Local Communities	<p>Special Provisions for Scheduled Tribes</p> <ul style="list-style-type: none"> <li>• Fifth Schedule</li> <li>• Scheduled Castes and Scheduled Tribes (Prevention of Atrocities) Act, 1989</li> </ul>	<p>Not applicable for the project.</p> <p>The project area does not fall under Schedule V area of the Indian Constitution and the affected population of the project area does not meet the characteristics outlined in ESS 7. As a result, the specific requirements and safeguards mandated by ESS 7 regarding indigenous peoples and</p>

<sup>18</sup> Land will be purchased in accordance with the GMRL Policy For Direct Purchase of Private Land/Property through Mutual Negotiations.

World Bank Standards	Government of India Regulations	Gaps and Action
	<ul style="list-style-type: none"> <li>Panchayats (Extension to the Scheduled Areas) Act, 1996 (PESA)</li> </ul>	their rights, cultural heritage, and traditional knowledge are not applicable to this project.
<b>ESS8:</b> Cultural Heritage	<ul style="list-style-type: none"> <li>The Treasure Trove Act, 1878</li> <li>The Ancient Monuments and Archaeological sites and Remain Act, 1958 amended in 2010</li> <li>The Antiquities and Art Treasures Act, 1972 and its rules</li> <li>The Ancient Monuments Preservation Act, 1904</li> </ul>	Gap Exists. Legislations exists for protected monuments; however, no legislations exist for religious structures or cultural properties, or activities having social and cultural value. These shall be taken care as per ESS 8.
<b>ESS 9:</b> Financial Intermediaries	Not Applicable for the project	Not Applicable for the project
<b>ESS10:</b> Stakeholder Engagement and Information Disclosure	<ul style="list-style-type: none"> <li>EIA Notification 14<sup>th</sup> Sep 2006 and amendments.</li> <li>The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013</li> <li>The Right to Information Act, 2005</li> <li>Haryana Lokayukta's Citizen's Charter.</li> </ul>	Gap Exists. The Indian legislation partly meets the ESS requirements. As per the act, the information shall be provided when it is requested and asked for. Almost all government agencies have GM and Citizen Charters detailing the redressal services. ESS 10 has the provision for borrower to respond grievances of project-affected parties related to the environmental and social performance of the project in a timely manner as well as to proactively disclose publicly about project related information. In addition to above Haryana Lokayukta's Citizen's Charter outlines its mandate to address public grievances against state public servants, with the objective of promoting transparency, accountability, and integrity in governance.

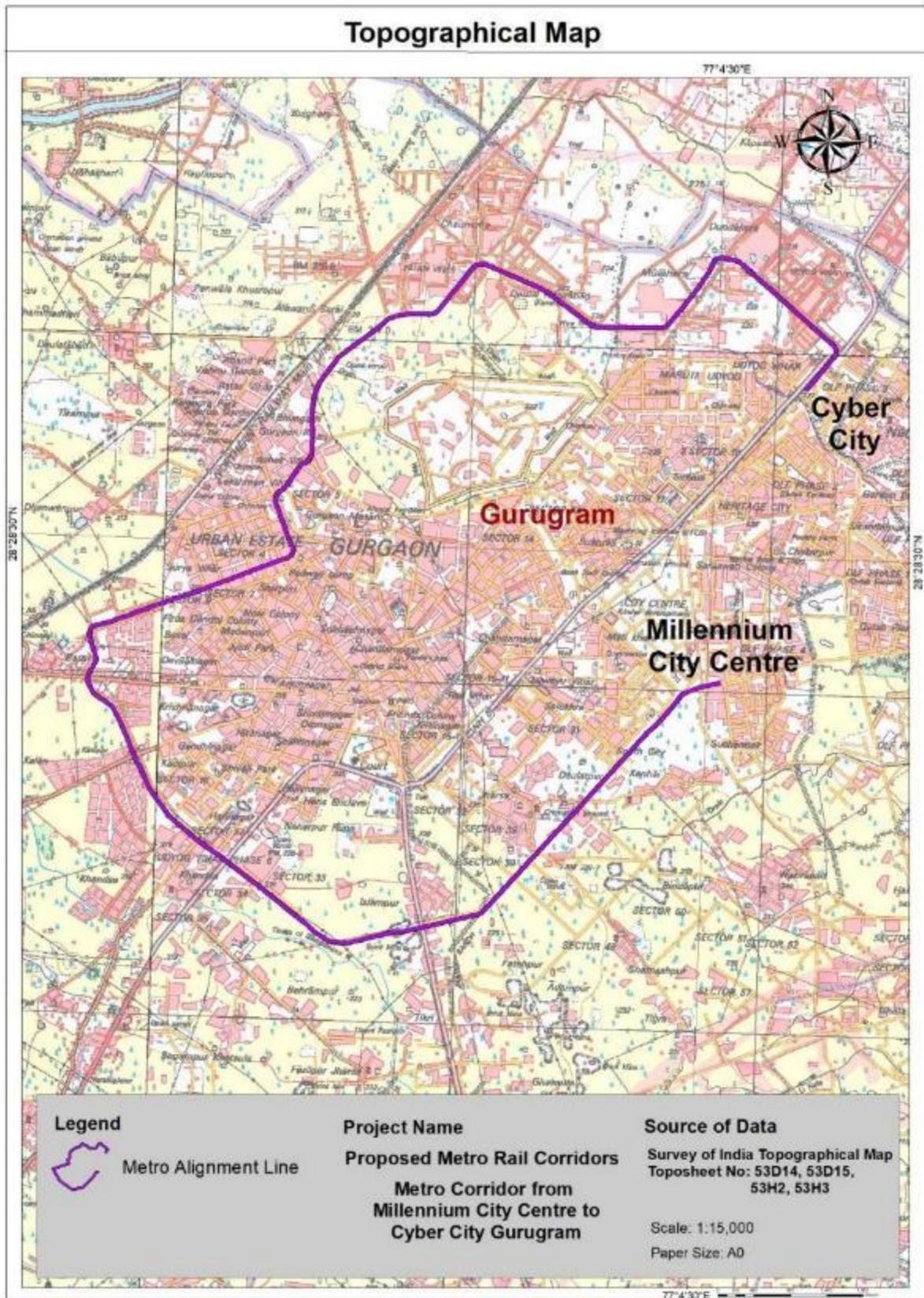
## Annexure 3.1

## Details of Proposed Stations along the Corridor

S. No.	Station Name	Chainage (in meters)	Inter Station Distance (in meters)
1	Millennium City Centre	0	0
2	Sector 45	1000	1000
3	Cyber Park	2200	1200
4	District Shopping Centre Sector 47	3665	1465
5	Subhash Chowk	4515	850
6	Sector 48	5500	985
7	Sector 72A	6360	860
8	Hero Honda Chowk	7789	553
9	Udyog Vihar Phase 6	9168	1379
10	Sector 10	10133	965
11	Sector 37	10808	675
12	Basai Village	11620	812
13	Sector 9	12445	825
14	Sector 7	13222	777
15	Sector 4	14487	1265
16	Sector 5	15466	979
17	Ashok Vihar	16514	1048
18	Sector 3	17514	1000
19	Bajghera Road	18439	925
20	Palam Vihar Ex.	19595	1156
21	Palam Vihar	20404	809
22	Sector 23 A	21495	1091
23	Sector 22	22781	1286
24	Sector 21	23785	1004
25	Udyog Vihar Phase 1	24830	1045
26	Cyber City	26450	1620
27	Sector 101* (Spur from Basai Village to Dwarka Expressway)	13426	1784
28	New Spur to Railway Station*	-	-

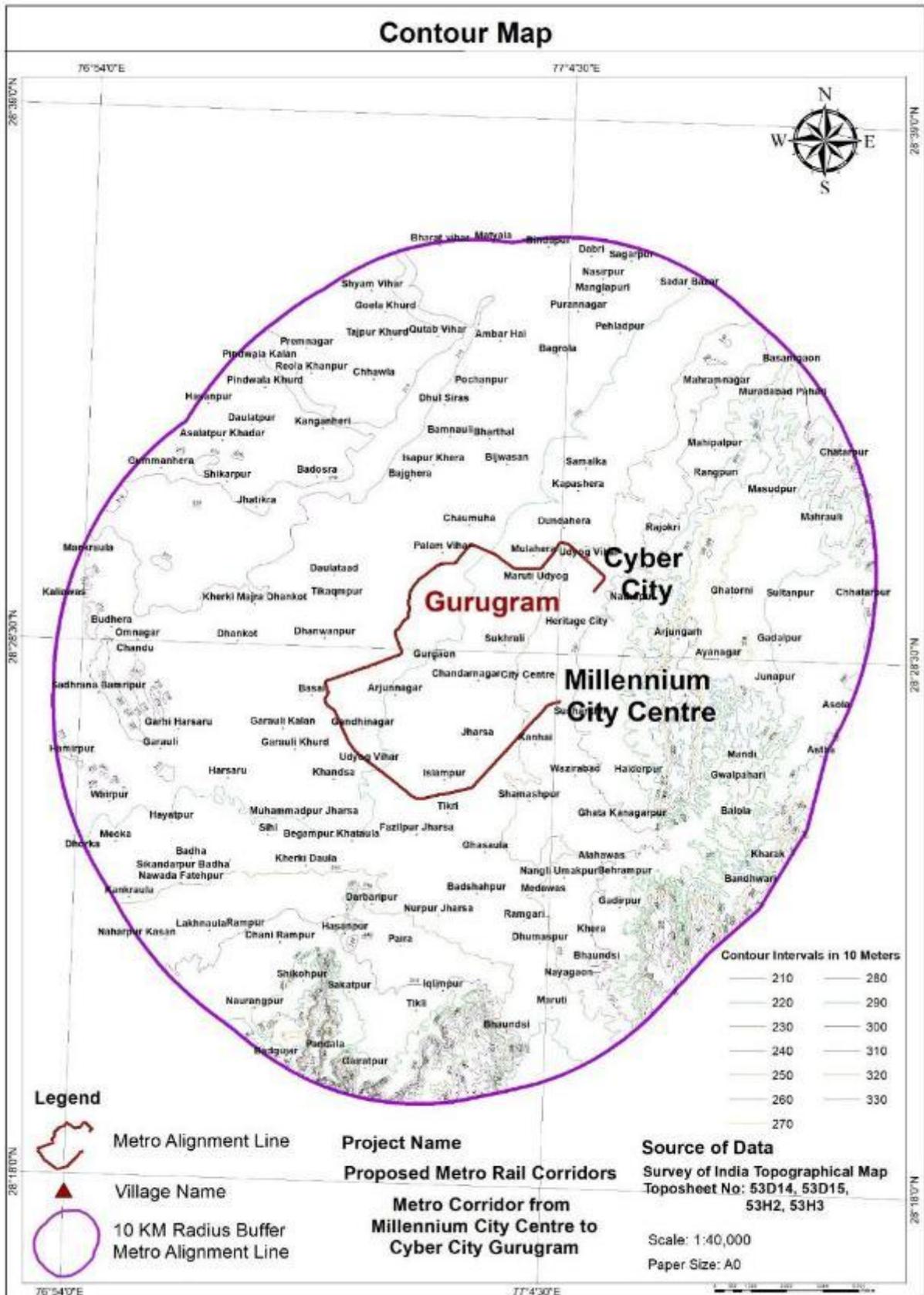
\*Design has not been finalized yet and will be updated once finalized.

Topographical Map of the Study Area



Source- Rites Study

Contour Map of the Study Area



Source- Rites Study

## Annexure 5.2

## Animals in Gurugram District

S. No.	Common name	Scientific name	IUCN status	WPA, 1972 Schedule
1	Common langur	<i>Semnopithecus entellus</i>	LC	II
2	Golden Jackal	<i>Canis aureus indicus</i>	LC	II
3	Leopard	<i>Panthera pardus</i>	VU	I
4	Jungle Cat	<i>Felis chaus</i>	LC	II
5	Indian Grey Mongoose	<i>Herpestes edwardsii</i>	LC	II
6	Nilgai	<i>Boselaphus tragocamelus</i>	LC	III
7	Monkey	<i>Macaca mulatta</i>	LC	II
8	Sambar	<i>Rusa unicolor</i>	VU	III
9	Indian Hare	<i>Lepus nigricollis</i>	LC	IV
<b>Mammals</b>				
10	Three-striped palm squirrel	<i>Funambulus palmarum</i>	LC	IV
11	Mouse	<i>Mus musculus</i>	LC	V
<b>Reptiles</b>				
12	Common garden lizard	<i>Calotesvescicolor</i>	LC	IV
13	Rat snake	<i>Ptyas mucosa</i>	LC	II

LC – Least Concerned, VU – Vulnerable

## List of Birds in Gurugram District

S. No.	Common name	Scientific name	IUCN Status	WPA, 1972 Schedule
1.	Asian Dowitcher	<i>Limnodromus semipalmatus</i>	NT	IV
2.	Bank myna	<i>Acridotheres ginginianus</i>	LC	IV
3.	Barn swallow	<i>Hirundo rustica</i>	LC	IV
4.	Bar-headed goose	<i>Anser indicus</i>	LC	II
5.	Baya weaver	<i>Ploceus philippinus</i>	LC	IV
6.	Besra	<i>Accipiter virgatus</i>	LC	I
7.	Black drongo	<i>Dicrurus macrocercus</i>	LC	IV
8.	Black kite	<i>Milvus migrans</i>	LC	I
9.	Black bittern	<i>Ixobrychus flavicollis</i>	LC	IV
10.	Black-headed ibis	<i>Threskiornis melanocephalus</i>	NT	IV
11.	Black-winged kite	<i>Elanus caeruleus</i>	LC	I
12.	Black-winged stilt	<i>Himantopus himantopus</i>	LC	IV
13.	Black-bellied tern	<i>Sterna acuticauda</i>	EN	IV
14.	Brown-headed barbet	<i>Psilopogon zeylanicus</i>	LC	IV
15.	Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	NT	IV
16.	Cattle egret	<i>Bubulcus ibis</i>	LC	IV
17.	Cinnamon bittern	<i>Ixobrychus cinnamomeus</i>	LC	IV
18.	Collared dove	<i>Streptopelia decaocto</i>	LC	IV
19.	Common coot	<i>Fulica atra</i>	LC	IV
20.	Common kestrel	<i>Falco tinnunculus</i>	LC	IV
21.	Common kingfisher	<i>Alcedo atthis</i>	LC	IV
22.	Common myna	<i>Acridotheres tristis</i>	LC	IV

S. No.	Common name	Scientific name	IUCN Status	WPA, 1972 Schedule
23.	Common moorhen	<i>Gallinula chloropus</i>	LC	IV
24.	Common pigeon	<i>Columba livia</i>	LC	IV
25.	Common quail	<i>Coturnix coturnix</i>	LC	IV
26.	Common redshank	<i>Tringa totanus</i>	LC	IV
27.	Common tailorbird	<i>Orthotomus sutorius</i>	LC	IV
28.	Common sandpiper	<i>Actitis hypoleucos</i>	LC	IV
29.	Eurasian sparrowhawk	<i>Accipiter nisus</i>	LC	I
30.	Ferruginous duck	<i>Aythya nyroca</i>	NT	IV
31.	Gadwall	<i>Mareca strepera</i>	LC	IV
32.	Glossy ibis	<i>Plegadis falcinellus</i>	LC	IV
33.	Great bittern	<i>Botaurus stellaris</i>	LC	IV
34.	Great thick-knee	<i>Esacus recurvirostris</i>	NT	IV
35.	Greater coucal	<i>Centropus sinensis</i>	LC	IV
36.	Green sandpiper	<i>Tringa ochropus</i>	LC	IV
37.	Grey francolin	<i>Ortygornis pondicerianus</i>	LC	IV
38.	Greylag goose	<i>Anser anser</i>	LC	II
39.	Greater Spotted Eagle	<i>Clanga clanga</i>	VU	I
40.	Imperial Eagle	<i>Aquila heliaca</i>	VU	I
41.	Indian great reed warbler	<i>Acrocephalus stentorus</i>	LC	IV
42.	Indian peafowl	<i>Pavo cristatus</i>	LC	I
43.	Indian pond-heron	<i>Ardeola grayii</i>	LC	IV
44.	Indian robin	<i>Copsychus fulicatus</i>	LC	IV
45.	Indian roller	<i>Coracias benghalensis</i>	LC	IV
46.	Indian spot-billed duck	<i>Anas poecilorhyncha</i>	LC	IV
47.	Jungle Myna	<i>Acridotheres fusca</i>	LC	IV
48.	Jungle babbler	<i>Argya striata</i>	LC	IV
49.	Lesser whistling duck	<i>Dendrocygna javanica</i>	LC	IV
50.	Lesser kestrel	<i>Falco naumanni</i>	LC	IV
51.	Little cormorant	<i>Microcarbo niger</i>	LC	IV
52.	Little egret	<i>Egretta garzetta</i>	LC	IV
53.	Little grebe	<i>Tachybaptus ruficollis</i>	LC	IV
54.	Long-tailed shrike	<i>Lanius schach</i>	LC	IV
55.	Mallard	<i>Anas platyrhynchos</i>	LC	IV
56.	Marbled teal	<i>Marmaronetta angustirostris</i>	NE	IV
57.	Northern shoveler	<i>Spatula clypeata</i>	LC	IV
58.	Egyptian Vulture	<i>Neophron percnopterus</i>	EN	I
59.	Oriental Darter	<i>Anhinga melanogaster</i>	NT	IV
60.	Oriental magpie-robin	<i>Copsychus saularis</i>	LC	IV
61.	Oriental skylark	<i>Alauda gulgula</i>	LC	IV
62.	Plain prinia	<i>Prinia inornate</i>	LC	IV
63.	Pallas's fish eagle	<i>Haliaeetus leucoryphus</i>	EN	I

S. No.	Common name	Scientific name	IUCN Status	WPA, 1972 Schedule
64.	Painted Stork	<i>Mycteria leucocephala</i>	NT	IV
65.	Pallid harrier	<i>Circus macrourus</i>	NT	I
66.	Water rail	<i>Rallus aquaticus</i>	LC	IV
67.	Red-headed vulture	<i>Sarcogyps calvus</i>	CE	IV
68.	Red-naped ibis	<i>Pseudibis papillosa</i>	LC	IV
69.	Red-vented bulbul	<i>Pycnonotus cafer</i>	LC	IV
70.	Red-wattled lapwing	<i>Vanellus indicus</i>	LC	IV
71.	Rose-ringed parakeet	<i>Psittacula krameri</i>	LC	IV
72.	Rufous treepie	<i>Dendrocitta vagabunda</i>	LC	IV
73.	Saker falcon	<i>Falco cherrug</i>	VU	I
74.	Sarus crane	<i>Grus Antigone</i>	VU	IV
75.	Shikra	<i>Accipiter badius</i>	LC	I
76.	Spotted dove	<i>Spilopelia chinensis</i>	LC	IV
77.	Spotted owlet	<i>Athene brama</i>	LC	IV
78.	Sociable Lapwing	<i>Vanellus gregarius</i>	CR	I
79.	Crested Sparrow hawk	<i>Accipiter trivirgatus</i>	LC	IV
80.	White-throated kingfisher	<i>Halcyon smyrnensis</i>	LC	IV
81.	White-breasted waterhen	<i>Amaurornis phoenicurus</i>	LC	IV
82.	White-rumped vulture	<i>Gyps bengalensis</i>	CE	I
83.	White-browed wagtail	<i>Motacilla maderaspatensis</i>	LC	IV
84.	Yellow bittern	<i>Ixobrychus sinensis</i>	LC	IV
85.	Yellow-footed green-pigeon	<i>Treron phoenicopterus</i>	LC	IV

CR-Critically Endangered, EN-Endangered, LC – Least Concerned, VU – Vulnerable, NT – Near Threatened, NE – Not Evaluated

## Annexure 5.3

## Details of Sensitive Receptors

Section	Name	Type of Sensitive Receptors	Distance from Centre Line (in m)	Chainage (in m)	Nearest Noise Monitoring Location
Start Point-Millennium City Centre	Shri Jaganath Temple	Temple	28.2	-171.5	N1
Millennium City Centre-Sector 45	Fortis Memorial Research Institute	Hospital	48.24	85.61	N1
	Radha Krishna Temple	Temple	70.5	704	N1
Sector 45-Cyber Park	Lifeaid Medical Centre	Hospital	81.1	2104.5	N13
Cyber Park-Sector 47	Safe Hands Hospital	Hospital	44.67	2753	N13
	Durga Mata Mandir	Temple	40.9	2775	N13
	Sai Siddhi Urology and Multispecialty Hospital	Hospital	40.86	2888	N13
	Kirpa Ram Hanuman Mandir	Temple	30.2	3131	N14
	Vishwas Vidyalaya	School	43.2	3143	N14
	Sukhmani Hospital	Hospital	38.6	3625	N14
Sector 47-Subash Chowk	Ram Sharnam Aashram	Temple	48.6	4128	N14
Subash Chowk-Sector 48	Vedanya International School	School	32	5309	N2
Sector 48-Sector 72 A	Yaduvanshi Shiksha Neketan	School	43	5788	N15
	Kangaroo Kids International Pre School	School	40.7	5824	N15
Sector 72 A - Hero Honda Chowk	IBMR Business School	College	67	6974.8	N15
Udyog Vihar Ph-6-Sector 10	Shani Mandir	Temple	60	9350	N3
	Temple	Temple	60	9875	N3
	Vedic Hospital	Hospital	78	9895	N3
	Temple	Temple	60.17	9949.1	N3
	Temple Median	Temple	27.23	9985.3	N3
Sector 10-Sector 37	Devi Mandir	Temple	22.08	10565.7	N4
Sector 37-Basai Village	Helix Hospital	Hospital	85.37	10864	N4
	Shri Balaji Multispecialty Hospital	Hospital	97	11225	N4
	Sagar Hospital	Hospital	25	11150.45	N4
	Shiv Temple near Basai Pond	Temple	4.6	11684	N4

Section	Name	Type of Sensitive Receptors	Distance from Centre Line (in m)	Chainage (in m)	Nearest Noise Monitoring Location
Basai Village-Sector 9	Greenwood Public School	School	34	11717	N4
	Vidya Medical Centre	Hospital	23	11829	N4
	Yashroop Hospital Maternity & Multispecialty Hospital	Hospital	31.58	12080	N4
Sector 9-Sector 7	Dr Shivangi Infertility Gynae Consultant	Hospital	19.5	12824	N5
	Shri Shiv Nararyan Sidheswar Senior Secondary Public School	School	78	12678	N5
	ESIC Hospital	Hospital	43.64	13063	N5
Sector 7-Sector 4	Guru Goraknath Temple	Temple	48.65	13457	N5
	Jiwan Jyoti Senior Secondary Public School	School	48.2	13742	N5
	Arya Public School	School	48.92	13995	N5
Sector 4-Sector 5	Blue Bells Preparatory School	School	26	14954	N17
	Prachin Shiv Hanuman Mandir	Temple	90	15000	N17
	Jain Sant Phool Chand Ji Charitable Hospital	Hospital	17	15244	N6
	Sarvodaya Hospital	Hospital	17.1	15252	N6
	Maa Chintapuri Mandir	Temple	17	15262	N6
Sector 5-Ashok Vihar	Xion International Convent School	School	64	15752.9	N6
	Aastha Medicare Maternity Centre	Hospital	13	15945	N18
	Vardhman Hospital	Hospital	28	16066.2	N18
	Eurokids Pre School & Day Care	School	68	16213	N18
	Mittal Ortho & fracture clinic	Hospital	34.8	16264	N18
Ashok Vihar-Sector 3	New Light Public School	School	42	16502	N18
	Jannat Hospital	Hospital	10	16829	N18
	Shri Dataram Mandir	Temple	17	16888	N7
	Balaji Life Care Hospital and Maternity Centre	Hospital	10.74	16953	N7
	Shiv Mandir	Temple	54	17040	N7

Section	Name	Type of Sensitive Receptors	Distance from Centre Line (in m)	Chainage (in m)	Nearest Noise Monitoring Location
	Blossom Primary School	School	25	17333	N7
	Hanuman Mandir	Temple	14.9	17506	N7
	GAV International School	School	23	17989	N8
	Narayan e-Techno School	School	75	17984	N8
	SCR Global School	School	76	18577	N9
	Presidium School	School	17	18711	N9
	Krishnal Chowk Palam Vihar DB Baba	Temple	18.4	18565	N9
	DPSG Palam Vihar	School	19.55	20095	N10
	Manipal Hospital	Hospital	26.6	20140	N10
	Hanuman Mandir	Temple	30	20269	N10
	Hanuman Mandir	Temple	17.4	22212	N11
	Rotary Public School	School	30.66	22422	N11
	Nest Play School and Day Care	School	8.21	22702	N19

## Detailed Summary of Consultations and Interviews

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People's perceptions/ Suggestions	Mitigation Measures
<b>Consultation with the Project Affected Population</b>			
1	<p>Consultation with Project Affected Resident of Sector-4, Gurugram Haryana, Date: 21.12.2023</p> <p>No. of Participants: 04</p>	<p>The participants requested to review the alignment again to avoid impact on their residential structure.</p> <p>The participants have also been requested to share the timelines for construction and land acquisition.</p> <p>They have also requested to share how their loss will be compensated and what will happen to the remaining land.</p> <p>It was requested to share the copy of the RFCTLARR Act and alignment CAD Drawing of Sector 4.</p>	<p>The participants were informed that alignment is designed to avoid and minimize the impact as much as possible on their residential structure. The structure will be affected due to the sharp curve in the alignment.</p> <p>The construction work will likely start at the end of 2024. The land acquisition as per the RFCTLARR Act, 2013.</p> <p>They were informed that GMRL will first try to purchase the affected land through Mutual Negotiation/Direct Purchase Method. In case of failure of negotiation, delay, resistance, or refusal of the land or property owner, it shall be acquired through the RFCTLARR Act, 2013<sup>20</sup>.</p> <p>They were informed that the remaining land will be acquired by the GMRL, if the balanced land is unviable.</p>

<sup>20</sup> Land shall be purchased through GMRL Policy for Direct Purchase of Private Land/Property through Mutual Negotiations

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People's perceptions/ Suggestions	Mitigation Measures
			A copy of the RFCTLARR Act, 2013 and the alignment CAD drawing of Sector 4 are shared with the participant.
2	Consultation with affected fruits vendor Near Chintpurni Mata Mandir, Sector 4 & 5 Date: 22.12.2023 No. of Participants: 8	Participants have concerns that the metro project would have negative impacts in terms of loss of income and customers during the construction period. Also, the proposed will not serve the last mile connectivity. However, the metro project will have the following benefits: <ul style="list-style-type: none"> <li>• Increase in accessibility to facilities, employment, property value, customers, educational levels etc.</li> <li>• Improvement in transportation system and decrease in accidents.</li> </ul>	The participants were informed that the compensation will be paid as per RFCTLARR Act, 2013
3	Consultation Affected Persons (Banjaras Vulnerable Group) at Rezangla Chowk Date: 22.12.2023 No. of Participants: 7 (Male 5 and Female 2)	Participants were not aware of the project. Suggestion: <ul style="list-style-type: none"> <li>• Requested to avoid the impact and if their huts get impacted then compensation shall be paid or provide space near Rezangla Chowk.</li> </ul>	The participants were informed that alignment is designed to avoid and minimize the impact as much as possible. The compensation will be paid as per the RFCTLARR Act, 2013, for residual impacts.
4	Consultation with Shop Owners at Ashok Vihar (Proposed Station), Gurugram, Haryana 29.12.2023 No. of Particioants:10	<ul style="list-style-type: none"> <li>• The participants requested to review the proposed metro station plan to avoid impact commercial establishments. One of them has suggested shifting the station around 300 meters where more-wider space and land is available to plan station. The chainage of the suggested station is 16833.577, which is near the Hindustan Petrol Pump (Ashok Vihar Phase II, Gurugram).</li> <li>• Participants have suggested that the station entry and exit need to be reconsidered and proposed along the station extension rather than on the left and right sides of the</li> </ul>	The participants were informed about the project design and expected impact on their commercial establishments. The project alignment, station and entry/exits will likely impact two shops permanently on the right side. But nine shops on the left side will likely be affected, as they are coming under 3 meters of working space considered for construction stage. They were informed that the impact on these nine shops will be temporary during the construction

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People's perceptions/ Suggestions	Mitigation Measures
		<p>station. The alternative would be beneficial for the commercial establishment as it would not impact their source of income during the construction phase.</p> <ul style="list-style-type: none"> <li>• They also raised concern regarding the project compensation of employees, as most of them used to pay salaries in cash, but they have a maintained register or logbook.</li> </ul>	<p>period. After completion of metro construction, they can operate as usual as they are presently operating. Participants were informed that suggestion to shift the alignment and change of entry/exit location will be discussed with the GMRL and Detailed Design Team.</p> <p>The Detailed Design Team will review the viability of the suggested station plan and entry/exit location. The findings will be communicated to the participants.</p>
5	<p>Consultation with Shop Owners of Ashok Vihar, Gurugram, Haryana 08.01.2024 No. of Participants: 4</p>	<ul style="list-style-type: none"> <li>• The participants requested that the proposed metro station at Ashok Vihar's entry/exit plan be reviewed to minimize any potential effects on commercial establishments. The roads leading to homes will be blocked by the proposed project. proposed entry/exit location will block the ways to residences.</li> <li>• These are the only roads that provide connectivity to the local population. These roads would be blocked during the construction and operation of the metro project.</li> <li>• They suggested shifting to the Ashok Vihar metro station at Sector 5 Gol Chakkar.</li> </ul>	<p>Participants were informed about the project design and expected impact on their commercial establishments. The project entry/exits will temporarily affect nine shops on the left side, as they are coming under 3 meters of working space considered for the construction stage.</p> <p>Participants were informed that suggestions to shift the station and change of entry/exit location will be discussed with the GMRL Detailed Design Team.</p> <p>The Detailed Design Team will review the viability of the suggested station plan and entry/exit location. The findings will be communicated to the participants.</p>
6	<p>Consultation with Shop Owners of Ashok Vihar, Gurugram, Haryana 10.01.2024 No. of Participants: 19 (Male 17 and Female 02)</p>	<ul style="list-style-type: none"> <li>• The proposed metro project will have lifts, stairs, entry-exit points, ramps, etc. starting from OKAYA Electric Scotty Shop and is proposed to end at Shri Syam Rasoi.</li> <li>• Apart from the same, a Wall is also proposed to be constructed which shall cover the said facilities.</li> <li>• The proposed facilities will have following difficulties and problems forever throughout our life:</li> </ul>	<p>Affected persons were informed that suggestion to shift the station and change of entry/exit location will be discussed with the GMRL and Detailed Design Team.</p> <p>The Detailed Design Team will review the viability of the suggested station plan and entry/exit location. The findings will be communicated to the participants. If potential income reduction occurs during the construction phase due to restriction of access to their</p>

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People’s perceptions/ Suggestions	Mitigation Measures
		<ul style="list-style-type: none"> <li>• There is a road measuring approximately 20 Feet just from the spot where lift is proposed to be installed. The said road is the only road for commutation for approximately 100 families residing in area where said 20 feet road leads to.</li> <li>• If lift is installed at the proposed spot, there would be a great hindrance in movement of traffic in/out of that road, mainly comprising of residents residing in the area.</li> <li>• Likewise, the spot where proposed ramp/stairs for entry &amp; exit points is proposed to be constructed shall block a road measuring approximately 18 Feet, which is the only entry-exit points for residents residing in said lane and a plot measuring 800 sq. yds., which again will lead to big restrictions for movements and entry/exit of residents &amp; their vehicles.</li> <li>• The proposed wall shall close front of all the shops which shall be covered by the said wall. Undoubtedly, if this happens, it will lead to huge financial losses for shopkeepers and may also lead them to vagrancy.</li> <li>• The space which shall be left after construction of wall, ramps, lift, stairs, etc. will be very less towards the shops which again will lead to congestion &amp; chaos in sub-lanes. Otherwise, all the passengers using the metro shall alight on main road which definitely will lead to huge traffic jams, chaos, etc. Needless to point out, the road on which Metro Station is proposed to be constructed otherwise witnesses heavy traffic movement and jams almost during the entire day;</li> <li>• Likewise, the spot where proposed ramp/stairs for entry &amp; exit points is proposed to be constructed opposite to the lift, shall block a road measuring approximately 18 Feet,</li> </ul>	<p>shops. They were informed that the issue would be discussed with GMRL. Also, they were further advised to maintain up-to-date records of their ITR and GST filings to facilitate income assessment. So that, compensation will be provided for loss of income due to obstruction in accessing their establishments during the construction period.</p> <p>In the event of potential income reduction during the construction phase due to restricted access to shops, affected individuals were informed that the matter would be discussed with GMRL. They were also advised to maintain up-to-date records of their Income Tax Returns (ITR) and Goods and Services Tax (GST) filings to facilitate accurate income assessment. This will support the provision of appropriate compensation for any loss of income resulting from limited access to their establishments during the construction period.</p>

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People's perceptions/ Suggestions	Mitigation Measures
		<p>which is the only entry-exit points for residents residing in said lane opposite to the aforesaid spot, which again will lead to big restrictions for movements and entry/exit of residents &amp; their vehicles.</p>	
7	<p>Consultation with Affected Persons at Rao Gajraj Singh Chowk, Gurugram Date: 25.01.2024, No. of Participants: 5</p>	<ul style="list-style-type: none"> <li>• Participants have concerns that the metro project would have negative impacts in terms of loss of income, customers, structures and decrease the property value.</li> <li>• The proposed project will not serve the last mile connectivity, decrease the migration, increase the property value etc.</li> <li>• However, metro project will increase the accessibility to facilities, decrease accidents, improve the transportation system, and provide safe means of transportation.</li> </ul> <p>Suggestion:</p> <ul style="list-style-type: none"> <li>• Participants suggested that traffic management is very necessary during construction as the area is very congested.</li> </ul>	<p>The participants were informed that traffic during construction will be managed with the assistance of traffic police.</p>
8	<p>Consultation with Affected Persons at Pardeshi Dhaba near Rao Gajraj Singh Chowk, Gurugram Date: 29.01.2024 No. of Participants: 5</p>	<p>Participants have concerns that the metro project would have negative impacts in terms of loss of income and customers during construction period. Also, the proposed will not serve the last mile connectivity.</p> <p>However, metro project will have following benefits:</p> <ul style="list-style-type: none"> <li>• Increase in accessibility to facilities, employment, property value, customers, educational levels etc.</li> <li>• Improvement in transportation system and decrease in accidents.</li> </ul> <p>Suggestion:</p> <ul style="list-style-type: none"> <li>• The participants requested to avoid the impact on their shops and if it impacted compensation will be paid.</li> </ul>	<p>The participants were informed that alignment is designed to avoid and minimize the impact as much as possible. The compensation will be paid as per the RFCTLARR Act, 2013.</p>

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People’s perceptions/ Suggestions	Mitigation Measures
9	Consultation with manager and employee of The Theka, Wine Shop near Rao Gajraj Singh Chowk, Gurugram Date: 30.01.2024 No. of Participants: 3	Metro project will have following impacts: <ul style="list-style-type: none"> <li>• Provide safe and affordable transport, increase income, customers, employment, property value, accessibility to facilities, educational levels, and decrease accidents &amp; migration, enhanced or improved transportation system.</li> </ul> Suggestion: <ul style="list-style-type: none"> <li>• The participants requested that compensation be paid to the owner and employees if their shops will get closed or affected during the construction phase of the metro.</li> </ul>	Compensation would be provided if their shops were affected during the construction period in accordance with the RFCTLARR Act, similar to what is offered to other PAPs.
10	Consultation with Shop Owners at Sector 33 (Depot Location), Gurugram, Haryana 29.12.2023 No. of Participants: 4	<ul style="list-style-type: none"> <li>• The shop owners at Marble Market were shifted to Sector 33 Site from Sikandarpur on Mehrauli-Gurugram Road in Year 2004 by HSVP (HUDA).</li> <li>• The shop owners have filed a petition alleging that the authority has not adopted fair and appropriate criteria/method for the newly allotted site. The marble market area falls in the proposed depot location got stay order by Hon'ble Court for operations of Marble Market (copy of the same provided by marble market association is attached for reference).</li> <li>• The proposed project will have a direct and indirect impact (40 shops are likely to be affected).</li> <li>• The shop owners will not participate in the census and socio-economic survey until the Hon'ble Court gives them the order to vacate the said location.</li> </ul> Suggestion: <ul style="list-style-type: none"> <li>• The shop owners will not participate in the census and socio-economic survey until the Hon'ble Court gives them the order to vacate the said location.</li> </ul>	The shop owners were informed that a census and socio-economic survey will be conducted after the Hon'ble Court issues its verdict on the matter.
<b>Consultations and Discussions with Other Interested Groups</b>			

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People's perceptions/ Suggestions	Mitigation Measures
1	Consultation with RWA Members at Ambedkar Chowk, Sector-10A Gurugram, Date: 21.12.2023 No of Participants: 07	<p>Participants believe that the metro project would be beneficial for the local population and have the following benefits:</p> <p>Increase in income, employment, property value, customers, accessibility to facilities, educational levels etc.</p> <p>Improvement in transportation system and decrease in accidents.</p> <p>Suggestion: Proper and designated space for autos and e-rickshaws to avoid chaos at metro stations. Parking space would be beneficial for metro users. Metro feeder services would be beneficial for metro users for last-mile connectivity. Provisions for dust pollution reduction and management of service lanes during the construction phase. Metro construction work should be started as soon as possible.</p>	The participants were informed that the issue will be discussed with GMRL and based on the applicability it shall be incorporated into the design.
2	Consultation with Street Vendors (Fruits and Vegetables), Udyog Vihar Phase-6, Sector 10 Date: 21.12.2023, 16:00 No. of Participants: 08	<p>Participants believed that the proposed project would have multiple benefits in terms of better connectivity to the Industrial Area of Sector 10, reduction in dust pollution between Hero Honda Chowk and Umang Bhardwaj Chowk, and an increase in their income.</p> <p>Suggestion: The participants suggested that auto, e-rickshaw, taxi, and feeder services would be beneficial for metro users for last-mile connectivity where such locations are not connected to metro stations</p>	The participants were informed that necessary action would be taken to improve the last mile connectivity.
3	Consultation with Auto Drivers, Near ESIC Hospital, Sector-7,	Participants believe that the metro project would be beneficial for the local population and have the following benefits:	The participants were informed that designated auto stands would be proposed considering the land availability and necessary action would be taken to improve the last mile connectivity.

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People's perceptions/ Suggestions	Mitigation Measures
	Date: 21.12.2023, 13:17 hrs (No. of Participants: 8)	Increase in income, employment, property value, accessibility to facilities, educational levels etc and improvement in existing transportation system. Participants have concerns that the metro project would have negative impacts in terms of loss of income, customers, and an increase in accidents. Suggestion: Proper and designated space for autos at metro stations. Street vendors near metro station would increase the chances of traffic jams. Auto rickshaw would provide last-mile connectivity to metro users.	
4	Consultation with General Public Near Sector 7 Metro Station, Gurugram Date: 21.12.2023 No. of Participants: 5	Metro project will have following benefits: Increase in income, employment, property value, customers, accessibility to facilities, educational levels etc. Improvement in transportation system and decrease in accidents. Suggestion: Metro feeder services from the metro station to Bhandwari village would be beneficial for the local population for last-mile connectivity. Traffic management plan for temporary interruptions to vehicular and pedestrian traffic to avoid jams during the construction stage.	The participants were informed that necessary action would be taken to improve the feeder buses and last mile connectivity.
5	Consultation with Street Vendor at Sector 48, Gurugram Date: 21.12.2023 No of Participants: 5	Participants are not aware of perceived positive and negative impacts of the project. Suggestion Participants mentioned that they have a seasonal business therefore there will be no impact due to the proposed metro.	

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People's perceptions/ Suggestions	Mitigation Measures
6	Shop Owners of Ashok Vihar (General Public), Date 27.12.2023 No of Participants: 04 (Male)	<p>The participants were requesting to shift the alignment and station locations towards the right side, from Ashok Vihar to Carterpuri Chowk. The participants were saying that the land in this section has already been acquired by the government authority, and compensation has been paid to the landowners. Some of them have not collected their cheques from the treasury.</p> <p>The participants raised the issue of loss or reduction of income during the construction stage. Presently, they have sufficient space in front of their shops, but during construction, GMRL will barricade the project site to avoid any safety-related incidents. After barricading, they will left with 1 or 1.5 meter of space. Now, they are expecting that their sales will reduce during construction.</p>	<p>The Detailed Design Team will review the viability of the alignment and stations design between Ashok Vihar and Carterpuri Chowk towards the right-side suggested station plan and entry/exit location. The findings will be communicated to the participants.</p> <p>The participants were informed that the loss or reduction of income will only be temporary during the construction period. After completion of metro construction, they can operate as usual as they are presently operating.</p> <p>They were also informed that the issue of loss or reduction of income will be discussed with the GMRL officials. They will be informed about the outcome of the discussion.</p>
7	Consultation with e-Rickshaw Driver near Jwala mill Auto Stand, Phase IV, Gurugram Date: 25.01.2024 No. of Participants: 5	<p>Metro project will have following benefits: Increase in income, employment, property value, customers, accessibility to facilities, educational levels etc. Improvement in transportation system and decrease in accidents.</p> <p>Also, the proposed project will not serve last-mile connectivity to metro users.</p> <p>Suggestion: The metro project will have negative impacts in terms of loss of income as traffic from Salarpur, Kapashera Border and Mullahera would get diverted.</p>	<p>The participants were informed that necessary action would be taken to provide an alternate route for better connectivity during construction phase.</p>
8	Consultation with Shopkeepers near Rao Gajraj Singh Chowk, Gurugram	<p>Metro project will have following impacts: Provide safe means of transportation, increase in customers, property value, accessibility to facilities, educational levels, decrease in accidents etc.</p>	<p>The participants were informed that compensation shall be provided as per RFCTLARR Act for their loses.</p>

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People's perceptions/ Suggestions	Mitigation Measures
	Date: 25.01.2024 No. of Participants: 06	<p>Participants believe that the proposed project will not enhance or improve the existing transportation system, increase employment, income, or educational level.</p> <p>Participants have concerns that the construction of the metro project would reduce the right of way and have negative impacts in terms of loss of income and customers.</p> <p>Suggestion: The participants requested that compensation to be paid if their shops will be closed or affected during the construction phase of the metro.</p>	
9	Consultation with Metro Users at Udyog Vihar Phase-IV, Gurugram Date: 29.01.2024 No. of Participants: 04	<p>Metro project will have the following benefits: Increase in income, employment, property value, customers, accessibility to facilities, educational levels etc. Improvement in transportation system and decrease in accidents.</p> <p>However, the proposed project will not serve last-mile connectivity to metro users.</p> <p>Suggestions: Traffic management plan for temporary interruptions to vehicular and pedestrian traffic to avoid jams during the construction stage.</p>	The participants were informed that traffic management plan shall be developed during implementation of the project and traffic shall be managed with the assistance of traffic police Gurugram.
10	Consultation with Auto Drivers near Auto Stand Palam Vihar Mor, Sector 22, Gurugram Date: 30.01.2024 No. of Participants: 5	<p>Metro project will have following benefits: Increase in accessibility to facilities, employment, property value, educational level etc. Provide safe and affordable public transport, an improved transportation system, and a decrease in accidents.</p> <p>The proposed project will not serve last-mile connectivity to metro users.</p>	The participants were informed that necessary action would be taken to improve the feeder buses and last mile connectivity.

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People’s perceptions/ Suggestions	Mitigation Measures
		<p>However, participants have concerns that during and after construction, the auto fare would be reduced from Gol Chakkar to Palam Vihar Mor and Palam Vihar Mor Vyapar Kendra Market.</p>	
11	<p>Consultation with NGO at KBA/IBA in Sector 101, Basai Date: 15.10.2024  No. of Participants: 3</p>	<p>Participants were aware of the project but didn’t know the details. They believe the project will not affect the KBA/IBA in Sector 101, Basai. The water source to KBA/IBA in Sector 101, Basai is mainly from overflow water from the broken drain, which carries effluent from STP. Recent repairs carried out by the authorities have halted this outflow, causing the waterbody to dry up. Previously, the continuous flow had drawn bird watchers and photographers to the area, but since the repairs, bird activity has noticeably decreased. Metro project will have the following benefits: Property value will rise as the area becomes more accessible for residents and commuters, making the surrounding neighbourhoods more appealing to homebuyers and businesses. Use of commercial Reduction in pollution due to decreasing the number of private vehicles on the road, leading to lower emissions, and by promoting the use of cleaner public transportation. Improvement in transportation system by providing a fast, reliable, and efficient mode of travel, reducing congestion on roads and affordable public transit making it accessible for a larger population. There will be a reduction in traffic by encouraging commuters to opt for public transport. Suggestion:</p>	<p>Traffic diversion plans will be formulated and followed during the execution of project. Contractors will develop and execute a traffic management plan, including measures such as traffic diversion, avoiding school hours, market activities, religious activities, adhering to speed limits, and employing licensed drivers, etc. Frequent sprinkling of water on the local roads and worksites will be undertaken to control dust emissions. Use water sprays or dust suppressants to keep dust levels low. Cover construction materials with green nets to prevent dust from blowing away.</p>

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People's perceptions/ Suggestions	Mitigation Measures
		<p>Traffic management measures like diversions, adequate pedestrian, optimized signal timings can reduce congestion. These should be undertaken to ensure less noise and air pollution.</p> <p>Dust control measures during metro construction should be undertaken including regular water spraying on construction sites and covering materials to prevent dust spread, along with using dust barriers and air filters to maintain air quality.</p>	
<b>GBV Discussion and Consultation with Police Station Enroute the Corridor</b>			
1	<p>Women Police Station Palam Vihar, District Gurugram, Haryana. 21.12.2023 No of Participant: 05 Female Police Officials</p>	<p>SHO along with the team participated in the discussion. The police department has identified five hotspots for patrolling to stop the crime against women. The five hotspots are Bus Stand, Devi Lal Park, Sector-14, Choma Gaon Park and IFFCO Chowk.</p> <p>The women police officials are posted there in civil dress from 17:00 to 20:00 and 20:00 to 24:00.</p> <p>One FIR was registered against an unidentified person for harassment in the month of October, 2023.</p> <p>The police team have organized 13 awareness camps in schools, to aware the students about good and bad touch.</p> <p>The Principal of Sadar School has requested that the police team carry out regular patrols at the time of students leaving after school hours.</p> <p>The training was provided by women officials both in uniform. For women safety, designated helpline number which is 112 called as Durga Shakti is started by the department to report the cases related to women safety.</p> <p>Durga-Shakti Rapid action Force vehicles patrols at hotspots. Durga Shakti a software application is initiated by Haryana Police which offers panic button facility for women in distress.</p>	<p>The participants were informed that necessary steps shall be taken during implementation and operation of the project.</p>

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People's perceptions/ Suggestions	Mitigation Measures
		<p>Suggestion: The participant suggested that the provisions of CCTV at Devilal Park, Sector-22, Railway Station, and Sheetla Mandir. It was suggested that the screening of major crimes and their punishment should be displayed at the metro stations to make commuters aware.</p>	
2	<p>Women Police Station, Sector-51, Haryana, 22.12.2023 No of participants: 05 Women Police officials</p>	<p>The Women Police Station (Sector-51) is 1.25 km away from proposed corridor. A dedicated Women Helpdesk with one female assistant sub-inspector and one female constable are assigned at Helpdesk is at Station. The majority of cases registered at the station are dowry and domestic violence. For cases related to molestation, immediate action is taken by filing an FIR against the criminal. In the month of November No case has been registered for eve-teasing/harassment. One case was registered under the PCOSO Act. One rape case was registered. The women officials have organized 14 awareness camps in schools, to aware the students and teachers. The topics of awareness camps were cybercrime (social media: facebook and Instagram), good and bad touch, POCSO Act. The officials have also organized self-defense training programme. Durga-Shakti a software application is initiated by Haryana Police which offers panic button facility for women in distress. The training was provided by women officials both in civil and uniform dress. For patrolling," Durga Shakti" PCR has been started by the government which is meant for patrolling at the identified</p>	<p>The participants were informed that necessary steps shall be taken during implementation and operation of the project.</p>

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People’s perceptions/ Suggestions	Mitigation Measures
		<p>hotspots areas in three shifts: starting from 07:30-15:30,15:30-23:30, 23:30-07:30, to tackle the cases of eve teasing or any other offence related to women.</p> <p>Night patrolling at metro stations is carried out on a daily basis by officials to restrict prostitution activities.</p> <p>Suggestion: It was suggested by the officials that, for the safety of women and other passengers, provision for cameras at stations and nearby locations should be proposed.</p> <p>It was also suggested that only those auto and taxi drivers should be allowed at metro stations whose police verification has been done on a regular basis.</p> <p>It was also suggested photographs of auto and taxi drivers with criminal record be displayed at metro stations.</p> <p>Concerned police stations should be consulted at the time of construction to identify grey areas and hotspots for regular police patrolling and CCTV installation.</p>	
3	<p>Women Police Station Palam Vihar, District Gurugram, Haryana. 29.12.2023</p> <p>No of Participant: 02 Female Police Officials</p>	<p>Women Police Officials participated in the discussion. Eve teasing, Molestation, cases are addressed directly. Rape cases, POCSO (Child cases) are addressed through legal adviser. Accordingly, FIR is registered.</p> <p>Five hotspots (Bus Stand, Devi Lal Park, Sector-14, Choma Gaon Park and IFFCO Chowk) has been identified by the department. For women safety, designated helpline number which is 112 called as Durga Shakti is started by the department to report the cases related to women safety. Also, cases reported by women on 100/1091 are transferred to the nearest Women Police Station.</p>	<p>The participants were informed that necessary steps shall be taken during implementation and operation of the project.</p>

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People’s perceptions/ Suggestions	Mitigation Measures
		<p>Most of the cases reported are related to domestic violence. In last 6 months – 160 cases registered, 100 are resolved and 60 are pending.</p> <p>The police team have organized 30 awareness camps in schools, colleges, public and private organization and slum areas to aware the about good &amp; bad touch and crime against women.</p> <p>Suggestion: Provisions of Two dedicated women coaches, CCTV at metro premises and Parking Area.</p>	
4	<p>Consultation with Police Officials, Sector 39, Jhadsa, Gurugram, Haryana 29.12.2023 No of participants: 01</p>	<p>Police Officials participated in the discussion.</p> <p>No major complaints were reported in the last two months. Mostly rental dispute-related complaints were reported between the owners and tenants.</p> <p>Officially a women police official is assigned to inquiry about the gender related crimes. Accordingly, actions have been taken as per the law.</p> <p>For women safety, designated helpline number which are 1091, and 112 called as Durga Shakti is started by the department to report the cases related to women safety. Also, cases reported by women on 100 are transferred to the nearest Women Police Station.</p> <p>Suggestion: Provision for first aid and cameras at stations and nearby locations.</p> <p>Separate and dedicated space for autos and taxis must be proposed in the project.</p> <p>A police booth with a residential facility are provided at the station location for 24/7 police officials deployment.</p>	<p>Participants were informed that first aid kit is already provided, and their concerns of dedicated auto and taxi parking will be discussed with the GMRL and Detailed Design Team.</p>
<p><b>GBV Discussion and Consultation with Women as Transport Users:</b></p>			

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People’s perceptions/ Suggestions	Mitigation Measures
5	<p>GBV discussion has been carried out with 27 Women as Transport Users 29.12.2023 No of participants: 49 Women</p>	<p>The participants were between the age group of 20 to 62 years of age group. It was revealed by the five participants that they have faced physical threats or eve-teasing during travel on roads. One participant has physically retaliated against the action, one participant has called the police but did not receive any response and three participants did nothing against the act. The participants revealed that the principal mode of transport used by women in the project area are Auto, Bicycle, Bike, Bus, Car, Ola/ Uber/Rapido, Scooty etc. 20 participants believe that it is common for women to travel alone in auto/buses/tempos/sharing cab. 23 participants believe that better Metro connectivity will help people travel from one place to another easily. 10 participants are daily users, six participants are weekly users, and five participants are monthly users of metro services. 17 participants feel safe while travelling in the metro, three participants do not feel safe in metro travel, and one participant does not feel safe while travelling in general metro coaches. It was revealed by the two participants that they have faced physical threats or eve-teasing while travelling in the metro, and one participant did nothing against the act and one participant ignored the act due to less time. One participant was the victim of theft and was not aware of whom to contact and made a complaint. 15 participants believe that the metro can be considered as a child-friendly mode of transport. Other participants believe that children can travel under the supervision of adults.</p>	<p>The participants were informed that necessary steps shall be taken during implementation and operation of the project.</p>

S. No	Location of the Consultations, Date, No. of Participants	Stakeholder/ People's perceptions/ Suggestions	Mitigation Measures
		<p>Suggestion:                      For the safety of women and other passengers, provision for CCTV at stations (also near escalators and elevators) and nearby locations should be proposed.                      Provisions for Platform Screen Door (PSD) to prevent accidents, objects falling on track, and trespassing.                      Provisions for the deployment of police officials both men and women at the entry or exit of metro stations to restrict bad elements at and near metro premises.                      Metro premises must have Sanitary Pad Vending Machines, Transparent Elevators, Gender Neutral Toilets, Dedicated Women Coaches and App for Online Complaint.                      Emergence helpline numbers must be displayed at and near metro premises and require immediate response from them.</p>	

Annexure: 6.2

Photos of Consultations and Interview



Elderly Affected Resident, Sector 4,  
Date 21.12.2023



Affected Shop Owners of Ashok Vihar,  
Ashok Vihar Station, Date 29.12.2023



Affected Vulnerable Group (Banjaras),  
Rezangla Chowk, Date 22.12.2023



Affected Persons (Fruit Vendors), Sector 4  
& 5, Date 21.12.2023



Affected Shop Owners of Ashok Vihar,  
RITES Office, Date 08.01.2024



KBA/IBA in Sector 101, Basai, Sangharsh  
with Soul NGO, Date 15.10.2024



Affected Persons, Rao Gajraj Singh Chowk,  
Date 25.01.2024



Affected Persons, Rao Gajraj Singh Chowk,  
Date 29.01.2024



Affected Persons, Rao Gajraj Singh Chowk,  
Date 30.01.2024



Affected Persons, Marble Market, Sector  
33, Date 05.02.2024



RWA Members, Sector 10A, Date  
21.12.2023

Fruit Vendors, Sector 10A,  
Date 21.12.2023



Auto Drivers, ESIC Hospital, Sector 7  
Date 21.12.2023

General Public, Sector 7, Date 21.12.2023



Street Vendors, Sector 48, Date 21.12.2023



General Public, RITES Office, Gurugram,  
Date 27.12.2023



E-rickshaw Driver, Jwala Mill, Phase 4, Date  
25.01.2024



General Public, Rao Gajraj Singh Chowk,  
Date 25.01.2024



General Public, Udyog Vihar Phase 4, Date  
29.01.2024



Auto Drivers, Palam Vihar Mor, Date  
30.01.2024



Women Police Officials, Palam Vihar,  
Date 21.12.2023



Women Police Officials, Sector 51,  
Date 22.12.2023



Women Police Officials, Palam Vihar,  
Date 29.12.2023



Police Official, Jhadsa, Sector 39,  
Date 29.12.2023



Tau Devi Lal Park, Palm Vihar Extn,  
Date 23.12.2023



Phase 2, Gurugram  
Date 29.12.2023



Basai Chowk, Gurugram  
Date 29.12.2023



Basai Village, Gurugram  
Date 29.12.2023



Basai Village, Gurugram

Date 29.12.2023



Surya Vihar, Gurugram

Date 29.12.2023



Ashok Vihar, Gurugram

Date 29.12.2023

Sector-4, Gurugram

Date 29.12.2023

**Outline for Site Clean-Up/Remediation Plan for Contaminated Sites/Locations****1. Background and Context**

The site assessment undertaken as part of the present Environmental and Social Impact Assessment (ESIA) for the Metro Project indicates that no contaminated sites have been identified within the project's area of influence.

However, given the dense urban context of the project, the possibility of encountering previously unknown or legacy contamination (e.g., due to past industrial, fuel storage, or waste disposal activities) during excavation or construction cannot be excluded.

In line with good international practice, and consistent with the requirements of the World Bank Environmental and Social Framework (ESS3: Resource Efficiency and Pollution Prevention and Management), a Framework for Contamination Assessment and Remediation has been developed.

This framework also complies with relevant Indian legislation, including:

- Environment (Protection) Act, 1986 and Rules;
- Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 (amended 2021);
- Solid Waste Management Rules, 2016;
- Construction and Demolition Waste Management Rules, 2016; and
- CPCB Guidelines for Investigation and Remediation of Contaminated Sites (2015).

**2. Objective of the Framework**

The main objectives of this Framework are to:

- Establish clear procedures for identifying, assessing, and remediating contamination encountered during construction or operation;
- Ensure compliance with national environmental laws and international financing institution (IFI) standards;
- Protect workers, nearby communities, and the environment from potential pollution risks; and
- Integrate contamination management into the Environmental and Social Management Plan (ESMP) and related implementation procedures.

**3. Scope of Application**

This Framework applies to all project components involving ground disturbance or excavation, including:

- Station and depot construction sites;

- Tunnels, cut-and-cover sections, and access shafts;
- Utility relocation and underground cable works;
- Temporary storage, stockpile, and laydown areas; and
- Disposal or borrow sites associated with the project.

#### 4. Potential for Contamination

Although no contamination was identified during baseline investigations, potential sources could include:

- Historical industrial or commercial land uses;
- Leakage from fuel or chemical storage tanks;
- Improper disposal of waste materials or oils; and
- Accidental spills during construction activities.

#### 5. Triggers for Assessment

Contamination assessment shall be initiated if any of the following signs are observed during construction:

- Discolored, odorous, or oily soils;
- Buried waste, drums, or other foreign materials;
- Unusual color or odor in groundwater;
- Evidence of prior industrial use or dumping activity; or
- Reports or complaints of contamination from workers or the community.

#### 6. Mitigation and Management Measures

##### A. Immediate Response Procedures

- Notification: Upon discovery, the Contractor shall immediately inform the General Consultant and the GMRL Environmental Health & Safety Experts.
- Site Isolation: The affected area shall be cordoned off and access restricted to prevent disturbance or spread.
- Health and Safety Precautions: Workers shall wear appropriate Personal Protective Equipment (PPE) and avoid direct contact with contaminated materials.

##### B. Assessment and Investigation

If contamination is suspected:

- A rapid site inspection will be conducted to characterize the extent of contamination;
- If required, carry out detailed soil and/or groundwater sampling and laboratory analysis, in accordance with CPCB guidelines; and
- Contaminant concentrations will be compared with Indian and internationally accepted threshold values to assess risk levels.

##### C. Preparation of Site-Specific Remediation Plan (SSRP)

If contamination is confirmed, a Site-Specific Remediation Plan (SSRP) shall be developed by the GMRL, in consultation with relevant authorities (e.g., State Pollution Control Board (SPCB)). The SSRP shall include:

- Type, extent, and concentration of contamination;
- Cleanup targets and regulatory standards;
- Remediation strategy (e.g., excavation, containment, in-situ treatment, bioremediation);
- Health, Safety, and Environmental (HSE) protection measures;
- Waste handling, transport, and disposal plan (in accordance with the Hazardous Waste Rules, 2016);
- Monitoring and verification plan; and
- Roles and responsibilities of all implementing entities.
- The SSRP shall be approved by the SPCB prior to implementation.

7. Mitigation and Management Measures

- All contamination incidents shall be documented in a Contamination Incident Report (CIR), including photographs, sampling results, and mitigation actions taken.
- The GMRL will consolidate all CIRs and include a summary in quarterly Environmental and Social Monitoring Reports (ESMRs) submitted to the World Bank.
- Follow-up soil and groundwater monitoring shall be conducted post-remediation to confirm effectiveness and compliance with cleanup targets.
- All documentation shall be retained in the project’s environmental records for audit purposes.

8. Institutional Responsibilities

Entity	Responsibilities
Contractor	Identify and report suspected contamination; implement site isolation and initial safety measures; cooperate with investigations.
Health & Safety Expert (GC)	Verify findings, direct initial containment actions, and ensure compliance with this Framework.
Environmental Health and Safety Expert (GMRL)	Coordinate assessments, engage qualified consultants, prepare SSRPs, and liaise with SPCB.
State Pollution Control Board (SPCB)	Review and approve SSRPs; oversee waste management and final clearance.
Independent Environmental and Social Monitoring Consultant	Provide external verification and report to the World Bank.

## 9. Integration with ESMP and Contractor Requirements

This Framework forms part of the Environmental and Social Management Plan (ESMP) and must be incorporated into:

- Contractor's Environmental and Social Management Plan (C-ESMP); and
- Emergency Response Plan (ERP).

Contract documents shall include provisions requiring the Contractor to follow these procedures and bear the costs associated with contamination response, investigation, and remediation.

## 10. Compliance with Indian and International Standards

All assessments and remediation works shall be conducted in compliance with:

- CPCB Guidelines for Remediation of Contaminated Sites (2015);
- MoEF&CC Environmental Standards for soil and groundwater;
- World Bank ESS3 – Resource Efficiency and Pollution Prevention and Management; and

Where discrepancies exist, the more stringent standard (between Indian regulations and World Bank Guidelines) shall apply.

## Annexure-7.2

Cumulative Noise Levels at Sensitive Receptors due to Metro Operations

S. No	Receptor	Distance from Centre Line (in m)	Noise Baseline Data in dB(A) of nearest monitoring location			Cumulative Noise for Year 2021		Noise Criteria	
			Location	LeqD	LeqN	LeqD	LeqN	LeqD	LeqN
<b>Temple</b>									
1.	Shri Jaganath Temple	28.2	N1	63.9	49.9	65.0	56.8	No Impact	No Impact
2.	Radha Krishna Temple	70.5	N1	63.9	49.9	64.1	52.2	No Impact	No Impact
3.	Durga Mata Mandir	40.9	N13	64.5	50.5	65.0	54.8	No Impact	No Impact
4.	Kirpa Ram Hanuman Mandir	30.2	N14	54.5	44.4	59.5	55.6	No Impact	No Impact
5.	Shani Mandir	31.3	N3	54.1	44.6	56.0	50.3	No Impact	No Impact
6.	Temple Rhs1	41.5	N3	54.1	44.6	57.8	53.3	No Impact	No Impact
7.	Temple Rhs2	41.1	N3	54.1	44.6	57.8	53.4	No Impact	No Impact
8.	Temple Median	24.2	N3	54.1	44.6	60.7	57.2	No Impact	No Impact
9.	Devi Mandir	45.5	N4	54.9	44.8	55.8	48.4	No Impact	No Impact
10.	Shiv Temple	11.0	N4	54.9	44.8	58.0	53.1	No Impact	No Impact
11.	Gur Goraknath Temple	35.3	N5	54.5	44.8	56.0	49.7	No Impact	No Impact
12.	Prachin Shiv Hanuman Mandir	89	N17	54.3	44.1	55.4	48.3	No Impact	No Impact
13.	Maa Chintpuri Mandir	18.9	N6	54.0	43.7	57.7	53.2	No Impact	No Impact
14.	Shri Dataram Mandir	49.2	N7	54.3	44.5	57.1	52.1	No Impact	No Impact
15.	Shiv Mandir	54	N7	54.3	44.5	56.8	51.5	No Impact	No Impact
16.	Hanuman Mandir	15.7	N7	54.3	44.5	58.6	54.4	No Impact	No Impact
17.	Krishna Chowk Palam Vihar By Db Baba	18.4	N9	62.6	48.3	63.4	54.2	No Impact	No Impact
18.	Hanuman Mandir	34.7	N10	54.1	44.4	55.8	49.7	No Impact	No Impact
19.	Hanuman Mandir	17.4	N11	54.8	44.7	62.7	59.4	Moderate	Moderate
<b>Educational Institute</b>									

S. No	Receptor	Distance from Centre Line (in m)	Noise Baseline Data in dB(A) of nearest monitoring location			Cumulative Noise for Year 2021		Noise Criteria	
			Location	LeqD	LeqN	LeqD	LeqN	LeqD	LeqN
20.	Vishwas Vidyalaya	43.2	N14	54.5	44.4	57.8	53.0	No Impact	No Impact
21.	Vedanya International School	13	N2	64.4	52.2	65.2	56.8	No Impact	No Impact
22.	Yaduvanshi Shiksha Niketan Sec-School	43	N15	54.8	44.9	55.8	48.7	No Impact	No Impact
23.	Kangaroo Kids International Pre School	40.7	N15	54.8	44.9	58.2	53.5	No Impact	No Impact
24.	IBMR Business School	76.2	N15	54.8	44.9	56.1	49.5	No Impact	No Impact
25.	Greenwood Public School	64.5	N4	54.9	44.8	55.4	47.0	No Impact	No Impact
26.	Shri Shiv Narayan Sidheswar Senior Secondary School	70	N5	54.5	44.8	55.0	46.7	No Impact	No Impact
27.	Jiwan Jyoti Senior Secondary School	76.5	N5	54.5	44.8	55.9	49.4	No Impact	No Impact
28.	Arya Public School	75.6	N5	54.5	44.8	55.9	49.5	No Impact	No Impact
29.	Blue Bells Preparatory School	34.9	N17	54.3	44.1	58.7	54.5	No Impact	No Impact
30.	Xion International convent School	82.2	N6	54.0	43.7	54.4	45.5	No Impact	No Impact
31.	Euro Kids Pre-School & Day Care	88.4	N18	54.8	44.2	55.8	48.4	No Impact	No Impact
32.	New Light Public School	75.9	N18	54.8	44.2	55.2	46.1	No Impact	No Impact
33.	Blossoms Primary School	28.5	N7	54.3	44.5	56.4	50.9	No Impact	No Impact
34.	GAV International School	26.3	N8	64.7	45.7	65.7	56.7	No Impact	No Impact

S. No	Receptor	Distance from Centre Line (in m)	Noise Baseline Data in dB(A) of nearest monitoring location			Cumulative Noise for Year 2021		Noise Criteria	
			Location	LeqD	LeqN	LeqD	LeqN	LeqD	LeqN
35.	Narayan e-Techno School	58.6	N8	64.7	45.7	65.0	51.3	No Impact	No Impact
36.	SCR Global School	78	N9	62.6	48.3	62.7	49.1	No Impact	No Impact
37.	Presidium School	16.7	N9	62.6	48.3	63.5	54.7	No Impact	No Impact
38.	DPSG Palam Vihar	30.8	N10	54.1	44.4	59.3	55.5	No Impact	No Impact
39.	Rotary Public School	24.8	N11	54.8	44.7	60.7	57.0	No Impact	Moderate
40.	Nest Play School and Day Care	8.21	N19	64.8	47.4	66.0	57.5	Moderate	No Impact
<b>Hospitals</b>									
41.	Fortis Memorial Research Institute	57.6	N1	63.9	49.9	64.0	50.9	Moderate	No Impact
42.	Lifeaid Medical Centre	81.1	N13	64.5	50.5	64.5	51.0	Moderate	No Impact
43.	Safe Hands Hospital	33.8	N13	64.5	50.5	65.2	55.9	Moderate	Moderate
44.	Sai Siddhi Urology Multispeciality Hospital	56	N13	64.5	50.5	64.8	53.4	Moderate	No Impact
45.	Sukhmani Hospital	38.6	N14	54.5	44.4	55.8	49.1	No Impact	No Impact
46.	Vedic Hospital	99	N3	54.1	44.6	55.1	48.0	Moderate	No Impact
47.	Helix Hospital	60.3	N4	54.9	44.8	55.5	47.2	No Impact	No Impact
48.	Shri Balaji Multi speciality Hospital	93	N4	54.9	44.8	55.8	48.4	No Impact	No Impact
49.	Sagar Hospital	25	N4	54.9	44.8	60.7	57.0	Moderate	Moderate
50.	Vidya Medical Centre	15.3	N4	54.9	44.8	58.9	54.6	Moderate	Moderate
51.	Yashroop Hospital Maternity & Multi speciality Hospital	36	N4	54.9	44.8	58.8	54.4	Moderate	Moderate

S. No	Receptor	Distance from Centre Line (in m)	Noise Baseline Data in dB(A) of nearest monitoring location			Cumulative Noise for Year 2021		Noise Criteria	
			Location	LeqD	LeqN	LeqD	LeqN	LeqD	LeqN
52.	Dr. Shivangi Infertility and Gynae Consultant Hospital	19.5	N5	54.5	44.8	62.0	58.7	Severe	Severe
53.	ESIC Hospital	66.2	N5	54.5	44.8	55.0	46.9	No Impact	No Impact
54.	Jain Sant Phool Chand Ji Charitable Hospital	27	N6	54.0	43.7	56.4	51.0	Moderate	No Impact
55.	Sarvodya Hospital	17.1	N6	54.0	43.7	58.1	53.8	Moderate	Moderate
56.	Aastha Medicare Maternity Centre	33.2	N18	54.8	44.2	59.2	54.9	Moderate	Moderate
57.	Vardhman Hospital	36.4	N18	54.8	44.2	58.7	54.2	Moderate	Moderate
58.	Mittal Ortho & fracture Clinic	34.8	N18	54.8	44.2	58.9	54.6	Moderate	Moderate
59.	Jannat Hospital	14	N18	54.8	44.2	59.2	55.0	Moderate	Moderate
60.	Balaji Life Care Hospital	14	N7	54.3	44.5	63.8	60.7	Severe	Severe
61.	Manipal Hospital	26.6	N10	54.1	44.4	60.1	56.5	Moderate	Moderate

## Annexure-7.3

## Predicted Vibration Level at Sensitive Receptors

S. No	Sensitive Receptors	Chain age of SR	Distance from Centre Line (m)	Predicted Vibration due to Operation (VdB)	Permissible Limits* in (VdB)
<b>Temples</b>					
1	Shri Jaganath Temple	-171.5	28.2	62.54	75
2	Radha Krishna Temple	704	70.5	59.23	75
3	Durga Mata Mandir	2775	40.9	61.20	75
4	Kirpa Ram Hanuman Mandir	3019.5	30.2	62.29	75
5	Shani Mandir	9290.5	31.3	62.17	75
6	Temple Rhs1	9866.7	41.5	61.15	75
7	Temple Rhs2	9949.1	41.1	61.18	75
8	Temple Median	9945.3	1.6	72.90	75
9	Devi Mandir	10574.6	45.5	60.82	75
10	Shiv Temple	11657.5	4.6	69.09	75
11	Gur Goraknath Temple	13445	35.3	61.73	75
12	Prachin Shiv Hanuman Mandir	14997	89	58.39	75
13	Maa Chintpuri Mandir	15238	18.9	63.99	75
14	Shri Dataram Mandir	16884.1	49.2	60.53	75
15	Shiv Mandir	17012.7	54	60.20	75
16	Hanuman Mandir	17477.8	15.7	64.66	75
17	Krishna Chowk Palam Vihar By Db Baba	18521.9	18.4	64.08	75
18	Hanuman Mandir	20237	34.7	61.79	75
19	Hanuman Mandir	22160.5	17.4	64.28	75
<b>Church</b>					
	Nil				
<b>Mosque</b>					
	Nil				
<b>Educational</b>					
1	Vishwas Vidyalaya	3143	43.2	61.00	75
2	Vedanya International School	5270	13	65.34	75
3	Yaduvanshi Shiksha Niketan Sec-School	5774	43	61.02	75
4	Kangaroo Kids International Pre School	5831	40.7	61.22	75
5	IBMR Business School	6983.7	76.2	58.95	75
6	Greenwood Public School	11697.7	64.5	59.56	75

S. No	Sensitive Receptors	Chain age of SR	Distance from Centre Line (m)	Predicted Vibration due to Operation (VdB)	Permissible Limits* in (VdB)
7	Shri Shiv Narayan Sidheswar Senior Secondary School	12600	70	59.26	75
8	Jiwan Jyoti Senior Secondary School	13715	76.5	58.94	75
9	Arya Public School	13970.9	75.6	58.98	75
10	Blue Bells Preparatory School	14926.6	34.9	61.77	75
11	Xion International convent School	15728.9	82.2	58.68	75
12	Euro Kids Pre-School & Day Care	16200	88.4	58.42	75
13	New Light Public School	16473.4	75.9	58.97	75
14	Blossoms Primary School	17314	28.5	62.50	75
15	GAV International School	17967.8	26.3	62.79	75
16	Narayan e-Techno School	17977.1	58.6	59.90	75
17	SCR Global School	18520	78	58.87	75
18	Presidium School	18686.6	16.7	64.43	75
19	DPSG Palam Vihar	20061.2	30.8	62.22	75
20	Rotary Public School	22400	24.8	63.01	75
21	Nest Play School and Day Care	22647	8.21	66.99	75
<b>Hospitals</b>					
1	Fortis Memorial Research Institute	239	57.6	59.96	65
2	Lifeaid Medical Centre	2104.5	81.1	58.73	65
3	Safe Hands Hospital	2722.6	33.8	61.89	65
4	Sai Siddhi Urology Multispeciality Hospital	2903	56	60.07	65
5	Sukhmani Hospital	3625	38.6	61.41	65
6	Vedic Hospital	9902	99	58.01	65
7	Helix Hospital	10859.8	60.3	59.80	65
8	Shri Balaji Multispeciality Hospital	11197.5	93	58.23	65
9	Sagar Hospital	11149	25	62.98	65
10	Vidya Medical Centre	11808	15.3	64.75	65
11	Yashroop Hospital Maternity & Multispeciality Hospital	12053.7	36	61.66	65
12	Dr. Shivangi Infertility and Gynae Consultant Hospital	12800	19.5	63.87	65

S. No	Sensitive Receptors	Chain age of SR	Distance from Centre Line (m)	Predicted Vibration due to Operation (VdB)	Permissible Limits* in (VdB)
13	ESIC Hospital	13030	66.2	59.46	65
14	Jain Sant Phool Chand Ji Charitable Hospital	15226.3	27	62.70	65
15	Sarvodya Hospital	15221	17.1	64.35	65
16	Aastha Medicare Maternity Centre	15971.8	33.2	61.95	65
17	Vardhman Hospital	16066.2	36.4	61.62	65
18	Mittal Ortho & fracture Clinic Orthopedic Surgeion	16225.3	34.8	61.78	65
19	Jannat Hospital	16800	14	65.07	65
20	Balaji Life Care Hospital and Maternity Centre Hospital	16924.7	14	65.07	65
21	Manipal Hospital	20116.7	26.6	62.75	65

## ASBESTOS MANAGEMENT PLAN

### Introduction

The platform roofs at various stations of the Gurgaon Metro Project are constructed using Asbestos Cement (AC) sheets. Asbestos waste generated during dismantling or maintenance activities must be handled and disposed of in a safe and environmentally responsible manner to prevent health hazards and environmental contamination.

### Applicable Regulations and Guidelines:

Asbestos fibers are classified as a hazardous airborne contaminant with known carcinogenic effects, primarily posing an inhalation risk. Therefore, any asbestos-containing material (ACM) must be handled and disposed of in accordance with the following regulations and guidelines:

1. **Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016** (including relevant amendments) for disposal of hazardous waste.
2. **Ministry of Environment, Forest and Climate Change (MoEF&CC)** guidelines and applicable **World Bank environmental safeguards**.

### Removal, Repair, and Disposal Plan:

The contractor shall prepare and submit a comprehensive Asbestos Handling and Disposal Plan, subject to the approval of the Engineer. The plan must ensure minimal exposure to asbestos for both workers and the community and must include the following components:

#### 1. Work Area Preparation:

- Restrict access to work zones.
- Ensure adequate lighting and clearly mark hazardous areas.
- Provide safe access routes for workers.

#### 2. Interior Containment:

- Use negative pressure enclosures where applicable.
- Cover walls, floors, and surfaces with plastic sheeting.

#### 3. Decontamination Facilities:

- Set up worker decontamination stations.
- Use appropriate Personal Protective Equipment (PPE): Hooded overalls, non-laced boots, respiratory protection.

#### 4. Required Equipment for Dismantling:

- 500- and 1000-gauge polythene sheeting, duct tape.
- Warning signs, tape, and asbestos waste labels.
- Garden sprayer with wetting agent.
- Buckets of water, rags, asbestos waste containers.
- Bolt cutters, rope, webbing straps.
- Lockable skip for larger waste volumes.

### Approved Asbestos Removal Procedures:

1. Use **wet methods** to prevent fiber release.
2. Immediately place removed ACM into sealed, impermeable containers.
3. **Do not break AC sheets**; handle them intact as far as possible.
4. Dampen fasteners and remove or cut bolts without disturbing AC.
5. Dismantle gutters, drainpipes, ridge caps carefully, avoiding AC contact.
6. Lower large pieces carefully; **do not drop or slide sheets**.
7. Stack removed sheets safely; wrap large pieces in 1000-gauge polythene and seal with duct tape.
8. Label all packages with **asbestos hazard warnings**.
9. Place small debris and fasteners in designated asbestos containers.
10. **Avoid crushing** any AC waste on-site.

### Cleaning and Final Disposal:

- Clean tools and area using **damp rags** (not dry brushing).
- Inspect bolt holes and other crevices for debris.
- Place used cleaning materials, polythene sheeting, webbing, and rope in asbestos waste containers.
- Securely **seal containers** and double-bag with clear polythene.

### Waste Disposal Protocol:

As the Gurgaon Metro Project does not have its own hazardous waste disposal facility, all asbestos waste shall be sent to an authorized hazardous waste landfill site. The following steps must be observed:

- Disposal shall comply with the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and its amendments.
- Waste Authorization must be obtained from the Haryana State Pollution Control Board (HSPCB).
- Waste must be **disposed of within 90 days** of generation; on-site storage beyond this period is not permitted.

## Annexure 7.5

## Affected Private Structures including NTHs

S. No	Chainage	Owner Id	Name	Status of Ownership	Type of Property	Use of Property	Impact
1	-168	DIL061228	Sarwan	Informal Occupiers	Commercial	Kiosk	Full
2	-168	COR10	Dev Karan Rawat	Informal Occupiers	Commercial	Kiosk	Full
3	3665	DIL191206	Ravindra Mahato	Hawkers holding MCG License	Commercial	Kiosk	Full
4	3665	DIL061230	Hira Lal	Hawkers holding MCG License	Commercial	Kiosk	Full
5	4480	N1	-	Informal Occupiers	Commercial	Kiosk	Full
6	4930	N2	-	Informal Occupiers	Commercial	Kiosk	Full
7	4930	N3	-	Informal Occupiers	Commercial	Kiosk	Full
8	4937	PUN071215	Shah Alam	Informal Occupiers	Commercial	Kiosk	Full
9	5045	DIL071225	Subhash Kumar	Informal Occupiers	Commercial	Kiosk	Full
10	5125	PUN071216	Deshraj	Informal Occupiers	Commercial	Kiosk	Full
11	6370	DIL071233	Bishwanath Coudhary	Informal Occupiers	Commercial	Kiosk	Full
12	6370	DHE071217	Biswanath Chowdhary	Hawkers holding MCG License	Commercial	Kiosk	Full
13	7420	DIL081239	-	Informal Occupiers	Commercial	Kiosk	Full
14	7430	VIK090101	Suresh Mandal	Informal Occupiers	Commercial	Kiosk	Full
15	8030	Squ/HHC/LFT/1	-	Informal Occupiers	Commercial	Kiosk	Full
16	8030	Squ/HHC/LFT/2	-	Informal Occupiers	Commercial	Kiosk	Full
17	8030	Squ/HHC/LFT/3	-	Informal Occupiers	Commercial	Kiosk	Full
18	8030	Squ/HHC/LFT/4	-	Informal Occupiers	Commercial	Kiosk	Full
19	8030	Squ/HHC/LFT/5	-	Informal Occupiers	Commercial	Kiosk	Full
20	8030	Squ/HHC/LFT/6	-	Informal Occupiers	Commercial	Kiosk	Full
21	8030	Squ/HHC/LFT/7	-	Informal Occupiers	Commercial	Kiosk	Full
22	8030	Squ/HHC/LFT/8	-	Informal Occupiers	Commercial	Kiosk	Full
23	8030	Squ/HHC/LFT/9	-	Informal Occupiers	Commercial	Shop	Full
24	8080	NEW 1	Na	Informal Occupiers	Commercial	Shop	Full
25	10655	N12	-	Informal Occupiers	Commercial	Kiosk	Full
26	10743	N13	-	Informal Occupiers	Commercial	Kiosk	Full

S. No	Chainage	Owner Id	Name	Status of Ownership	Type of Property	Use of Property	Impact
27	10770	RIT081205	Ram Naresh	Informal Occupiers	Commercial	Kiosk	Full
28	10800	DIL091235	Devi Rao	Informal Occupiers	Commercial	Kiosk	Full
29	10815	DIL091224	Firasat	Informal Occupiers	Commercial	Shop	Full
30	10815	COR09	Gouri Shankar	Title Holder	Other	Under Construction	Full
31	10815	DHE091219	Asraf	Title Holder	Commercial	Shop	Full
32	10815	Dhe081218	Surendra Kumar	Informal Occupiers	Commercial	Kiosk	Full
33	10865	DHE091210	Babita Devi	Informal Occupiers	Commercial	Kiosk	Full
34	11045	PUN091217	Did Not Share	Informal Occupiers	Commercial	Shop	Full
35	11080	Private House-3	Did Not Share	Informal Occupiers	Residential	House	Full
36	11085	Private House-4	Did Not Share	Informal Occupiers	Residential	House	Full
37	11092	Private House-5	Did Not Share	Informal Occupiers	Residential	House	Full
38	11096	DHE091209	Nisar	Informal Occupiers	Commercial	Shop	Full
39	11096	DHE091218	Nasir	Informal Occupiers	Commercial	Shop	Full
40	11096	NAR091001	Did Not Share	Informal Occupiers	Commercial	Shop	Full
41	11110	PUN091226	Vinay Yadav	Informal Occupiers	Commercial	Shop	Full
42	11115	N14	-	Informal Occupiers	Commercial	Shop	Full
43	11115	N15	-	Informal Occupiers	Commercial	Shop	Full
44	11120	PUN091227	Satbir Singh	Informal Occupiers	Commercial	Kiosk	Full
45	11120	DHE091221	Ramesh Barik	Informal Occupiers	Commercial	Kiosk	Full
46	11120	DIL091223	Shailesh Panday	Informal Occupiers	Commercial	Kiosk	Full
47	11450	NEW 2	Na	Informal Occupiers	Commercial	Shop	Full
48	11460	NEW 3	Na	Informal Occupiers	Commercial	Shop	Full
49	11470	NEW 4	Na	Informal Occupiers	Commercial	Shop	Full
50	11480	NEW 5	Na	Informal Occupiers	Commercial	Shop	Full
51	11789	N16	-	Trust	Other	Boundary Wall	Partial
52	11895	Private House-2	Did Not Share	Title Holder	Residential	House	Full
53	12518	NAR101201	Jyoti Prakash	Informal Occupiers	Commercial	Kiosk	Full

S. No	Chainage	Owner Id	Name	Status of Ownership	Type of Property	Use of Property	Impact
54	12548	DHE201239	Ram Snehi Chaurasia	Informal Occupiers	Commercial	Kiosk	Full
55	13000	Kiosk1303	Munni Devi	Informal Occupiers	Residential	Hut	Full
56	13020	COR32	Jeetendra	Informal Occupiers	Commercial	Kiosk	Full
57	13090	DIL211214	Rekha Devi	Hawkers holding MCG License	Commercial	Kiosk	Full
58	13175	COR 17	Pappu Kumar	Informal Occupiers	Commercial	Kiosk	Full
59	13215	COR37	Ajay Kumar Choudhary	Hawkers holding MCG License	Commercial	Kiosk	Full
60	13215	COR18	Chandragupt	Informal Occupiers	Commercial	Kiosk	Full
61	13215	COR17	Pappu Kumar	Informal Occupiers	Commercial	Kiosk	Full
62	13215	N20	-	Informal Occupiers	Commercial	Kiosk	Full
63	13430	DIL101244	Rijwan Ahamad	Hawkers holding MCG License	Commercial	Kiosk	Full
64	13430	VIK090103	Neha	Title Holder	Residential	House	Full
65	13450	DIL101216	Bharat Chouhan	Informal Occupiers	Mixed (R+C)	Res-cum-commercial	Full
66	13450	DHE101223	-	Informal Occupiers	Commercial	Kiosk	Full
67	13610	PUN111229	Sunil Kumar	Hawkers holding MCG License	Commercial	Kiosk	Full
68	13610	COR15	Vinod Choudhary	Hawkers holding MCG License	Commercial	Kiosk	Full
69	13610	RIT111209	Sharvan Chaurasiya	Hawkers holding MCG License	Commercial	Kiosk	Full
70	13630	DIL111209	Satyapal Singh	Hawkers holding MCG License	Commercial	Kiosk	Full
71	13630	COR42	Amar Singh	Hawkers holding MCG License	Commercial	Kiosk	Full
72	14480	COR36	Sanjay Chaudhary	Hawkers holding MCG License	Commercial	Kiosk	Full
73	13400	NEW 6	Na	Title Holder	Commercial	Shop	Full
74	14790	Private House-1	Closed	Title Holder	Residential	House	Full
75	14800	RIT111207	J S Katariya	Title Holder	Residential	House	Full
76	15050	PUN111230	Ram Dayal	Hawkers holding MCG License	Commercial	Kiosk	Full
77	15050	COR23	Rakesh Kumar	Hawkers holding MCG License	Commercial	Kiosk	Full
78	15050	COR40	Amit Kumar	Hawkers holding MCG License	Commercial	Kiosk	Full
79	15050	DIL111213	Shambhu Choudhary	Hawkers holding MCG License	Commercial	Kiosk	Full

S. No	Chainage	Owner Id	Name	Status of Ownership	Type of Property	Use of Property	Impact
80	15052	PUN111228	Rahul Kumar	Hawkers holding MCG License	Commercial	Kiosk	Full
81	15052	COR38	Ram Kumar Choudhary	Hawkers holding MCG License	Commercial	Kiosk	Full
82	15052	DIL111210	-	Hawkers holding MCG License	Commercial	Kiosk	Full
83	15465	COR 04	Murari Lala	Informal Occupiers	Mixed (R+C)	Res-cum-commercial	Full
84	15500	N28	-	Informal Occupiers	Commercial	Kiosk	Full
85	15510	VIK020103	Sumit Saroj	Informal Occupiers	Commercial	Shop	Full
86	15556	Private House-6	Did Not Share	Title Holder	Commercial	Shop	Full
87	15620	DIL221219	Lakhi Ram	Informal Occupiers	Commercial	Kiosk	Full
88	15633	DIL221201	Nanda	Informal Occupiers	Residential	Hut	Full
89	15633	DIL221202	Ranpal (Karu)	Informal Occupiers	Residential	Hut	Full
90	15633	COR05	Akash	Informal Occupiers	Residential	Hut	Full
91	15633	DHE221204	Hansh Raj	Informal Occupiers	Residential	Hut	Full
92	15633	DIL121215	Vijay Mnadal	Informal Occupiers	Commercial	Kiosk	Full
93	15633	DIL221226	Rahul	Informal Occupiers	Mixed (R+C)	Res-cum-commercial	Full
94	15633	BHO221201	Gajpat Singh	Informal Occupiers	Residential	Hut	Full
95	15633	DIL221203	Pooja	Informal Occupiers	Residential	Hut	Full
96	15633	COR 30	Ram Swarup	Informal Occupiers	Residential	Hut	Full
97	15633	DHE221202	Jeetu	Informal Occupiers	Residential	Hut	Full
98	15633	DHE221201	Vijay	Informal Occupiers	Residential	Hut	Full
99	15633	VIK080201	Dinesh	Informal Occupiers	Residential	Hut	Full
100	15633	COR04/DHE221205	Murari Lal	Informal Occupiers	Residential	Hut	Full
101	15633	COR25	Gyarsi Devi	Informal Occupiers	Mixed (R+C)	Res-cum-commercial	Full
102	16438	DIL101211	Jeetendra Kr Kushwaha	Hawkers holding MCG License	Commercial	Kiosk	Full
103	17510	RIT141218	-	Informal Settlers	Commercial	Kiosk	Full

S. No	Chainage	Owner Id	Name	Status of Ownership	Type of Property	Use of Property	Impact
104	18400	NAR141208	Raju	Informal Settlers	Commercial	Shop	Partial
105	18535	Private House-7	Mahesh Yadav	Informal Occupiers	Commercial	Shop	Full
106	18575	JIT141202	Vinod Singh	Informal Occupiers	Commercial	Kiosk	Full
107	19100	DHE141201	Bhoop Singh	Hawkers holding MCG License	Commercial	Kiosk	Full
108	19100	RIT141210	Gauri	Informal Occupiers	Commercial	Kiosk	Full
109	19120	NAR141207	Dayaram Namdev	Informal Occupiers	Commercial	Kiosk	Full
110	19130	DHE141236	Hans Raj	Informal Occupiers	Commercial	Kiosk	Full
111	19240	JIT141204	Khushi Lal	Informal Occupiers	Commercial	Kiosk	Full
112	19325	RIT141211	Chandra Dev Mandal	Informal Occupiers	Commercial	Kiosk	Full
113	19591	DHE141235	Ravinder Sharma	Informal Occupiers	Commercial	Kiosk	Full
114	19640	NAR141206	Arun Kumar	Informal Occupiers	Commercial	Kiosk	Full
115	19810	NAR141209	Rajesh Shresth	Informal Occupiers	Commercial	Kiosk	Full
116	19822	N33	-	Hawkers holding MCG License	Commercial	Kiosk	Full
117	19824	RIT141219	Radha Mohan Pandey	Informal Occupiers	Commercial	Kiosk	Full
118	19835	N34	-	Hawkers holding MCG License	Commercial	Kiosk	Full
119	19860	JIT141203	Santosh Shah	Informal Occupiers	Commercial	Kiosk	Full
120	20170	BHO030205	Brham Prakash Yadav	Exice & Taxation Department License for Wine Shop	Commercial	Shop	Full
121	20250	JIT141201	Ram Mishra	Informal Occupiers	Commercial	Kiosk	Full
122	20350	DHE151232	Saroj	Hawkers holding MCG License	Commercial	Kiosk	Full
123	20658	PUN151218	Lalan Kumari	Hawkers holding MCG License	Commercial	Kiosk	Full
124	21149	PUN151201	Shivani	Hawkers holding MCG License	Commercial	Kiosk	Full
125	22120	DHE161202	Satish	Informal Occupiers	Commercial	Kiosk	Full
126	22170	NAR151202	Rajnish Kumar	Hawkers holding MCG License	Commercial	Kiosk	Full
127	22340	RIT151212	Amar Kishore Podar	Informal Occupiers	Commercial	Kiosk	Full
128	22340	DIL151222	Vishwanath Jha	Hawkers holding MCG License	Commercial	Kiosk	Full
129	22345	RIT151214	Suraj Singh	Hawkers holding MCG License	Commercial	Kiosk	Full

S. No	Chainage	Owner Id	Name	Status of Ownership	Type of Property	Use of Property	Impact
130	22397	RIT151213	Mukesh Kumar	Hawkers holding MCG License	Commercial	Kiosk	Full
131	22450	NAR151205	Lakshmi Bibi	Hawkers holding MCG License	Commercial	Kiosk	Full
132	22450	RIT151215	Sujankant Pradan	Hawkers holding MCG License	Commercial	Kiosk	Full
133	22460	DIL151221	Vipin Kumar	Hawkers holding MCG License	Commercial	Kiosk	Full
134	22570	NAR151203	Kuldeep	Hawkers holding MCG License	Commercial	Kiosk	Full
135	22613	Dhe151231	Indradev Sahani	Hawkers holding MCG License	Commercial	Kiosk	Full
136	22620	PUN151223	Ahmad	Informal Occupiers	Commercial	Kiosk	Full
137	22660	PUN151231	Yogendra Singh	Hawkers holding MCG License	Commercial	Kiosk	Full
138	22673	DHE151233	Kamla Kumari Sharma	Hawkers holding MCG License	Commercial	Kiosk	Full
139	22685	RIT151217	Kamaish	Hawkers holding MCG License	Commercial	Kiosk	Full
140	22700	NAR151204	Dhan Singh	Hawkers holding MCG License	Commercial	Kiosk	Full
141	22760	COR41	Navin Kumar Thakur	Informal Occupiers	Commercial	Kiosk	Full
142	22773	DHE151237	Kumarpal	Hawkers holding MCG License	Commercial	Kiosk	Full
143	22773	DHE151238	Santosh	Hawkers holding MCG License	Commercial	Kiosk	Full
144	22773	DHE161206	Manu Kumar	Hawkers holding MCG License	Commercial	Kiosk	Full
145	22773	PUN161208	Trilochan Rout	Hawkers holding MCG License	Commercial	Kiosk	Full
146	22773	DLL161231	Satyam	Informal Occupiers	Commercial	Kiosk	Full
147	22773	RIT151216	Manoj Kumar Yadav	Hawkers holding MCG License	Commercial	Kiosk	Full
148	Spur	Spur	Did Not Share	Title Holder	Commercial	Shop (Mechanic)	Full
149	Spur	Spur	Did Not Share	Title Holder	Commercial	Shop	Full
150	Spur	Spur	Did Not Share	Title Holder	Commercial	Polictical Party Office	Full
151	Spur	Spur	Did Not Share	Title Holder	Commercial	Shop (Gym)	Full
152	Spur	Spur	Na	Title Holder	Residential	House (Abundant)	Partial
153	Spur	Spur	Na	Title Holder	Other	Boundary Wall	Partial

## Annexure 7.6

## Affected Government, Religious and Community Structures

S. No	Chainage	Owner Id	Status of Ownership	Use of Property	Impact
1	-168	DIL191205	Government	Police Booth	Full
2	200	COR12	Government	Bus Stop	Full
3	260	PUN071220	Government	Generator Room	Full
4	650	BS-12	Government	Bus Stop	Full
5	2200	BS-13	Government	Bus Stop	Full
6	2200	BS-14	Government	Bus Stop	Full
7	3425	PUN071223	Government	Boundary Wall	Partial
8	3425	BW-2	Government	Boundary Wall	Partial
9	3490	PS-2	Government	Police Booth	Full
10	3540	PS-5	Government	Police Booth	Full
11	3665	BS-15	Government	Bus Stop	Full
12	5500	PUN071212	Government	Bus Stop	Full
13	5500	PUN071225	Government	Bus Stop	Full
14	5500	N4	Community	Water tank/ Water ATM	Full
15	7400	DIL071203	Government	Bus Stop	Full
16	10100	PUN0812WP	Community	Water tank/ Water ATM	Full
17	11190	Arp091201	Government	Police Booth	Full
18	11645	Pun091210	Religious	Temple	Full
19	11700	DIL091240	Community	Pond	Partial
20	12350	BS130304	Government	Bus Stop	Full
21	12438	N17	Government	Bus Stop	Full
22	12438	N18	Government	Bus Stop	Full
23	12670	BS130303	Government	Bus Stop	Full
24	13000	N19	Government	Bus Stop	Full
25	13115	DHE101207	Government	Bus Stop	Full
26	13215	ARP211201	Government	Others	Full
27	13215	N21	Government	Boundary Wall	Partial
28	13215	N22	Government	Boundary Wall	Partial
29	13380	DIL101218	Government	Bus Stop	Full
30	13815	BS-9	Government	Bus Stop	Full
31	13857	N23	Government	Bus Stop	Full
32	14465	MCG Staff-1	Government	Bus Stop	Full
33	14480	N25	Government	Boundary Wall	Partial
34	15465	DHE121229	Government	Boundary Wall	Partial
35	15465	DIL121245	Community	Water tank/ Water ATM	Full
36	15465	N27	Government	MCG Office	Full
37	15610	BS130302	Government	Bus Stop	Full
38	15610	N29	Government	Bus Stop	Full
39	15690	N30	Government	Police Booth	Full
40	15790	BS-11	Government	Bus Stop	Full
41	16200	BS-10	Government	Bus Stop	Full
42	16272	N31	Government	Bus Stop	Full
43	18671	BS-4	Government	Bus Stop	Full
44	19246	BS-3	Government	Bus Stop	Full
45	19760	N32	Government	Bus Stop	Full
46	20020	BS-7	Government	Bus Stop	Full
47	20200	RIT141209	Government	Police Booth	Full

S. No	Chainage	Owner Id	Status of Ownership	Use of Property	Impact
48	20266	N35	Government	Bus Stop	Full
49	20460	BS-2	Government	Bus Stop	Full
50	21491	BS-1	Government	Bus Stop	Full
51	22600	DIL161248	Government	Police Booth	Full
52	23710	C1	Government	Bus Stop	Full
53	24040	C2	Government	Bus Stop	Full
54	24070	C3	Government	Shed	Full
55	24160	C4	Government	Boundary Wall	Partial
56	24160	C5	Government	Police Booth	Full
57	24400	C6	Government	Boundary Wall (IDPL)	Partial

## Annexure 7.7

## List of Trees to be affected due to Alignment and Depot

S. No	Section / Station	Number of Trees
1.	Start to Millenium City Centre	23
2.	Millenium City Centre Station	33
3.	MCC-Sector-45	51
4.	Sector-45 Station	60
5.	Sector-45-Cyber Park	55
6.	Cyberpark Station	65
7.	Cyber park-Sector-47	94
8.	Sector-47 Station	65
9.	Sector-47-Subhash Chowk	84
10.	Subhash Chowk Station	47
11.	Subhash Chowk-Sector-48	216
12.	Sector-48 Station	53
13.	Sector-48-Sector-72/A	182
14.	Sector-72/A Station	29
15.	Sector-72/A-Hero Honda Chowk	129
16.	Hero Honda Chowk Station	29
17.	Hero Honda Chowk-Udyog Vihar Ph-6	15
18.	Udyog Vihar Ph-6 Station	5
19.	Udyog Vihar Ph-6-Sector-10	73
20.	Sector-10 Station	18
21.	Sector-10-Sector-37	5
22.	Sector-37 Station	0
23.	Sector-37-Basai Village	5
24.	Basai Village Station	50
25.	Basai Village-Sector-09	110
26.	Sector-09 Station	90
27.	Sector-09-Sector-07	30
28.	Sector-07 Station	20
29.	Sector-07-Sector-04	54
30.	Sector-04 Station	33
31.	Sector-04-Sector-05	3
32.	Sector-05 Station	19
33.	Sector-05-Ashok Vihar	56
34.	Ashok Vihar Station	0
35.	Ashok Vihar-Sector-03	9
36.	Sector-03 Station	10
37.	Sector-03-Bajghera Road	10
38.	Bajghera Road Station	8
39.	Bajghera Road-Palam Vihar Ext.	15
40.	Palam Vihar Extension Station	17

S. No	Section / Station	Number of Trees
41.	Palam Vihar Ext.-Palam Vihar	29
42.	Palam Vihar Station	18
43.	Palam Vihar-Sector 23A	50
44.	Sector 23A Station	39
45.	Sector 23A-Sector 22	40
46.	Sector 22 Station	85
47.	Sector 22- Sector 21	96
48.	Sector 21 Station	4
49.	Sector 21-Udyog Vihar Ph 1	68
50.	Udyog Vihar Ph 1 Station	34
51.	Udyog Vihar Ph 1-Cyber City	94
52.	Cyber City Station	60
53.	Cyber City-End Point	31
<b>Sub-Total</b>		<b>2518</b>
54.	Depot	259
<b>Total</b>		<b>2777</b>

**Annexure 9.1**

**Details of Batching Plant  
(To be filled in by the contractor)**

Name of Location: .....

Reporting Month: .....

Date of Submission: .....

**1. Environment Features of the surrounding area**

1.1	Name and location of Batching Plant	
1.2	Wind direction	
1.3	Name (s), distance population and type of settlements in a 1.5 km radius of site.	

**2. Details of Batching Plant and Mitigation Measures taken**

2.1	Installed Capacity	
2.2	Average Utilization	
2.5	Last maintenance date	

**3. Explain Air Pollution Control Measures taken at the Batching Plant site**

--

**4. Explain Noise Pollution Control Measures taken at the Batching Plant site**

--

Remark
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Submitted	Checked	Approved
Signature .....	Signature .....	Signature .....
Name .....	Name .....	Name .....
Designation .....		
Contractor	Environmental Engineer of Construction Supervision Consultant	In-charge Officer (GMRL)

**Annexure 9.2**

**Details of Muck Dumping Operations  
(To be filled by the contractor)**

Dumping site location: .....

Reporting Month:.....

Date of Submission: .....

**1. Environment Features of the surrounding area**

1.1	Location of Dumping site	
1.2	Capacity of Dumping site	
1.3	Safety measure taken at Dumping site (s)	
1.		
2.		
3.		
4.		
5.		

Remark
--------

**Submitted**

Signature .....

Name .....

Designation .....

Contractor

**Checked**

Signature .....

Name .....

Environmental Engineer of  
Construction Supervision  
Consultant

**Approved**

Signature .....

Name .....

In-charge Officer (GMRL)

**Annexure 9.3**

**Details of Machinery during Construction  
(To be filled monthly by the Contractor)**

Location Name: .....

Reporting Month: .....

Date of Submission: .....

**1. Details of Machinery Operation**

1.1	Total machinery in operation (Nos.)	
1.2	Number of pavers	
1.3	Number of rollers	
1.4	Number of excavators	
1.5	Number of graders	
1.6	Number of dumpers	
1.7	Number of Cranes	
1.8	No. of workshops with repairs facility (furnish location and type of facility provided)	
1.9	Number of vehicles in repair at each location	
1.10	Details of waste disposal	
1.11	Others	

Remark
--------

**Submitted**

Signature .....

Name .....

Designation .....

Contractor

**Checked**

Signature .....

Name .....

Environmental Engineer of  
Construction Supervision  
Consultant

**Approved**

Signature .....

Name .....

In-charge Officer (GMRL)

**Annexure 9.4**

**Safety Check List  
(To be filled by the contractor)**

1	Contract No.	
2	Name of Contractor	
3	Representation	
4	Name of Safety Officer	
5	Date of Inspection	

Location 1 .....	Location 2 .....			Location 3 .....			Remark			
	Location 1			Location 2				Location 3		
Adequate at time of Inspection (A)	A	B	C	A	B	C	A	B	C	
Needs Improvement (B)										
Needs Immediate Attention (C)										
General										
House keeping										
Stacking of Material										
Passageway										
Lighting										
Ventilation										
Others										
Electrical										
Switches										
Wirings										
Fixed Installation										
Portable Lighting										
Portable Tool										
Welding Machine										
Others										
Fire Prevention										
Fire Fighting Appliance										
Dangerous Goods Store										
Gas Welding Cylinders										
Others										
Dust Control										
Noise Control										
First Aid Equipment										
Washing Facility										
Latrine										
Canteen										
Provision of Personal Protective Equipment										
Helmet										
Eye Protector										
Ear Protector										
Respirator										
Safety Shoes										
Safety Belts										
Others										

Remark

**Submitted**  
Signature .....  
Name .....  
Designation .....  
Contractor

**Checked**  
Signature .....  
Name .....  
  
Environmental Engineer of  
Construction Supervision Consultant

**Approved**  
Signature .....  
Name .....  
  
In-charge Officer (GMRL)

**Accident Report**  
**(To be completed on Occurrence of Injury by the Safety Officer)**

**Type of Accident**

Fall of person from a height	Explosion
Slip, trip or fall on same level	Fire
Struck against fixed objects	Contact with hot or corrosive substances
Struck by flying or falling objects	Contact with poisonous gas or toxic substances
Struck by moving objects	Contact with electric current
Struck / caught by cable	Hand tool accident
Stepping on nail etc.	Vehicle / Mobile plant accident
Handling without machinery	Machinery operation accident
Crushing / burying	Other (please specify)
Drowning or asphyxiation	

**Agent Involved in Accident**

Machinery	Excavation / underground working
Portable power appliance	Floor, ground, stairs or any working, surface
Vehicle or associated equipment/ machinery	Ladder
Material being handled, used or stored	Scaffolding/gondola
Gas, vapour, dust, fume or oxygen	Construction formwork, shuttering and falsework
Hand tools	Electricity supply cable, wiring switchboard and associated equipment
Floor edge	Nail, splinter or chipping
Floor opening	Other (Please specify)
Left shaft	
Stair edge	

**Unsafe Action Relevant to the Accident**

Operating without authority	Failure to use proper footwear
Failure to secure objects	Failure to use eye protector
Making safety devices inoperative	Failure to use respirator
Working on moving or dangerous equipment	Failure to use proper clothing
Using un-safety equipment	Failure to use warn others or given proper signals
Adopting unsafe position or posture	Horseplay

	Operating or working at unsafe speed		No unsafe action
	Unsafe loading, Placing, mixing etc.		Others (please specify)
	Failure to use helmet		
	No Protective gear		Unsafe layout of job, traffic etc.
	Defective protective gear		Unsafe process of job methods
	Improper dress / footwear		Poor housekeeping
	Improper guarding		Lack of warming system
	Improper ventilation		Defective tool, machinery or materials
	Improper illumination		No unsafe condition
	Improper procedure		Others (please specify)

**Personal Factor Relevant to the Accident**

	Incorrect attitude/motive		Unsafe act by another person
	Lack of knowledge or skill		No unsafe personal factor
	Physical defects		Other (please specify)

Remark
--------

**Submitted**

Signature .....

Name .....

Designation .....

Contractor

**Checked**

Signature .....

Name .....

Designation .....

Environmental engineer.  
Construction Supervision Consultant

**Approved**

Signature .....

Name .....

Designation .....

In-charge Officer (GMRL)

**Pollution Monitoring**

Construction site location.....  
 Construction Stage: Report Date: .....Month: .....Year: .....  
 Mitigation measures suggested in last report complied or Not: Yes/No  
 If not reasons thereof:.....

S. No.	Chainage (km)	Details of locations	Duration of monitoring	Instrument used	Completion	Monitoring Parameters	Standards	Results	Reasons for exceeding standards	Mitigation Measures suggested	Type of area (Residential / Industrial / Commercial)	Remark
<b>1. Air Monitoring (As per National Ambient Air Quality Standards, CPCB (2009))</b>												
		As per decision of Engineer in Charge				PM <sub>2.5</sub>	60 µg/m <sup>3</sup>					
			PM <sub>10</sub>	100 µg/m <sup>3</sup>								
			SO <sub>2</sub>	80 µg/m <sup>3</sup>								
			CO	02 mg/m <sup>3</sup>								
			NO <sub>x</sub>	80 µg/m <sup>3</sup>								
<b>2. Water Monitoring (As per Drinking Water Quality Standards, IS 10500, 2012)</b>												
		As per decision of Engineer in Charge				pH	6.5-8.5					
			BOD	Nil								
			COD	Nil								
			TDS	500 mg/l								
			Chlorides	250 mg/l								
			Nitrates	45 mg/l								
			Sulphates	200 mg/l								
			Iron	0.3 mg/l								
			Calcium	75 mg/l								
		Lead	0.01 mg/l									
<b>3. Soil Monitoring</b>												
		As per decision of Engineer in Charge				pH	<7.0 Acid 6.5–7.5 Neutral >7.5 Alkaline					
			Organic Matter	0.5 -0.75 %								
			Sodium	0-1 %								
			Potassium	2-6 %								

S. No.	Chainage (km)	Details of locations	Duration of monitoring	Instrument used	Completion			Monitoring Parameters	Standards	Results	Reasons for exceeding standards	Mitigation Measures suggested	Type of area (Residential / Industrial / Commercial)	Remark
								Chloride	0-1 %					
								Available Nitrogen	280-560 kg/hac					
								Phosphorous	11.5 – 24.5 kg/hac					
								Arsenic	< 20 mg/kg					
								Cadmium	< 1 mg/kg					
								Mercury	< 1 mg/kg					
								Lead	< 35 mg/kg					
								Electric Conductivity	0.0-2.0 Non Saline 4.1-8.0 Saline 16.0 Strongly Saline					
<b>4. Noise Monitoring (As per National Ambient Noise Standards, CPCB)</b>														
		As per decision of Engineer in Charge						L <sub>day</sub>	Residential-55 dB(A) Commercial-65 dB(A)					
								L <sub>night</sub>	Residential-45 dB(A) Commercial-55 dB(A)					
Remark														

Submitted  
Signature .....

Name .....

Designation .....

Contractor

Checked  
Signature .....

Name .....

Environmental Engineer of  
Construction Supervision Consultant

Approved  
Signature .....

Name .....

In-charge Officer (GMRL)

**Format for Vibration monitoring**

Construction site location: .....  
 Construction Stage: Report Date: .....Month: .....Year:.....  
 Mitigation measures suggested in last report complied or Not: Yes/No  
 If not reasons thereof.....

Format for Vibration monitoring									
Sampling code	Location	Date	Start Time	Stop Time	Latitude	Longitude	Vibration level (PPV in mm/s)	Standard	Remarks
1								DGMS (Directorate General of Mines and Safety)	
2									
3									

Submitted  
 Signature .....  
 Name .....  
 Designation .....  
 Contractor

Checked  
 Signature .....  
 Name .....  
 Environmental Engineer of  
 Construction Supervision Consultant

Approved  
 Signature .....  
 Name .....  
 In-charge Officer (GMRL)

**Annexure 9.8**

**Restoration of Construction Sites**

- **(To be filled by the Contractor)**

Construction site location: .....

Construction stage: Monthly Report Date: .....Month:.....Year:.....

Sl. No.	Contract Package	Labor Camp		Construction Camp		Plant Site		Disposal Locations		Top Soil	
		Yes	No	Yes	No	Yes	No	Yes	No	Preserved	Restored

Remark

Submitted

Signature .....

Name .....

Designation .....

Contractor

Checked

Signature .....

Name .....

Designation .....

Environmental engineer of

Construction Supervision

Consultant

Approved

Signature .....

Name .....

Designation .....

In-charge Officer (GMRL)

**Annexure 9.9**

**Format for keeping Records of consent obtained by Contractor**

Construction site location: .....

Construction Stage: Report Date: .....Month:..... Year:.....

S. No.	Contractor's Name	Clearance	Applicable Acts	Agencies	Obtained on	Valid up to	Remarks
<b>Construction Site Location</b>							

Remark
--------

Submitted  
Signature .....  
Name .....  
Designation .....  
Contractor

Checked  
Signature .....  
Name .....  
Designation .....  
Environmental engineer of  
Construction Supervision  
Consultant

Approved  
Signature .....  
Name .....  
Designation .....  
In-charge Officer (GMRL)

**Checklist for Environment Inspection  
(Points / Issues to be covered)**

Construction site location:.....

Date of Inspection:.....

S. No.	ESMP Measures
1	Provision of a personnel accountable for implementation of ESMP/Safety Measures with Contractor
2	Consent of PCB to Establish Batching Plant
3	Consent of PCB to operate Batching Plant
4	Compliance of PCB Conditions for Batching Plant installation and operation
5	Whether compliance reported through monthly Progress report to In-Charge (GMRL)
6	PUC taken for all Construction vehicles
7	Concrete platform with trap under bitumen boiler, Fuel Tank for Batching Plant and generator set provided or not
8	Precautions to prevent contamination of soil by emulsion, oil and lubricant taken while storing
9	Providing cover to fine construction material & bituminous mix during transportation
10	Muck /debris disposal:
	a) Present status of land
	b) Closure and completion plan
11	Site specific traffic Safety management Plan:
	a) Contractor installed the warning/regulatory Traffic signs at the construction site
	b) The arrangement adequate
12	Safety equipment i.e. helmet, gloves, gumboot, mask, earplugs etc. provided to workers
13	Health Facility at camp and work site i.e. First Aid kit & suitable vehicle for conveyance in case of emergency / accident
14	Permit for Procuring River sand
15	License from Department of mines for quarrying
16	Consent to establish/operation of crusher
17	Provision of labour camp with sanitation & potable water
18	Fire precautions at Plant and site Office
19	Air and noise monitoring done in camp site
20	Whether any cultural property is being impacted
21	Status of drainage provision in camp area
22	General House Keeping

Remarks:.....

**Submitted**

Signature .....

Name .....

Designation .....

Contractor

**Checked**

Signature .....

Name .....

Designation .....

Environmental engineer of  
Construction Supervision Consultant

**Approved**

Signature .....

Name .....

Designation .....

In-charge Officer (GMRL)

## Annexure 11.1

**Summary Sheet**

(To be filled monthly by supervisory staff and Submitted to GMRL)

Construction site location: .....

Month: .....Date:.....

<b>S No.</b>	<b>Description</b>	<b>Remarks</b>
<b>1</b>	<b>No Objection Certificate</b>	
A	Cement Batching Plant	
	Location 1	
	Location 2	
	Location 3	
<b>2</b>	<b>Pollution Under Certificate</b>	
	Vehicles	
	Machineries	
<b>3</b>	<b>No Objection Certificate for Diesel Gen set</b>	
	Location 1	
	Location 2	
<b>4</b>	<b>Labour Camps</b>	
	No. of sites Identified	
	Approved	
	Opened	
	Conforms to conditions imposed at the time of opening of sites	
	Closed	
<b>5</b>	<b>Workers</b>	
	No of workers employed	
	No of male workers	
	No of female workers	
	No of day workers	
<b>6</b>	<b>Borrow Area</b>	
	No. of sites identified	
	Approved	
	Opened	
	Quantity of available material	
	Quantity of material Utilized	
	Quantity of Topsoil preserved	

S No.	Description	Remarks
	Quantity of top soil used	
	No of sites closed	
	No. of sites Rehabilitated	
<b>7</b>	<b>Quarry</b>	
	No. of sites identified	
	Approved	
	Opened	
	Material available	
	Material obtained	
	No. of sites Rehabilitated	
<b>8</b>	<b>Disposal Locations</b>	
	No. of sites identified	
	Approved	
	Opened	
	Amount of Waste disposed	
	Type of waste disposed	
	No. of sites Rehabilitated	
<b>9</b>	<b>Road Safety</b>	
	Road Safety norms and approved Traffic plan	
<b>10</b>	<b>Cleaning of Culvert/ drains</b>	
	No. of culverts/ drains	
	No. Cleaned	
<b>11</b>	<b>Trees</b>	
	No of trees marked for cutting in field	
	No of trees cut	
	No of trees to be Planted	
	Trees Planted	
<b>12</b>	<b>Haul Roads</b>	
	Adequacy of maintenance of Haul Road Network	

Remarks:.....

**Submitted**

Signature .....

Name .....

Designation .....

Contractor

**Checked**

Signature .....

Name .....

Designation .....

Environmental engineer of  
Construction Supervision  
Consultant

**Approved**

Signature .....

Name .....

Designation .....

In-charge Officer (GMRL)