



**ASIAN INFRASTRUCTURE
INVESTMENT BANK**

July 23, 2024

Sovereign-Backed Financing

Approval Project Document

P000365 Republic of India: Mumbai Metro Line 5

Currency Equivalents

(As at date, September 8, 2023)

Currency Unit – Indian Rupee (INR)

INR1.00 = USD 0.012

USD1.00 = INR 82.945

Fiscal year

April 1 - March 31

Abbreviations

ADB	Asian Development Bank
AFC	Automatic Fare Collection
AIIB	Asian Infrastructure Investment Bank
AMC	Additional Metropolitan Commissioner
ASS	Auxiliary Sub-Station
BB	Building Block
DEA	Department of Economic Affairs
DPR	Detailed Project Report
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
ENPV	Economic Net Present Value
ESDD	Environmental and Social Due Diligence
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESP	Environmental and Social Policy
ESS	Environment and Social Standards
FIRR	Financial Internal Rate of Return
FM	Financial Management
FY	Fiscal Year
GC	General Consultant
GDP	Gross Domestic Product
GESI	Gender Equality and Social Inclusion
GHG	Green House Gases
GOM	Government of Maharashtra
GPS	Global Positioning System
GRM	Grievance Redress Mechanism
GSDP	Gross State Domestic Product
HQ	Headquarters
HVAC	Heating, Ventilation, Air-Conditioning
IC	Investment Committee
IEE	Initial Environment Examination
IMF	International Monetary Fund
INR	Indian Rupee
IOCT	International Open Competitive Tender

IUFR	Interim Unaudited Financial Reports
MDB	Multilateral Development Bank
MMMOCL	Maha Mumbai Metro Operation Corporation Limited
MMR	Mumbai Metropolitan Region
MMRDA	Mumbai Metropolitan Region Development Authority
MoHUA	Ministry of Housing and Urban Affairs
MUTP	Mumbai Urban Transport Project
NCT	National Competitive Tender
NDC	National Determined Contribution
NGO	Non-Governmental Organization
NOCT	National Open Competitive Tender
NPV	Net Present Value
OHE	Overhead Equipment
OPEC	Organization of the Petroleum Exporting Countries
PA	Paris Agreement
PAP	Project Affected Persons
PD	Project Director
PDS	Project Delivery Strategy
PIR	Procurement Instructions for Recipients
PIU	Project Implementing Unit
PMO	Project Management Office
PPM	Project-affected People's Mechanism
PPP	Public Private Partnership
PSD	Platform Screen Doors
PWD	People with Disabilities
RBI	Reserve Bank of India
RFP	Request for Proposal
RP	Resettlement Plan
SCADA	Supervisory Control and Data Acquisition
SCF	Standard Conversion Factor
SDC	Software Testing, and development Centre
SIA	Social Impact Assessment
SPD	Standard Procurement Document
TOR	Terms of Reference
TSS	Traction Substation
USD	United States Dollar
VAT	Value Added Tax
VOC	Vehicle Operating Cost
VOT	Value of Time

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1. Summary Sheet

Project No.	P000365
Project Name	Mumbai Metro Line 5
AIIB Member	India
Borrower	Ministry of Finance, India
Project Implementation Entity	Mumbai Metropolitan Region Development Authority
Sector	Transport
Subsector	Urban transport
Alignment with AIIB's thematic priorities	Green infrastructure; Connectivity and Regional Cooperation; Technology-enabled Infrastructure
Project Objective	The Project's objective is to increase transport capacity and provide a green, fast, and accessible metro system for passengers.
Project Description	The Project will finance rolling stock, signaling and telecommunications, platform screen doors, and automatic fare collection for the entire Metro Line 5 (Thane to Kalyan) and the civil works, traction and power supply, electrical and mechanical for stations and depot, depot machinery and plant, and consulting services for the first section of Mumbai Metro Line 5 (Thane to Bhiwandi), composed of 6 stations. The Project is part of a larger Program, aiming to finance the civil works, rolling stock and metro systems, and consulting services for the entire Metro Line 5 (Thane to Kalyan).
Implementation Period	10/01/24 10/01/28
Expected Loan Closing Date	10/01/28
Proposed Amount of AIIB Financing (USDm)	USD200.00 million
Financing Plan	Project Cost: USD535.94 million Financing Plan: AIIB (Lead Financier): USD200.00 million OPEC Fund: USD84.00 million MMRDA: USD251.94 million
ES Category (or AIIB equivalent, if using another MDB's ES Policy)	A
Risk (Low/Medium/High)	Medium
Key Covenants	Conditions for effectiveness: (a) the Subsidiary Agreement has been executed on behalf of the State of Maharashtra and the Project Implementing Entity, and all conditions precedent to its effectiveness have been fulfilled; (b) the Co-financing Agreement has been executed on behalf of the Co-financier and the Borrower, and all conditions precedent to its effectiveness or to the right of the Borrower to make withdrawals under it (other than the effectiveness of this Loan Agreement) have been fulfilled; (c) The Project Co-financiers' Agreement has been executed on behalf of the Bank and the Co-financier, and

	all conditions precedent to its effectiveness have been satisfied; and (d) the Project Implementation Manual has been prepared in form and substance satisfactory to the Bank.
Retroactive Financing (Loan % and dates)	Up to 20% of Loan Amount and 12 months prior to Loan signing.
Policy Waivers Requested	No
Policy Assurance	The Vice President, Policy and Strategy, confirms an overall assurance that AIIB is in compliance with the policies applicable to the project.
Economic Capital (ECap) Consumption (USDm)	USD15.36

President	Liqun Jin
Vice President	Rajat Misra
Director General	Rajat Misra
Team Leader	Jawad Bentabet, Investment Officer
Back-up Team Leader	Andres Pizarro
Team Members	Jurminla Jurminla, SFD - Procurement Specialist Susrutha Goonasekera, SFD - Social Development Specialist Yogesh Malla, SFD - Financial Management Specialist Luiz Eduardo Rodrigues, Project Counsel Liu Yang, Alternate Counsel Dale Pham, SFD - Environment Specialist

2. Context

2.1 **Country and Macroeconomic Overview.** India has experienced rapid urbanization over several decades, with the share of its urban population increasing from 17.9 percent in 1960 to 35.4 percent in 2021. By 2050, India's major cities are projected to be home to another 390 million people with the urban areas accounting of almost 53 percent of India's population. Urban India is slated to be the engine of the India's economic transformation with its contribution to India's GDP rising from 60 percent presently to more than 75 percent by 2030. However, urban infrastructure has not kept pace with the rapid growth and many urban areas are characterized by high economic activity and traffic congestion, overburdened public transport system, deficient water supply and drainage, lack of wastewater collection and treatment and inefficient solid waste management.

2.2 Considering the urban challenges, the government has introduced several programs to improve infrastructure and service delivery including Smart Cities Mission and Atal Mission for Rejuvenation and Urban Transformation (AMRUT). Smart Cities Mission aims to build cities where infrastructure is easily accessible and affordable, and AMRUT provides water supply, sewerage, urban transport, and safe public spaces to residents of urban centers. The government's Metro Rail Policy 2017 sets out the guidelines for the development of metro rail projects, and conditions for approval and funds provided by the central government. The three models outlined are Public Private Partnerships (PPPs) with central government assistance, grant by central government, and 50:50 equity sharing between central and state government. In 2021, there were 18 operational rapid transit (or metro) systems in India, covering 733 kilometers. By 2025 there will be 27 cities with rapid transit systems, covering 1700 kilometers.

2.3 The State of Maharashtra has the highest Gross State Domestic Product (GSDP) among all states and union territories, and accounts for more than 13 percent of India's output. It is home to nearly 126 million in 2023, second highest among all states of India. It ranks fifth among the Indian states in terms of per capita income. Maharashtra is the third most urbanized state of India, behind Tamil Nadu and Kerala, with 48.5 percent of the population living in urban areas. Estimates suggest a 6.8 percent growth in FY2022, similar to the all-India growth rate.

2.4 To improve the quality of life, especially in urban areas, Government of Maharashtra (GoM) introduced a State Urban Transport Policy (SUTP), 2017, which notes: "GoM and its cities will develop high quality public transport systems that are affordable, reliable, convenient, safe, and accessible by all regardless of age, income, gender, ability or social standing." The same document furthermore notes initiatives that include "Grade separated rapid transit such as metro rail or elevated Bus Rapid Transit (BRT) on public transport corridors with a current PT (public transport) demand of more than 15,000 PPHPD (persons per hour per direction)."

2.5 **Institutional Context.** Mumbai, the capital of State of Maharashtra, is known as the financial capital of India. It is the second most populous agglomeration in India with a population of 20.4 million in 2020 and expected to rise to 27.37 million by 2035. The city of Mumbai is a part of the Mumbai Metropolitan Region (MMR), which includes Mumbai suburban district, parts of Thane District (Thane, Bhiwandi, Kalyan and Ulhasnagar tehsils, Vasai tehsil), and parts of Raigad District (Uran tehsil, Panvel, Karjat, Khalapur, Pen and Alibaug tehsil). The MMR covers an area of 6,328 sq. km and is considered as one of the most densely

populated areas in the world. The region accounts for nearly 40 percent of Maharashtra's output. Two important ports, the Mumbai Port Trust and Jawaharlal Nehru Port Trust, in the region handle more than 30 percent of the maritime trade.

2.6 The entire area is overseen by the Mumbai Metropolitan Region Development Authority (MMRDA), a Maharashtra State Government organization in charge of town planning, development, transportation, and housing in the region. MMRDA was established in accordance with the Mumbai Metropolitan Region Development Authority Act, 1974, on 26th January, 1975. Its Board (the "Authority") is the highest policy making body and supervises and controls all the activities of MMRDA. It consists of 17 members, among which the Minister for Urban Development, Government of Maharashtra (Chairman), the Minister for Housing, the Minister of State for Urban Development, the Mayor of Mumbai, members of the Maharashtra Legislative Assembly and Maharashtra Legislative Council, etc.

2.7 **Sector Overview:** The Mumbai suburban railway system is extremely overloaded. The suburban railway system carries over 7.5 million passengers daily. Trains with a capacity of 1,750 passengers carries about 5,000 passengers with more than 14 passengers being squeezed in a square meter. The suburban railway system suffers from significant safety issues with approximately 3,000 accidental deaths per year. The urban bus system is also stretched in highly congested conditions. Thus, it is essential to enhance the public transport capacity to ensure safe and convenient mobility. This would also help in arresting the decline in ridership share of public transport from 88 percent in 1994 to 70 percent in 2015. Given the geographical layout and high population density, the development of metro rail system is a viable solution. MMRDA is planning a wide metro system across MMR, which will eventually include 14 lines for a total length of 337 km. Three lines of that system are currently operational, while five have started construction works.

2.8 **Addressing Key Development Challenges. The Program.** The Mumbai Metro Line 5 (MML5) – also referred to as Thane-Bhiwandi-Kalyan Line – is a 24.45 km-long elevated and underground metro rail system, part of the Mumbai Metropolitan Region's developing metro network. The line will comprise 16 stations, connecting under-construction line 4 to the west (Kapurbawadi station, Thane city), and the suburban railway and planned Line 12 to the east (Kalyan station). The line will have its own train depot for operation, storage and maintenance. The rolling stock will consist of 132 standard-gauge rolling stock coaches.

2.9 Considering site constraints, MMRDA has approved the implementation of Metro Line 5 in two phases ("the Program"). Civil works contracts for Phase 1 were awarded in August 2019 to construct the 12.125 km western section between Kapurbawadi (in Thane) and Dhamankar Naka (in Bhiwandi) - 6 stations, Kapurbawadi being constructed under the Line-4 project. The eastern section between Bhiwandi – Kalyan (Phase 2 of Line 5, 12.325 km, 9 stations), is on hold as the route alignment is being revised (changed from elevated to underground section, due to land acquisition issues in approximately 3 km stretch in Bhiwandi City).

2.10 **Project Description.** The Project covers the financing of the construction works (guideway, tracks, stations and depot), metro systems, and consulting services for the Phase 1, and the rolling stock, the signaling and telecommunications system, platform screen doors, and automatic fare collection for Phases 1 and 2 of the Program. A single procurement process for both Phases for the rolling stock package, for the signaling and

telecommunications, platform screen doors package, and for the automatic fare collection package will enable economies of scale, avoid having different providers, and seamless movement over the same metro line. Signaling systems are integrated with rolling stock manufacturers, as well as are the platform screen doors and automatic fare collection. Therefore, it is not conceivable to have different rolling stock and related systems along a line that is operated seamless, as a unity, as will be the Metro Line 5. Thus, the Project will be covering the rolling stock, the signaling system and the screen doors for both Phase 1 and 2 of the Program.

2.11 MMRDA finances civil works and consulting services for the 12.125 km-section between Thane and Bhiwandi. AIIB will finance the rolling stock, signaling and telecommunications, platform screen doors, and automatic fare collection for the entire Metro Line 5 (Thane to Kalyan), and electrical and mechanical equipment for stations and depot, traction and power supply equipment, lifts and escalators, and depot machinery and plants for the first section between Thane and Bhiwandi. OPEC Fund is jointly co-financing the Project (three packages, including rolling stock, signaling, telecommunications and platform screen doors, and overhead equipment. traction power supply and SCADA).

3. Rationale

3.1 **Project Objective.** The objective of the proposed project is to increase transport capacity and provide a green, fast, and accessible metro system for passengers. The Program will have the same Objective.

3.2 **Expected Beneficiaries.** The primary beneficiaries are metro passengers who will benefit from faster, accessible, safer, more reliable and better-quality new metro line compared to road-based public and private transport. With the implementation of the Gender Equality and Social Inclusion framework developed by MMRDA for Line 5, the Project will also significantly benefit women, children, the elderly and PwD passengers. Secondary beneficiaries are residential and commercial establishments along the new corridor who will benefit from improved accessibility and connectivity as well as increasing economic opportunities. The Project will assure universal accessibility allowing the overall population to use the metro system. Furthermore, new job opportunities will be available during construction and operation phase.

3.3 **Expected Results.** The Results Monitoring Framework is included in Annex 1. It consists of Project Objective Indicators and Project Intermediate Results Indicators formulated during Project preparation. The Project Objective Indicators are measured/calibrated once the Project becomes operational. The Project Objective Indicators are:

- (i) Number of passengers on Line 5 - Thane to Bhiwandi (unit: passenger)
- (ii) Reduced travel time between Thane and Bhiwandi (unit: minute)
- (iii) Number of commissioned electric-powered train vehicles (unit: number)
- (iv) Number of stations equipped with adequate facilities for different needs and preferences of women and PwD (unit: number)

The Program will have the same Objective Indicators, from Thane to Kalyan.

3.4 The Intermediate Results Indicators will be measured periodically during implementation to ensure that the Project is progressing in accordance with the implementation plan. The proposed Project Intermediate Results Indicators are:

- (i) Metro systems implementation (percent of total contract value)
- (ii) Overall construction progress of civil works (unit: percent)

3.5 **Co-financing.** The Project will be jointly co-financed by the Asian Infrastructure Investment Bank (AIIB) and the OPEC Fund, with the AIIB being the lead partner. AIIB's environmental and social, and procurement policies will be applicable to the project. There exists a formal framework agreement between the AIIB and the OPEC Fund. A draft project-specific co-financing agreement is also prepared.

3.6 **Strategic Fit for AIIB.** The project is aligned with AIIB's corporate and thematic strategies as follows:

- (i) Thematic priority on connectivity and Transport Sector Strategy. The Project increases the transport capacity of the mass transit system in Mumbai Metropolitan Area, and eases pressure on the road network through shifting road traffic to public transport.
- (ii) Sustainable Cities Strategy. MML5 is a G.R.E.A.T. project: (G) it contributes reducing the air pollution in Mumbai by shifting road users to a green metro

system; (R) the Project incorporates adequate climate adaptation features that makes it resilient to potential precipitation increase and urban flooding; (E) it is efficient to reduce congestion and reduce the travel time; (A) the new mass rapid transit system increases accessibility to infrastructure and social services in the urban area by connecting two secondary cities of the MMR region (Thane and Bhiwandi); (T) the Project contributes to Mumbai's thriving economy, increasing access to commercial establishments along the corridor, and creating job opportunities during its implementation and its operation. The Project enhances urban mobility, advances public transport network integration, provides households better access to and improves the efficiency of basic infrastructure and services.

- (iii) Thematic priority on Green Infrastructure. The proposed metro project is a clean mode of transportation that is expected to result in a net reduction in Greenhouse Gas (GHG) emissions and local air pollution. This will be achieved through a modal shift from a carbon-intensive transport mode (i.e., roads) to a low-carbon electrified metro line. Since the project provides electric traction, expected benefits include: (i) reduced fossil fuel consumption as electric-powered engines are not dependent on a single energy source and energy can be sourced from various sources such as renewable energy; (ii) a regenerative braking feature since the train's kinetic energy can be converted into electrical energy, thereby resulting to energy savings of up to 20 percent compared to conventional brakes. The project is also expected to increase the climate resilience of the metro infrastructure.
- (iv) Thematic priority on Technology-enabled Infrastructure. The proposed project design will include the latest technological, environmentally friendly and energy-efficient features in terms of signaling and telecommunications equipment (CBTC-Communication Based Train Control, passenger information system, automatic train operation) that will improve safety, accessibility and reliability for all passengers (including elderly, children, women and disabled), as well as transport operation and maintenance.

3.7 Value Addition by AIIB. Beyond providing financing, the value additions by AIIB in the Project include: (i) Support for implementing a single procurement process for rolling stock, signaling/telecom/platform screen doors and automatic fare collection components, ensuring technical and operation consistency between the Program, and enabling economies of scale; (ii) Introducing the concept of improving Mumbai's Metro technical and operational network integration by suggesting single procurement process for rolling stock and signaling/telecom components for line 5 and adjacent lines (Line 4, financed by KfW and under construction, and planned Line 12); (iii) technical support on integration and coordination of construction of signaling and telecommunications system with Line 4 and the anticipated line 12 in the future into a seamless network to avoid duplication of efforts, cost overruns and delays; (iv) Strengthening the implementing entity's technical due diligence, providing continuous support to the preparation of Environmental and Social (E&S) safeguard documents (ESDD, EIA, SIA); enhancing quality of the procurement document (tender documents, procurement plan and project delivery strategy); (v) Involvement in updating the economic analysis of the Program and the Project, originally in one implementing phase, to reflect the change in the implementation arrangement, capital costs, additional externalities (GHG emissions) and to

assist the PwD with the appropriate methodology; and (vi) Mobilizing capital through the investment from OPEC Fund as the co-financier.

3.8 Value Addition to AIIB. Through this Project, the Bank will further develop its expertise and knowledge in financing complex, high-demand urban, metro and transport projects in India and the region. The Project was the opportunity to develop knowledge and discuss on concepts such as multi-phasing program for the implementation of metro system, network integration, Make in India policy and other procurement issues. The Project contributes to promote working with OPEC Fund and other International Financing Institutions to facilitate future co-financing opportunities and will enhance AIIB's experience as the lead financier.

3.9 Lessons Learned. The preparation of this Project has benefited from the Bank's experience in similar projects and in the region: (i) Mumbai Metro Line 5 is the second AIIB project to involve OPEC Fund as a joint co-financier, therefore AIIB relied on the experience acquired from the first project (Chennai Peripheral Ring Road Sections II & III project), for the preparation of the co-lending agreement and during the procurement process; (ii) during the preparation of the rolling stock tender documents, AIIB has shared experience with MMRDA on procurement issues discussed in previous projects, namely the seat of arbitration in case of dispute (example taken from Chennai Metro Phase 2, Corridor 4), use of debarment lists, Make in India policy on other ongoing and past projects in India. The Project has also benefited from MMRDA's experience in the implementation and the operation of three metro lines in Mumbai (Line 1, Line 2A and Line 7).

4. Project Description

4.1 **Program Components.** Given the progress of civil works in the western section and the land acquisition challenges in the eastern section, the Program has been split into two phases by MMRDA, corresponding to the western and eastern sections. Phase 1, covering from Thane to Bhiwandi, corresponds to the provision of:

- 4.1.1 Program Component 1: construction works, including guideway, tracks, 6 stations, and depot,
- 4.1.2 Program Component 2: rolling stock and metro systems,
- 4.1.3 Program Component 3: consulting services.

4.2 Phase 2 corresponds to the provision of the same elements in the eastern section, covering from Bhiwandi to Kalyan.

4.3 **Project Components.** MMRDA will finance components 1 and 3 for Phase 1, AIIB and OPEC Fund will jointly co-finance component 2, Phase 1, and rolling stock, signaling, telecommunications and platform screen doors packages of component 2, Phase 2.

4.3.1 **Project Component 1 – financed by MMRDA.** Civil works for the Project include construction of the viaduct, guideway, tracks, over 12.125 km, 6 elevated stations including entry/exit structures (Balkum Naka station to Dhamankar Naka station, Kapurbawadi station - western terminus - being constructed under Line 4 project), Operation Control Center civil works, depot civil works, miscellaneous utilities, roadworks, diversion and shifting of utilities including high-tension lines, staff quarters and multimodal integration facilities.

4.3.2 **Project Component 2 - financed by AIIB and OPEC Fund.** Under the Project, AIIB will finance the rolling stock, signaling and telecommunications, platform screen doors and automatic fare collection for the entire line 5 (Thane to Kalyan), and electrical and mechanical equipment for stations, traction and power supply equipment, lifts and escalators, electrical and mechanical equipment for depot and depot machinery and plants for the first section between Thane and Bhiwandi. OPEC Fund will jointly co-finance rolling stock, signaling, telecommunications, platform screen doors and depot machinery and plants. The latest procurement plan is as follows:

- (i) Rolling Stock, Signaling & Telecommunication, Platform Screen Doors, Depot Machinery and Plants: (AIIB and OPEC Fund co-financing).
Design, Manufacture, Supply, Installation, Testing, Commissioning of 132 Standard Gauge Metro Rail coaches and training of maintenance staff after commissioning of coaches.
Design, Manufacture, Supply, Installation, Testing and Commissioning of Train Control and Signaling, Telecommunication over 24.45 km.
Design, Manufacture, Supply, Installation, Testing and Commissioning of Platform Screen Door System for 16 stations.
Manufacture, Supply, Installation, Testing, Commissioning of M&P for Kasheli Depot including training to maintenance staff of car shed.
- (ii) Overhead Equipment, Traction Power Supply & SCADA (Covering both traction & Auxiliary Service Station), Lifts & Escalators, Electrical & Mechanical (Stations) along with Auxiliary Substations, Electrical & Mechanical (Depot) along with Auxiliary Substations: (AIIB financing).

Design, detailed Engineering, Supply, Installation, Testing and Commissioning of 220kv/33KV Receiving cum Auxiliary Main Substation, 220kv/25KV single phase AC Traction Substation, OHE, Traction as well as Auxiliary SCADA, 33KV cables & ASS for line 5 including ASS & OHE in Kasheli Car Shed.

Design, Manufacture, Supply, Installation, Testing, Commissioning including Maintenance of Escalators & Lifts of 6 Elevated Stations.

Design verification, Manufacture, Supply, Installation, Testing and Commissioning of E&M, Fire Detection and Fire Suppression Systems including DG sets for 6 Elevated stations.

Design verification, Manufacture, Supply, Installation, Testing and Commissioning of E&M, Fire Detection and Fire Suppression Systems including DG sets for Kasheli Depot. (SDC).

(iii) Automatic Fare Collection: (AIIB financing).

Design, Manufacture, Supply, Installation, Testing and Commissioning of Automatic Fare Collection (AFC) systems for 15 Elevated/Underground Stations and AFC OCC, AFC Software Testing, and development Centre (SDC).

4.3.3 Project Component 3 – financed by MMRDA. In order to strengthen the in-house team and for better execution, monitoring and support, MMRDA has hired two General Consultants (GC) – one for systems and the other for civil works.

4.4 Cost and Financing Plan. The indicative financing plan of the Project is shown below. The Project is estimated to cost USD535.94million, per the breakdown below. Costs presented here do not include taxes and duties.

Table 1: Project Cost and Financing Plan (USD million)

Item	Project Cost (USD m)	Financing (USD m and %)		
		MMRDA	AIIB	OPEC Fund
<u>Component 1: civil works</u>	232.59	232.59	-	-
<u>Component 2: rolling stock and metro systems</u>	284.00	-	200.00 (70.42%)	84.00 (29.58%)
Rolling Stock ¹ , Signaling & Telecommunication, Platform Screen Doors ² , M & P for Depot	222.47	-	138.47 (62.24%)	84.00 (37.76%)
Overhead Equipment, Traction Power Supply & SCADA (Covering both traction & Auxiliary Service Station), Lifts & Escalators, Electrical & Mechanical (Stations) along with Auxiliary Substations,	45.73	-	45.73 (100%)	-

¹ Project cost for the Rolling Stock is USD164.55 million, broken down into USD89.75 million (55%) to be used for Phase 1, and USD74.79 million (45%) to be used for Phase 2

² Project cost for the Signaling & Telecommunication and Platform Screen Doors is USD53.34 million, broken down into USD27.21 million (51%) to be used for Phase 1, and USD26.13 million (49%) to be used for Phase 2

Electrical & Mechanical (Depot) along with Auxiliary Substations				
Automatic Fare Collection	9.65	-	9.65 (100%)	-
Contingencies (for unforeseen changes on Component 2)	6.15	-	6.15 (100%)	-
<u>Component 3: consulting services</u>	19.35	19.35	-	-
Total	535.94	251.94	200.00	84.00

4.5 Implementation Arrangements and Readiness

4.5.1 Implementation arrangements.

- (i) The Project is jointly co-financed by the OPEC Fund and AIIB is the lead partner. Procurement will be conducted in accordance with AIIB's Procurement Policy, January 2016 (updated November 2022), and Section II of Interim Operational Directives: Procurement Instructions for Recipients (PIR), June 2016. The procurement of goods and works will follow International Open Competitive Tender (IOCT) and National Competitive Tender (NCT) as set out in paragraph 10.1 and 10.4 of the Bank's PIR, respectively using Maharashtra Government's e-tender platform <https://mahatenders.gov.in/nicgep/app>.
- (ii) MMRDA shall be responsible for the overall project financial management. MMRDA PIU has been established with adequate and qualified staff for project implementation, monitoring and reporting. The planning, budgeting, accounting, funds flow and audit arrangements shall be aligned with MMRDA's system to the extent possible. In the annual GoM budget, a separate budget head shall be provided for this Project. All payments related to the Project shall be pre-financed by MMRDA. Taxes and audit costs shall be borne by MMRDA's counterpart funds. AIIB and OPEC Fund shall jointly co-finance eligible project expenditures in agreed financing ratios. AIIB shall partially administer disbursement of OPEC Fund. The GoI shall make available loan proceeds to MMRDA through GOM as per their standard on-lending practice. MMRDA shall submit withdrawal claims to co-financiers through CAAA (Controller of Aid Accounts and Audit) and details of disbursement arrangements shall be stated in the disbursement letter. MMRDA will submit Interim Unaudited Financial Reports (IUFRs) within 45 days from the end of each financial quarter. MMRDA shall submit an annual project internal audit report to AIIB within agreed timeline. The external audit reports for each year of project implementation shall be submitted as follows: (i) the project audit report within 6 months from the financial year-end and (ii) MMRDA Entity audit report within 12 months from the financial year end.
- (iii) The PIE is set with clear roles and responsibilities. The PIU is headed by the Additional Metropolitan Commissioner (AMC) who will act as the Project Director and take the overall responsibility for implementation under the guidance of the Metropolitan Commissioner (MC). PIU has separate divisions responsible for Civil works and Systems aspect of project implementation, headed by Director (Projects) and Director (Systems)

respectively. PIU is supported by MMRDA headquarters (HQ) for functions such as environment, social, land and finance. The PIU has current strength of about 80 employees, with MMRDA in the process of hiring more employees for implementation of planned metro lines.

- (iv) Metro PIU has appointed a General Consultant for all systems design development, assistance in procurement, construction supervision and management, systems integration, and interface management, testing and commissioning of the Project. The GC's scope of work includes tender packaging, preparation, and finalization of tender documents for all related systems including preparing the conceptual plans and evaluation of tenders. The GC will carry out verification of the design drawings submitted by contractors, certify vendor sources, inspect vendor-supplied items, supervise system-related construction activities, conduct safety and quality reviews, monitor and report on work progress, supervise system trials and system integration ensuring commissioning of the Project as per the target dates. The scope of the GC services also includes project management and costs control. The GC will also arrange training through contractor (OEM) MMRDA operation and maintenance staff. GC will deploy about 75 technical and 25 non-technical staff to support MMRDA in implementation. GC will have dedicated personnel to oversee coordination aspects between various contractors as well as between civil and the systems work.

4.5.2 Implementation period. Civil works construction commenced in October 2019. MML5 systems and rolling stock procurement has started in Q1 2024 and implementation is expected to commence in Q4 2024 and are planned for completion in Q3 2026 (for items used for Phase 1), concurrent with overall civil works commissioning and completion. Overall civil works, the rolling stock and systems procurement, implementation and commissioning would take 7 years.

4.5.3 Implementation readiness.

- (i) MMRDA is the Project Implementing Entity (PIE). A Metro Project Implementing Unit (PIU) has been setup within MMRDA to implement the proposed metro line in a time-bound manner. The General Consultant (GC) has also been hired to support the project implementation and augment the institutional capacity of the implementation entity. A procurement plan is in place, AIIB providing assistance to introduce a single procurement process.
- (ii) An Environmental and Social Due Diligence (ESDD) has been prepared and disclosed on AIIB and implementation entity's websites. A draft version of the Social Impact Assessment (SIA), the Resettlement Plan (RP) and the Environmental Impact Assessment (EIA) were also submitted, finalized, and disclosed on AIIB and implementation entity's websites.

4.5.4 Monitoring and Evaluation. The overall responsibility for monitoring Project results will be with MMRDA, supported by the GC. MMRDA will produce monthly or quarterly progress reports, which will be one of the main means of monitoring project implementation. These reports, which will be shared with AIIB, will highlight the status of achievement of agreed targets for monitoring indicators and detail project implementation progress.

4.5.5 **AIIB's Implementation Support.** Under normal circumstances AIIB is expected to conduct two field visits per year to monitor progress. Depending on the Project's progress and the performance of the GC, AIIB may conduct additional visits, especially during commissioning. In addition to the semi-annual visits, AIIB will likely engage local consultants for technical, environmental and social aspects to carry out more frequent supervision of progress, and environmental and social management activities.

5. Project Assessment

A. Technical

5.1 **Project Design.** The terminus points of Mumbai Metro Line 5, Thane (western terminus) and Kalyan (eastern terminus), are major trip-generating locations in MMR with considerable working-class population in those districts. Bhiwandi, in the middle of Mumbai Metro Line 5, is a hub for warehouses and small industries with considerable trip generation for Mumbai Metro Line 5. Yet, there is a lack of adequate transport options in this corridor. There are suburban railway stations at Thane and Kalyan, but not connecting the two, and predominantly suburban rails have passenger volumes far more than their capacity. Therefore, MMRDA considered the general status of public transportation in Thane, Bhiwandi and Kalyan resulting the Detailed Project Report (DPR) issued in 2016 and selecting metro as the preferred transportation option in the corridor.

5.2 The 24.45km line will comprise 16 stations, connecting under-construction line 4 to the west (Kapurbawadi station, Thane city), and the suburban railway and future Line 12 to the east (Kalyan station). Considering site constraints, MMRDA has approved the implementation of Line 5 in two phases. Civil works contracts for Phase 1 were awarded in August 2019 to construct the 12.125 km western section between Kapurbawadi - Dhamankar Naka (6 stations, Kapurbawadi station being constructed under the Line-4 project). Civil works on this section from Thane to Bhiwandi are under progress. The eastern section between Bhiwandi – Kalyan (Phase 2 of Line 5, 9 stations), is on-hold as the route alignment is being revised (changed from elevated to underground section, due to land acquisition issues in approximately 3 km stretch in Bhiwandi City).

5.3 The line will have its own train depot for operation, storage, and maintenance. The rolling stock will consist of 132 standard-gauge rolling stock coaches, allowing for 22 train sets in a configuration of 6 cars each. Each trainset will have a capacity of 1790 passengers, and will include two driving motor cars (DMC, one at each end of the train), two trailer cars (TC) and two motor cars (MC). The rolling stock will be well equipped with communication-based signaling & train control system. All cars will be air-conditioned and powered by an overhead electrical current collection system. Equipment will have built-in safety features, design features for the elderly, children, women, differently abled and will be energy efficient and environmentally friendly systems/features.

5.4 Stations will have platform access control systems integrated with fare collection & security features, and automatic platform screen door & edge doors fitted for the elderly, children, women, and differently abled, to ensure a high level of operational safety. The depot will be equipped with necessary facilities and amenities for systems maintenance over the complete life cycle, and all necessary amenities for staff, including training.

5.5 **Implementation.** The Project (including civil works, and the procurement, supply and commissioning of rolling stock and equipment) is planned to be completed before Q3 2026. The Program is planned to be completed before 2028.

5.6 Operational Sustainability. The operation of Line 5 will be carried out by Maha Mumbai Metro Operation Corporation Limited (MMMOCL), a subsidiary of MMRDA established in June 2019 to carry out the Operations and Maintenance of all the upcoming Metro corridors in the Mumbai Metropolitan Region (MMR). Operations and Maintenance of all Metro corridors will be integrated under one authority. MMOCL already operated line 2 (phase 1) and line 7, both opened in 2022.

5.7 Stated objectives of the company are: (1) To independently carry out business of Operation and Maintenance (O&M), and related functions of all Metro lines in Mumbai Metropolitan Region, (2) To carry out Planning, Identification, Development and Implementation of all Non-Fare Box Revenue measures, and (3) Execute Property development and construct or maintain or lease out various facilities in relation to rail transport system.

5.8 Train Operation Plan. The objective of the train operation plan is to provide reliable, safe and accessible connectivity by minimizing the waiting time of passengers. The plan is also needed for estimating the quantity of rolling stock and their technical requirements, to guarantee good levels of service quality. It is based on peak hour per direction traffic demand (PHPDT), and following features were considered:

Table 2: Train Operation Plan of Phase 1

Length of section (terminal to terminal station)	12.125 km
Number of stations	7 (including Kapurbawadi)
Scheduled commercial speed	32.4 kmph
Round trip time	50 minutes
Turnback time at each terminal	3.0 minutes
Number of trains required	12 (including 1 operation and 1 maintenance reserve)
Minimum headway (peak)	5 minutes
Maximum headway (off-peak)	10 minutes
Total trips per day	340

B. Economic and Financial Analysis

5.9 Demand Forecasts. The starting data used for modelling the network of Thane, Bhiwandi and Kalyan region are drawn from the Comprehensive Transport Study (CTS, 2005) for Mumbai Metropolitan Region carried out by MMRDA. In particular, this study concerned a detailed analysis of travel demand in different alternatives scenarios of population, employment and network development for various horizon years. These data were updated in the DPR (2016) taking into account the results of the 2011 census and new planned development plans of the area. These were further updated in 2023 by MMRDA (Transport Economics Department) to consider the new implementation phasing and timeline. The table below outlines the daily ridership for the Project and the Program for key years.

Table 3: Daily Metro Passenger Ridership (Thousands)

Line	2026	2028	2031	2041
Project: Phase 1	122.3	126	131.6	162.5
Program: Phase 1 + Phase 2	-	278	302.6	404.9

Source: Detailed Project Report for Mumbai Metro Line 5, updated by MMRDA Transport Economics Department

5.10 Economic analysis. The initial DPR (2016) included an economic analysis of the entire Line 5, before it was split into two Phases. The Bank Project team updated the analysis to take into account the change in the project phasing, timeline and costs. Two economic analyses were then performed: one for the Project, one for the Program. For each, the economic viability was assessed using a Cost-Benefit Analysis by comparing “with-project” and “without project” scenarios. The economic internal rate of return (EIRR) was calculated by comparing the economic and societal benefits with investment costs over a period of 36 to 38 years, including 30 years of operation (+2 years for the Program, considering Phase 2 is commissioned 2 years after Phase 1) and 6 years of construction. The analysis indicates that the Project is economically viable with an EIRR of 14.87 percent and a NPV of INR 15.10 billion (discount rate 12 percent). A similar analysis of the Program also substantiates its economic viability with an EIRR of 18.92 percent and an NPV of INR 95.24 billion. The key benefits of the project take the form of savings in travel time of passengers (VOT), Vehicle Operating Cost (VOC) savings, reduction in greenhouse gas (GHG) emissions and air pollution, and improved road safety.

5.11 Financial analysis. Similarly to the economic analysis, the initial DPR (2016) included a financial analysis of the entire Line 5 as a whole. The Bank Project team updated it to perform two financial analyses, to assess the financial viability of the Project and the Program. The post-tax Financial Rate of Return (FIRR) is used as the value measure for the analysis of financial sustainability. It is based on costs (investment and O&M costs, including taxes), and revenues (farebox revenues, property development, advertising...), over a period of 36 to 38 years, including 30 years of operation (+2 years for the Program, considering Phase 2 is commissioned 2 years after Phase 1) and 6 years of construction. The analysis was done in real (or constant) terms, without factoring escalations for the costs. The evaluation results show that the Project has an estimated post-tax real FIRR of 2.53 percent; the Program has an estimated post-tax real FIRR of 6.26 percent, which is acceptable. Operation and Maintenance costs are covered by fare box revenues throughout the assessment period. Given that fare box revenue is the main benefit stream from the project investment, the fare escalation and ridership projections will have crucial impact on the FIRR.

C. Fiduciary and Governance

5.12 Procurement. The project team has conducted a procurement assessment on MMRDA and note that MMRDA has implemented several MDB financed projects in the past and they are familiar with MDB procurement arrangements. MMRDA has also established Project Implementing Unit (PIU) with clear roles and responsibilities. The PIU is headed by the Addl. Metropolitan Commissioner who will act as the Project Director. The Project Director is supported by Directors (Project) for civil works and Director (Systems) which will take care of procurement activities under the AIIB funded project. In addition to MMRDA HQ resources, the PIU is supported by the General Consultant (GC) in project preparation and

implementation including procurement. The GC has been funded by MMRDA and is already on board.

5.13 MMRDA has submitted draft Project Delivery Strategy (PDS) for review and clearance. The draft PDS outlines procurement arrangements including the tendering and contracting strategies, capacity assessment, market analysis, procurement risk assessments and possible mitigation measures. Based on the current situation, the procurement risk for the project is rated as medium. The PIU has also submitted a procurement plan along with the PDS describing procurement methods, estimates, review levels, timelines etc. The Project Team has reviewed the draft PDS and provided in-principal clearance. The final clearance on PDS and procurement plan will be issued before project negotiation.

5.14 In accordance with the draft PDS, procurement under the project will involve procurement of rolling stock, signaling, telecommunications and platform screen doors etc. MMRDA will follow a single-stage two-envelop tender process and all procurement will be conducted using Government of Maharashtra's e-tender platform <https://mahatenders.gov.in/nicgep/app>. This e-tender platform has been assessed and found acceptable to be used for procurement of goods, works and services financed by MDBs. The use of e-tender portal will enhance transparency in procurement process, and it is also expected to promote competition among the potential tenderers. Since, MMRDA has implemented similar project funded by ADB in the past, the PIU will use ADB's Supply & Installation Standard Procurement Document (SPD) with suitable modification to meet AIIB's policy needs. All procurement packages estimated to cost more than USD40 million for works; USD3 million for goods and USD2 million for services will be conducted following International Open Competitive Tender (IOCT) and for those contracts estimated to cost less than these thresholds procurement may be conducted following National Open Competitive Tender (NOCT) procedures. Any contracts estimated to cost more than USD15 million for works, USD4 million for goods and information technology and USD2 million for services will be prior reviewed by AIIB.

5.15 To meet Department of Economic Affairs (DEA) readiness criteria, MMRDA has initiated an advance procurement process for Rolling Stock. The procurement of remaining packages is at various stages.

5.16 **Financial Management.** The financial management capacity of MMRDA was assessed focusing on institutional capacity, staffing, planning/budgeting, funds flow, accounting, internal controls/audit, reporting and external oversight. MMRDA has prior experiences implementing projects funded by MDBs and familiar with financial management requirements. Based on the FM assessment, the capacity is considered adequate and the FM risk as "Medium".

5.17 **Budgeting.** The Project shall follow MMRDA's planning and budgeting procedures. Based on procurement plan, MMRDA PIU shall provide estimated budgetary requirements on an annual basis to MMRDA for review and approval. The approved project work plan shall be included in annual GoM budget as a separate budget head. MMRDA PIU shall also apply for loan codes (AIIB+OPEC Fund) with the accounts/audit division of Principal Accountant General before loan signing date. MMRDA shall provide counterpart funds to cover taxes and any such other costs related to the project.

5.18 Accounting and Reporting. MMRDA follows double entry and accrual system. The financial transactions are posted in the Tally Accounting software and use this system for financial reporting. However, the auditor has raised issues on accounting as in practice MMRDA is following hybrid accounting for select transactions. For better transparency and credibility of financial statements, it is suggested that MMRDA comply with consistent accounting practice. For Project accounting, MMRDA may follow cash basis. All the payments for project activities are centralized in the Head Office. The Tally Accounting software has an option to account and report project activities separately. The Project shall maintain a separate account and have custody of project related supporting documents. MMRDA is not maintaining contract management and it is suggested to prepare contract wise ledger for project activities.

5.19 Staffing. MMRDA has a centralized Finance and Accounts division. It is headed by Chief Finance Officer and have experienced and qualified finance & accounts staff. The finance & accounts staff have undergone trainings on financial management and disbursement requirements of some MDBs. Since it's a centralized team, there is minimal impact on staff transfer issues.

5.20 Internal Controls and Internal Audit. MMRDA has its regulations/procedures laid out for internal control environment. However, in practice, the auditors have noted some weaknesses in the internal control environment such as revenue recognition, liability accounting etc. The auditors have raised issues on no physical verification of assets and inventories being carried out by MMRDA on annual basis. Though MMRDA has in-house internal audit team however, the auditors have questioned on its independence due to its executive function and capacity of the in-house internal audit team. The previous fiscal year (2021/22) internal audit was carried out by an external audit firm. For the project, MMRDA shall hire an accounting/auditing firm to carry out internal audit of the project activities and report to AIIB. MMRDA shall hire internal auditor based on agreed ToR with AIIB.

5.21 External Audit. CAG (Comptroller and Auditor General) and private audit firm have carried out external/statutory audit of MMRDA for the past two years. The auditors have raised some non-compliances such as hybrid accounting practices followed in the areas of revenue recognition such as capital receipts not treated as income/revenue reserve, no provision made against doubtful debtors, year-end liability provisioned after the actual payment of expenditures etc. The issues raised by the auditors may have impact on the credibility of financial statements. It is suggested that MMRDA follow acceptable accounting standards in preparation and presentation of financial statements. MMRDA also shared ADB financed project audit report. The auditors have raised issues on non-submission of utilization certificate, delay in submission of withdrawal claims etc. For the project, MMRDA shall hire an accounting/auditing firm to carry of external audit of the project activities and report to AIIB. MMRDA shall hire external auditor based on agreed ToR with AIIB. All the audit related costs (internal + external) shall be borne by MMRDA counterpart funds.

5.22 Funds Flow and Disbursement Arrangements. The Project shall follow its standard on lending and funds flow procedure for sovereign operations. AIIB and OPEC Fund shall jointly co-finance the project activities in agreed financing ratios. MMRDA shall finance taxes and audit costs through its own funds. The loan shall adopt reimbursement method of disbursement. The OPEC Fund's disbursement shall be partially administered by AIIB. MMRDA PIU shall pre-finance payments of eligible expenditures. It shall prepare withdrawal

applications together with supporting documents and submit to AIIB & OPEC Fund through CAAA. Upon receipt of the withdrawal claims, AIIB shall review and make disbursement to MMRDA's account. Based on AIIB's review of withdrawal claims, AIIB shall advise OPEC Fund to make disbursement for its share to MMRDA's account.

D. Environmental and Social

5.23 Environmental and Social Policy (including Standards). AIIB's Environmental and Social Policy (ESP), including the Environment and Social Standards (ESSs) and the Environmental and Social Exclusion List (ESEL) will apply to this Project. ESS 1 (Environmental and Social Assessment and Management) and ESS 2 (Land Acquisition and Involuntary Resettlement) will apply to this Project. ESS 3 (Indigenous Peoples) will not apply to the Project. The Project will be co-financed with OPEC Fund.

5.24 Categorization and Instruments. The Project has been assigned as Category A as the civil works related Project environmental and social risks and impacts, to be financed by MMRDA, are significant. An Environmental Impact Assessment (EIA) has been prepared including an Environmental and Social Management Plan (ESMP) and a Social Impact Assessment (SIA) and Resettlement Plan (RP). An Environmental and Social Due Diligence (ESDD) was conducted, and an environment and social corrective action plan (ESCAP) prepared for the already completed sections of the civil works component.

5.25 Environmental, Health, and Safety Aspects. The Project is expected to contribute to a reduction of vehicle exhaust emissions, traffic congestion and travel time in the densely populated areas of Mumbai. Majority of the project alignment runs along the median of existing highway (90%). The depot area is sited partly on public and mostly private land, avoiding environmentally/ecologically sensitive areas. However, the project will involve: (1) Clearance of 0.2274 hectares of the Coastal Regulatory Zone (CRZ) III and CRZ-IA and also impact 708 trees (147 trees were cut and others transplanted, pruned, and trimmed) along the alignment. CRZ clearance and permission for the trees were already obtained, respectively; (2) Clearance of 0.6983 hectares of mangrove area for the alignment in which obtaining permission from the High Court is ongoing. Alignment work (~340 m) in this area has not yet started. Once High Court permission is received, MMRDA will then submit application to the concerned Chief Conservator of Forests for work permission including mangrove cutting. Required funds were already deposited with the District/Division Forest Office (DFO), Mumbai Mangrove Conservation Unit; and (3) CRZ clearance for the depot area which is under processing, together with the permission for the approx. 60 trees affected in the depot area. No pre-construction/ construction/ land clearance/ tree cutting activities have occurred on the depot land yet; and depot contract is not yet awarded. The conditions in the clearance and permit shall be adhered to by the Project.

5.26 Construction-related environmental impacts are temporary and typical of metro rail projects. These include but are not limited to air emission; noise and vibration from construction vehicles and equipment; disposal of large quantities of construction waste; generation of solid and hazardous waste; and wastewater from construction camps and construction sites among others. Other impacts include but are not limited to use of hazardous

materials and generation of solid and hazardous waste, and generation of domestic wastewater and wastewater from maintenance and refurbishment.

5.27 Generation of noise and vibration is a key impact for rail operations in general. Other impacts include but are not limited to use of hazardous materials and generation of solid and hazardous waste, and generation of domestic wastewater and wastewater from maintenance and refurbishment.

5.28 Occupational health and safety (OHS) issues during operation and construction include exposure to noise and vibration, working at heights, electrical hazards, rail safety, and life and fire safety. Similar issues apply for community health and safety (CHS), and also issues related to worker influx, structural safety for trespassers on rail lines and other Project facilities, and potential issues with Project security personnel.

5.29 Mitigation measures to address the environmental impacts, including OHS and CHS, are in the Environmental Management Plan (EMP). The EMP, accompanied by an Environmental Monitoring Plan, describes the mitigation measures for the identified impacts, roles and responsibilities for implementation, and institutional arrangements for monitoring and reporting. The EIA Report is still in draft version and MMRDA agreed that updates will be made for the impact assessment and mitigation measures.

5.30 Key to note that construction was already completed by about 78% as of April 2023. An Environmental and Social Due Diligence (ESDD) has been conducted and an Environmental and Social Corrective Action Plan (ESCAP) has been prepared to improve the environmental and social performance of the civil works coming under the MMRDA financed component. ESCAP identified two key corrective actions: (1) an OHS Audit and a recommendation to adopt its conclusions, in which MMRDA has agreed to abide; and (2) a noise and vibration impact assessment that will be initiated by MMRDA shortly, wherein AIIB will provide TOR input and impact compensation measures will be discussed with MMRDA.

5.31 **Social Aspects.** Land acquisition is not required for the AIIB financed component as it includes the technology installation and rolling stock. The MMRDA financed component (civil works), on the other hand, will involve public and private land acquisition (8.2 ha and 27.2 ha respectively), physical and economic displacement (108 residential structures and 184 commercial structures). MMRDA has prepared a Social Impact Assessment (SIA) / Resettlement Plan (RP) for the entire Project including the AIIB financed component and has been reviewed by the Project team to bring the SIA/RP in compliance with AIIB's ESP. MMRDA has developed an elaborate Entitlement Matrix covering various probable categories of Project affected persons (PAPs), including (a) Owners of private lands, (b) Owners / formal tenants occupying structures on private lands; and Non-title holders such as (c) Encroachers occupying structures on private lands; and (d) Encroachers occupying structures on public lands, and their entitlements as per the provisions of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RFCTLARR Act) and Mumbai Urban Transport Project (MUTP) Resettlement & Rehabilitation Policy, which together with measures such as Livelihood Restoration Plan (LRP) included in the SIA / RP, ensure compliance with AIIB's ESF.

5.32 An Environmental and Social Due Diligence (ESDD) accompanied by an Environmental and Social Corrective Action Plan (ESCAP) has been prepared to improve the environmental and social performance of the civil works coming under the MMRDA financed component. Construction works of the project commenced in August, 2019 and more than 80 percent of civil works are completed on stretches not involving acquisition of private land and R&R. While the process of acquisition of 26.7 ha of the private lands affected by the project works is yet to be completed (corresponding to the depot land), MMRDA has resettled 109 occupant households / business establishments from 4 project affected locations. A majority of the relocation is scheduled to take place at a junction in Kapurbawadi and resettlement process is in progress. AIIB's recommendations to improve the RP includes details of livelihood restoration, public consultation, and internal/external monitoring.

5.33 A total of 35.41 ha land outside the current Right of Way is required, out of which 29.26 ha is required permanently and 6.15 ha temporarily for site office and casting yard. Out of permanent land required, 27.25 ha is private land (26.73 ha for depot) and 2.01 ha is public land. While proposals for acquisition of 26.81 ha private lands are submitted to the Competent Authority and are under process, the proposals for the balance 0.44 ha private lands are being prepared for submission to the Competent Authority. Permissions for carrying out works on most of the public land required for the project are obtained.

5.34 Stakeholder Engagement, Consultation and Information Disclosure. Consultations for general public and identified Project Affected Persons have been undertaken during the surveys and preparation of the EIA, SIA/RP and ESDD. The consultations will be continued during the Project implementation. Multi-lingual information brochures, providing information on social issues concerning the Project Affected Persons, have been specifically prepared and distributed. The draft versions of EIA, SIA/RP and ESDD in English and summaries of these documents in Marathi will be posted on MMRDA's and Bank's websites and made available in hard copies in the Project area.

5.35 Project Grievance Redress Mechanism (GRM). Appropriate Project level GRMs are in place to accept, address and resolve grievances related to execution of works and labor (through the EPC Contractor, General Consultant and Project Implementation Unit of MMRDA), land acquisition (legal process under the Act) and resettlement and rehabilitation of affected households and business establishments (two-tier Grievance Redressal Committees).

5.36 The grievances related to execution of works on sites are primarily addressed by the EPC Contractor. If these are not resolved, they are expected to be referred by the General Consultant to the Project Implementation Unit (PIU). The grievances related to legal process of acquisition of land and assets and payment of compensation are addressed through the remedies available under the RFCTLARR Act. The grievances related to eligibility and entitlements of PAPs (primarily non-title holders) are addressed and resolved first at the level of LA & RR Implementation Unit of Metro PIU, and if not resolved, these are heard and decided through a formal 2-tier mechanism of Field Level Grievance Redressal Committee (FLGRC) and the appellate Senior Level Grievance Redressal Committee (SLGRC).

5.37 AIIB Project-affected People's Mechanism. AIIB's Project-affected People's Mechanism (PPM) will be used for the Project. The PPM has been established by AIIB to provide an opportunity for an independent and impartial review for submissions from Project-

affected people who believe they have been or are likely to be adversely affected by AIIB's failure to implement its ESP in situations when their concerns cannot be addressed satisfactorily through the Project-level GRM or the processes of AIIB's management. For information on AIIB's PPM, please visit: <https://www.aiib.org/en/policies-strategies/operational-policies/policy-on-the-project-affected-mechanism.html>

5.38 Monitoring and Supervision Arrangements. MMRDA is implementing many Metro projects simultaneously and has internal monitoring and supervision mechanism operated through the Project Implementation Unit (PIU). The land acquisition and resettlement and rehabilitation are implemented and routinely monitored internally by the LA&RR Implementation Unit of the Metro PIU. Further, MMRDA will engage Independent ES Monitoring Agency to monitor environmental and social outcomes, including RP implementation. AIIB will monitor the project's E&S management performance during its implementation support missions.

E. Climate Change

5.39 BB1: PA Alignment in Climate Mitigation. The proposed Program is a rail infrastructure, which falls under the Framework's 'universally aligned' list of BB1 activities in the AIIB PA methodology in development.

5.40 BB2: PA Alignment in Climate Adaptation. The Joint MDB methodology for assessing the investment's climate adaptation alignment with the PA consists of three steps:

- (i) Step 1: Climate risk and vulnerability assessment. The climate risk and vulnerability assessment was prepared as part of the ESDD and EIA. Nevertheless, the Bank conducted its own climate risk and vulnerability assessment (using the Aware tool) and similarly, found that the Project is highly exposed to increased precipitation, flooding, and sea level rise.
- (ii) Step 2: Climate adaptation and resilience measure definitions: To limit the impact of a potential precipitation increase, flooding and sea level rise, MMRDA has integrated climate change considerations into the Project design (Phase 1) to address the need for adaptation, including:
 - Increased precipitation: provision of rainwater harvesting system to harvest rain water.
 - Sea level rise: Design of all structures above High Flood Level of the nearby rivers.
 - Flood: Piers at waterbody crossings designed so that they will occupy minimum space in the riverbed. Modelling studies are carried out to assess the impact of construction of riverbanks/beds. This will minimize the impact on the carrying capacity of the water bodies and will not aggravate the flooding.

Technical specifications of each system will have climate tolerances that will have to be ensured by the systems' designers. These tolerances are tailored to most severe climate parameters likely to be encountered during the codal life of the systems. This will ensure that the systems designed and installed under the project are resilient to climate changes.

- (iii) Step 3: Consistency with broader and national context for climate resilience: The Project is consistent with the National Determined Contribution (NDC) of India, the Maharashtra State Adaptation Action Plan on Climate Change (MSAAPCC, 2014), developed by the State of Maharashtra, and Mumbai Climate Action Plan (MCAP, 2022), developed by the Municipal Corporation of Greater Mumbai (MCGM).

F. Gender Aspects

5.41 A Gender Equality and Social Inclusion (GESI) framework has been developed for the Project. The GESI provides a range of activities which are integrated within the project design and include: (i) gender responsive and socially inclusive design features across all infrastructure; (ii) affirmative measures to enhance women's safe mobility such as 'women only coaches', mobile applications for women's security, instruction boards with helpline numbers and color-coded directional signs; (iii) designing and piloting special initiatives such as priority e-ticketing counters for the elderly and differently abled, separate ticketing counters and vending machines for women, reporting desks to address incidents of harassment, assigned quota allocated for commercial spaces in metro stations for enterprises owned by or operated by women and establishment of an all-women staff metro station.

G. Risks and Mitigants

Table 4: Summary of Risks and Mitigating Measures

Risk Description	Assessment (H/M/L)	Mitigation Measures
Program/Project Implementation Risks		
Implementation		
<ul style="list-style-type: none"> Delay in implementation 	M	<ul style="list-style-type: none"> Better planning of MMRDA work execution by utilizing lessons learned from implementing earlier and ongoing metro projects. Civil works are already at more than 80 percent completed.
<ul style="list-style-type: none"> Delay in work due to monsoons and system vulnerability to flooding during monsoon seasons. 	M	<ul style="list-style-type: none"> The improvements are designed in such manner so as to minimize earthwork that gets badly affected by floods. Monsoon seasons will be factored into the project schedule in such manner that as far as possible, the period is utilized for activities that are not affected by flooding.
Financial management		
<ul style="list-style-type: none"> Delay or inadequate release of funds 	M	<ul style="list-style-type: none"> MMRDA shall ensure adequate budget allocated on annual basis and follow-up with appropriate State authorities.
<ul style="list-style-type: none"> Delay in submission of financial reports 	M	<ul style="list-style-type: none"> MMRDA shall proactively prepare audit ToRs and agreed with AIIB.

Risk Description	Assessment (H/M/L)	Mitigation Measures
Procurement of large and complex packages		
<ul style="list-style-type: none"> ▪ Delays of the procurement of rolling stock and metro equipment 	M	<ul style="list-style-type: none"> ▪ Most of the tender documents floated in Q1 2024.
E&S risks and impacts during construction and operation		
<ul style="list-style-type: none"> ▪ Capacity of MMRDA to monitor implementation of the E&S plans. 	M	<ul style="list-style-type: none"> ▪ Independent ES Monitoring Agency will be equipped with adequate ES experts; and ▪ AIIB will conduct regular supervision on ES performances.

6. Annex 1: Results Monitoring Framework

Program Objective	To increase transport capacity and provide a green, fast, and accessible metro system for passengers							
Indicator Name	Unit of Measure	Baseline Year (2023)	Target Values			End Year	Frequency	Responsible Party
			2026	2027	2028			
Program Objective Indicators								
Number of passengers on Line 5 - Thane to Kalyan	number of passengers	0	122,300	122,300	278,000	2028	annual	MMRDA
Reduced travel time between Thane and Bhiwandi	minute	100			45	2028	annual	MMRDA
Number of commissioned electric-powered train vehicles	Number of vehicles	0	72	72	132	2028	annual	MMRDA
Number of stations equipped with adequate facilities for different needs and preferences of women and PwD	Number of stations	0	7	7	16	2028	annual	MMRDA

Project Objective	To increase transport capacity and provide a green, fast, and accessible metro system for passengers							
Indicator Name	Unit of Measure	Baseline Year (2023)	Target Values			End Year	Frequency	Responsible Party
			2024	2025	2026			
Project Objective Indicators								
Number of passengers on Line 5 - Thane to Bhiwandi	number of passengers	0	0	0	122,300	2026	annual	MMRDA
Reduced travel time between Thane and Bhiwandi	minute	50			23	2026	annual	MMRDA
Number of commissioned electric-powered train vehicles	Number of vehicles	0	0	0	72	2026	annual	MMRDA
Number of stations equipped with adequate facilities for different needs and preferences of women and PwD	Number of stations	0	0	0	7	2026	annual	MMRDA
Intermediate Results Indicators								
Metro systems implementation	percent of total contract value	0			100	2026	annual	MMRDA
Overall construction progress of civil works	percent	78			100	2026	annual	MMRDA

7. Annex 2: Detailed Project Description

A. Mumbai Metro Line 5.

7.1 Mumbai Metro Line 5. MMRDA is planning a wide metro system across MMR, which will eventually include 14 lines for a total length of 337 km. The table below lists the lines already in operation, under construction, and planned to be implemented in the next years.

Table 5: MMR metro network

Line	Route	Length (km)	Status
Line 1	Ghatkopar – Versova (Operational Line)	11.4	in operation (2014)
Line 2A	Dahisar – D N Nagar	18.6	in operation (2022)
Line 2B	D N Nagar – Mandale	23.6	under construction
Line 3	Colaba – SEEPZ	33.5	planned
Line 4	Wadala – Kasarwadavali	32.3	under construction
Line 4A	Kasarwadavali – Gaimukh	2.7	planned
Line 5	Thane – Bhiwandi – Kalyan	24.9	under construction
Line 6	S. Samarth Nagar – Vikhroli	14.5	under construction
Line 7	Dahisar (E) – Andheri (E)	16.5	in operation (2022)
Line 8	Airport Metro (CSIA-NMIA)	35.0	planned
Line 9/7A	Dahisar – Mira Bhayander & Andheri - CSIA	13.5	under construction
Line 10	Gaimukh – Shivaji Chowk	9.2	planned
Line 11	Wadala – CSMT	12.7	planned
Line 12	Kalyan – Dombivali - Taloja	20.7	planned
Line 13	Shivaji Chowk-Virar	23.0	planned
Line 14	Kanjurmarg-Badlapur	45.0	planned

7.2 The Mumbai Metro Line 5 – also referred to as Thane-Bhiwandi-Kalyan Line – is a 24.45 km-long elevated metro rail system, part of the Mumbai Metropolitan Region’s developing metro network. The line will comprise 16 stations, connecting under-construction line 4 to the west (Kapurbawadi station, Thane city), and the suburban railway and future Line 12 to the east (Kalyan station).

7.3 Phase 1 alignment starts from Kapurbawadi station, constructed as part of Metro Line 4, and continues as elevated section up to Dhamankar Naka station. From Dhamankar Naka station the alignment will go underground for part of the section and the underground portion including the ramp is excluded from Phase 1, thus keeping the whole of Phase 1 as elevated. Salient technical features of the alignment in tabular form are presented below.

Table 6: MML5 Phase 1 Alignment

Station/Depot	Chainage	Remarks
Kapurbawadi station	0	Interchange change for Line 4 and Line 5 Civil works under Line 4, systems divided between Line 4 and 5 Scissors cross-over after Kapurbawadi
Start of Phase 1 civil package	321.454 m	
Balkum Naka station	1766.850 m	
Kasheli depot		
Kasheli station	5551.650 m	Take off to Kasheli depot before Kasheli Scissors cross-over before Kasheli
Kalher station	7416.274 m	
Purna station	8250.704 m	
Anjur Phata station	10527.515 m	
Dhamankar Naka station	12125.516 m	Scissors cross-over before Dhamankar Ramp for underground section starts after Dhamankar
End of Phase 1	13020.078 m	

B. Detailed Description of Project Components

7.4 **Rolling Stock.** This component includes design, development, manufacture, supply, testing, delivery, commissioning, integrated testing of 132 numbers of standard gauge light weight, fully furnished metro rail cars. It also includes training of maintenance staff after commissioning of coaches, supply of spares, special tools, special test and diagnostic equipment and special training equipment in sufficient quantities to meet the maintenance and operation requirements, and allied activities like documentation etc. Comprehensive maintenance of the entire electronic items i.e. propulsion system, train control and management system, brake electronic control unit and passenger information and display system for a period of 10 year after completion of warranty period is also included at the discretion of MMRDA.

7.5 Out of 132 cars, 72 are required for Phase 1 and 60 for Phase 2. Since the procurement of all the coaches is to be done in one package, the entire requirement of Rolling Stock for complete MML5 corridor is included in the Project. The cars will be configured in 6-car trainsets as followed: DMC+TC+MC+MC+TC+DMC, where:

- (i) DTC is Driving Motor Car
- (ii) TC is Trailing Car
- (iii) MC is Motor Car

This composition will allow high seating capacity (max. 316) and ample space for standing passengers (max. 1474). The Rolling Stock will also have design features for the elderly, children, women and differently abled. It will also have a provision for dedicated bicycle carrying facility to improve last-mile connectivity and promote non-motorized transport.

7.6 During initial phase of the project, all trains shall be tested and commissioned for GoA2 (Grade of Automation #2) mode of automation operation. Upgradation of all trains from GoA2 to GoA3 and then GoA4 modes shall be done subsequently under the same contractual provisions. As defined by the International Association of Public Transport:

- (i) GoA2 is a semi-automatic train operation (STO) mode where starting and stopping are automated but a driver in the cab starts the train, operates the doors, drives the train if needed and handles emergencies.
- (ii) GoA 3 is driverless train operation (DTO) where starting and stopping are automated but a train attendant operates the doors and drives the train in case of emergencies;
- (iii) GoA 4 is unattended train operation (UTO) where starting and stopping, operation of doors and handling of emergencies are fully automated without any on-train staff.

7.7 High reliability and high efficiency of the lightweight stainless-steel coaches will enable low energy consumption. The Rolling Stock will also have regeneration features and it is expected that 30 percent of total traction energy will be regenerated and fed back to 25 kV AC OHE to be consumed by nearby trains.

7.8 The coaches will be fire retardant, air-conditioned and designed to reduce noise and vibration. They will be outfitted with several features for safety and convenience, including LCD screens, 3D route maps, first-aid kits, wheelchair facilities, fire-fighting equipment and intercom systems permitting communication with the train driver.

7.9 **Signaling & Telecommunication.** This component includes design, manufacture, supply, installation, testing and commissioning of Signaling and Telecommunication systems and equipment for 24.9 km network length. Since it is not technically advisable to have multiple suppliers of signaling system on a single line, it will be necessary to procure the system under one package. Hence, this component will cover the entire Line 5.

7.10 The signaling system of Mumbai Metro Line 5 will be based on the latest CBTC (Communication Based Train Control) technology. All the latest metro rail systems in India and abroad are being developed on the same technology and there are multiple networks in India running on the same (i-CBTC initiative is being developed in India, however it is not ready for deployment on metro systems). CBTC is a mature technology and includes ATP (Automatic Train Protection), ATO (Automatic Train Operation) and ATS (Automatic Train Supervision) sub-systems using radio communication between equipment on the track side and those borne on the trains. The proposed corridor will be compliant to the requirements of Unattended Train Operation (UTO), otherwise named as Grade of Automation, GoA4 level, which is the highest degree of automation level. Radio for CBTC shall work in License free ISM band.

7.11 The telecommunication system will be an amalgamation of different sub-systems for providing a communication backbone and different operational and passenger convenience services. It will include Fiber Optic System, Telephone Exchange, Mobile Radio Communication, Passenger Announcement System, Passenger Information Display System, Centralized Clock System and a Network Management System for monitoring and diagnostics.

The communication system will have suitable cybersecurity measures to protect it from external threats.

7.12 Platform Screen Doors. This will include design, manufacture, supply, installation, testing and commissioning of Platform Screen Doors (PSD) System for the 15 stations between Balkum Naka and Kalyan station (Kapurbawadi being covered by Line 4 project). PSD of around 1.5 / 2.1 m height and consisting of sets of bi-partition doors are proposed to be installed along the full length of platforms of all stations under the Project. The PSD system shall be integrated with the structure and architecture of the stations and operationally with signaling and rolling stock systems, in line with relevant international standards. PSD is included in the same package with Signaling and Telecommunication.

7.13 Automatic Fare Collection System. This component will comprise of design, manufacture, supply, installation, testing and commissioning of Automatic Fare Collection (AFC) system for 15 elevated/underground stations between Balkum Naka and Kalyan stations. This will also cover central elements meant for the whole corridor such as central AFC servers, applications, and Software Development Centre (SDC).

7.14 The AFC system for Mumbai Metro Line 5 will be an NCMC (National Common mobility Card) compliant open loop system and will have retractable flap type automatic gates for entry and exit to the stations. The fare media will be contactless smart cards, bank cards, and paper as well as mobile app based QR code-based tickets. There will be other AFC equipment like Automatic Ticket Vending Machines, Ticket Office Machines, Ticket Readers etc. The system architecture will include station computers, central computers along with their network components.

7.15 It is envisaged that the NCMC compliant open loop smart cards will provide for seamless travel between various modes of public transport over Mumbai in future. The proposed AFC system shall provide interfaces with other operators such as the suburban rail, public bus, parking, toll etc. so that these systems may also be integrated with the common smart card-based fare products. This will facilitate multi-modal integration as the commuters will be able to travel hassle free by different modes of transport and need not carry different cards or purchase multiple tickets.

7.16 Electrical & Mechanical Systems. This component involves design, manufacture, supply, installation, testing and commissioning of electrical system, plumbing, HVAC (Heating, Ventilation, Air-Conditioning), fire detection and fire suppression systems for 6 elevated stations between Balkum Naka and Dhamankar Naka, and Kasheli depot. It will also include a Building Management System (BMS) for monitoring and control of the mechanical, electrical, and electromechanical services in stations & depot. The BMS will be for the entire Mumbai Metro Line 5 corridor.

7.17 The components of electrical system will be low voltage panels, distribution boards, cables, cable containments, wiring, conduiting, lighting systems, earthing system, and UPS etc. DG sets & UPS of suitable capacity will be provided at stations as well as at Kasheli depot for supplying power to essential loads in case of failure of power supply. Auxiliary substations for distributing power to non-traction loads is part of this component. Plumbing part of the

component will cover the water supply, drainage and sewage infrastructure at the stations and depot.

7.18 Fire Detection & Alarm System shall be provided at all stations and depot to detect fire and initiate fire suppression action through fire hydrant system and automatic sprinkler system to provide protection. Gas Flooding System will be installed at all stations and depot at locations wherever it is required to protect critical equipment from fire.

7.19 **Lifts & Escalators.** It includes design, manufacture, supply, installation, testing, commissioning including maintenance of escalators & lifts of 6 elevated stations between Balkum Naka and Dhamankar Naka. Lifts and escalators will be provided at stations and the depot for passengers and staff. Stations will have lifts and escalators to carry passengers from the ground level through entry/exit structures to concourse for ticketing and entry into paid areas, and then to platforms. They will provide universal accessibility.

7.20 **Power Supply and Overhead Equipment.** This component will cover the provision of power supply for all the systems of MML5 as well as 25 kV AC Overhead Equipment (OHE) required for traction. It will include design, detailed engineering, supply, installation, testing and commissioning of 220 kV/33 kV Receiving cum Auxiliary Substation (RSS), 220 kV/25 kV single phase AC Traction Substation (TSS), OHE, traction as well as auxiliary SCADA, 33 kV cables & Auxiliary Substation (ASS) for the first 12.125-km section between Balkum Naka and Dhamankar Naka, and Kasheli depot.

7.21 The proposed traction system for powering trains is a 25 KV AC overhead catenary system. Three new substations are proposed for taking power from the state grid and feeding it to the MML5 network. The substations will also feed power for non-traction purposes for which 33 KV power cables will be laid. The stations and the depot will have auxiliary substations to step down voltages and feed power for local non-traction needs. Backup diesel generators will be placed at stations and the depot. Total power requirement for MML5 is estimated to be 14 MW at the start.

7.22 The power supply and its equipment will be monitored and controlled round the clock from a centralized Operation Control Centre (OCC) through Supervisory Control and Data Acquisition (SCADA) system. Modern SCADA system with intelligent remote terminal units (RTUs) will be provided. For increasing the reliability even further, a digital relay protection system shall be provided at RSS which will be coordinated with the state's power supply authority.

7.23 **Depot Machinery & Plants.** Specific equipment is required for safety and maintenance of rail systems and will be housed at Kasheli depot. Procurement of such equipment will be covered under this component. It includes manufacture, supply, installation, testing, commissioning of Machinery & Plants. It will also include provision of training to maintenance staff by the original equipment manufacturers.

C. Other Project Components not funded by the Bank.

7.24 Civil and Track Works. Civil works for Line 5 include construction of viaduct, 6 elevated stations including entry/exit structures (Kapurbawadi station being constructed under Line 4 project), OCC civil works, depot civil works, miscellaneous utilities, roadworks, diversion and shifting of utilities including high-tension lines, staff quarters and multimodal integration facilities. Contracts for civil works (except for depot) have already been awarded and work is ongoing. More than 80 percent works have been completed by June 2024.

7.25 Kasheli Depot will be the main location for maintenance of the facility. The depot will have sufficient space for establishment of a depot-cum-workshop and will have 5 km of ballasted track. It will have inspection lines, workshop lines and stabling lines fit for 6-car trains. Construction of Kasheli depot will be a separate contract and is likely to take 36 months.

7.26 Consultants. To strengthen the in-house team and for better execution, monitoring and support, MMRDA has hired consultants. There are two General Consultants (GC) – one for systems and the other for civil works. The General Consultants will provide day-to-day contract management, procurement support, design review, construction supervision, environmental and social management, and quality assurance services. In addition to having dedicated quality engineers, the GC will assign experts who will look after the quality and performance of the Project. For systems, the GC will prepare the tender documents and assist MMRDA in tender evaluation. The GC will also oversee the construction, installation, testing, commissioning, and act as the engineer. GC will deploy about 75 technical and 25 non-technical staff to support MMRDA in implementation. MMRDA has also appointed Detailed Design Consultants (DDC) for E&M, E&M Depot and Architectural and PEB work. These consultants are responsible for design of the systems as per their respective terms of reference.

D. Implementation Arrangement and Schedule.

7.27 Implementation Capacity. MMRDA will be the Project implementing entity overseeing and executing the Project. The PIU is headed by the Addl. Metropolitan Commissioner (AMC) who will act as the Project Director (PD) and take the overall responsibility for implementation under the guidance of the Metropolitan Commissioner (MC). PIU has separate divisions responsible for Civil works and Systems aspect of project implementation, headed by Director (Projects) and Director (Systems) respectively. PIU is supported by MMRDA headquarters for functions such as environment, social, land and finance. PIU has current strength of about 80 employees, with MMRDA in the process of hiring more employees for implementation of planned metro lines. Metro-PIU (Systems Unit) is having Director (Systems) as Technical Head for all System related activities and is supported by team of senior technical officers further assisted by other technical officers. The organization chart of MMRDA is shown in Figure below.

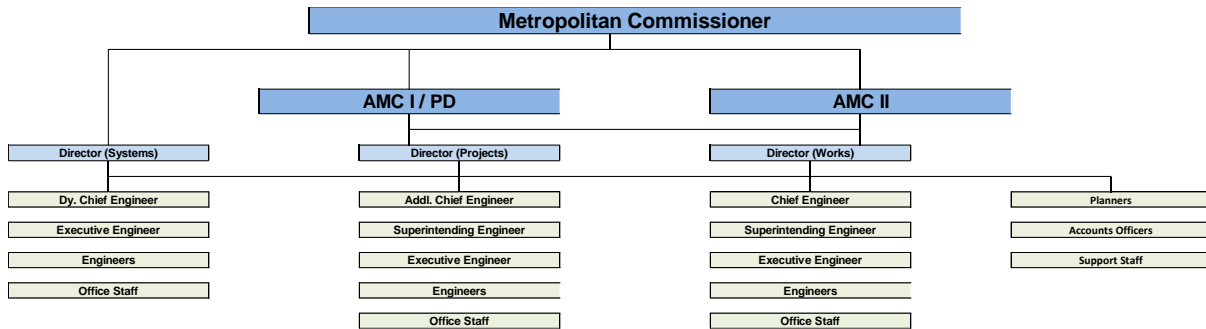


Figure 1: Organogram of the Project Implementing Entity

E. Operation & Maintenance

7.28 **Operation.** The operation of Line 5 will be done by Maha Mumbai Metro Operation Corporation Limited (MMMOCL), a subsidiary of MMRDA established in June 2019 to carry out the Operations and Maintenance of all the upcoming Metro corridors in the Mumbai Metropolitan Region (MMR). Operations and Maintenance of all Metro corridors will be integrated under one authority. MMOCL already operated line 2 (phase 1) and line 7, both opened in 2022.

7.29 Stated objectives of the company are: (1) To independently carry out business of Operation and Maintenance (O&M), and related functions of all Metro lines in Mumbai Metropolitan Region, (2) To carry out Planning, Identification, Development, and Implementation of all Non-Fare Box Revenue measures, and (3) Execute Property development and construct or maintain or lease out various facilities in relation to rail transport system.

7.30 **Train Operation Plan.** The objective of the train operation plan is to provide reliable, safe, and accessible connectivity by minimizing the waiting time of passengers. The plan is also needed for estimating the quantity of rolling stock and their technical requirements, to guarantee good levels of service quality. It is based on peak hour per direction traffic demand (PHPDT), and following features were considered:

Table 7: Train Operation Plan of Phase 1

Length of section (terminal to terminal station)	12.125 km
Number of stations	7 (including Kapurbawadi)
Scheduled commercial speed	34.2 kmph
Round trip time	50 minutes
Turnback time at each terminal	3.0 minutes
Number of trains required	12 (including 1 operation and 1 maintenance reserve)
Minimum headway (peak)	5 minutes (Program: 3 minutes)
Maximum headway (off-peak)	10 minutes (Program: 5 minutes)
Total trips per day	340

7.31 **Maintenance.** All the system contracts will have provision of Defect Liability Period, during which the system contractor will be contractually bound to undertake corrective maintenance. Some systems or sub-systems will also have provisions of comprehensive maintenance built into the contracts wherein the contractor will be responsible for all maintenance activities for that system. Overall responsibility of maintenance will be on MMMOCL.

7.32 **Multi-Modal Integration and Last Mile Connectivity.** MMRDA intends to study the station area and the station catchment/influence areas around each metro station and prepare detailed multi-modal integration plans for improving the access of people to & from metro stations by all modes of transport. The intention is to focus on the entire corridor, and aim to analyze, plan and design improved access to 15 metro stations (from Thane to Bhiwandi in Phase 1, and to Kalyan in Phase 2) and integrate multiple modes of transit around each one of them; key interchanges being Kapurbawadi and Kalyan. The objective is to improve the overall access to the stations, improve traffic flow near the stations, provide safe pedestrian first and last mile connectivity and integration with other modes of transport. Phase 1 passengers will benefit from such planning and will tend to make the line more attractive, thus increasing ridership.

8. Annex 3: Economic and Financial Analysis

A. Scope of the Economic Analysis

8.1 The Program will support the construction of the Mumbai Metro Line 5 – also referred to as Thane-Bhiwandi-Kalyan Line –as part of the Mumbai Metropolitan Region’s developing metro network. The line will comprise 16 stations, connecting under-construction line 4 to the west (Kapurbawadi station, Thane city), and the suburban railway and future Line 12 to the east (Kalyan station). The Project consists of the construction of the line between Thane and Bhiwandi (Phase 1) and the acquisition of rolling stock, signaling and telecommunications, platform screendoors and automatic fare collection for the entire line 5 (Phase 1 + Phase 2) and other metro systems for Phase 1 only. The key beneficiaries of both the Program and the Project are the passengers in Mumbai Metropolitan Region, who will benefit from faster, more reliable, and better-quality transport services, compared to alternative modes of transport. By diverting traffic from congested roads, the Line would also facilitate faster movement of the remaining traffic on the road.

8.2 The initial DPR (2016) included an economic analysis of the entire Line 5, before it was split into two Phases. The Bank Project team updated the analysis to consider the change in the project phasing, timeline and costs. Two economic analyses were then performed: one for the Project, one for the Program. For each, the economic viability was assessed using a Cost-Benefit Analysis by comparing “with-project” and “without project” scenarios. The economic internal rate of return (EIRR) was calculated by comparing the economic and societal benefits with investment costs over a period of 36 to 38 years, including 30 years of operation (+2 years for the Program, considering Phase 2 is commissioned 2 years after Phase 1) and 6 years of construction. The analysis indicates that the Project is economically viable with an EIRR of 14.87 percent and a NPV of INR 15.10 billion (discount rate 12 percent). A similar analysis of the Program also substantiates its economic viability with an EIRR of 18.92 percent and an NPV of INR 95.24 billion. The key benefits of the project take the form of savings in travel time of passengers (VOT), Vehicle Operating Cost (VOC) savings, reduction in greenhouse gas (GHG) emissions and air pollution, and improved road safety.

B. Demand Analysis

8.3 The traffic demand estimates are derived from the Detailed Project Report (DPR, 2016), using, and updating the traffic model developed for MMR Comprehensive Transport Study (CTS, 2005). It was further updated by MMRDA Transport Economics Department to consider the splitting into two construction phases and the delay in commissioning the Line. The travel demand assessment considers growth in income, employment, population, network development and modal shift from other vehicle categories.

8.4 In terms of population in particular, it is supposed that population will rise following CTS projections (i.e. long-term transportation strategy scenario “P3E3”). It is indeed likely that new areas under planned development, which may increase the number of inhabitants, will attract more people from other zones belonging to MMR. Therefore, between 2021 and 2031, it is assumed an average growth rate of 31.37%. This factor is adopted for updating the OD matrix

as regards the internal trips while external-internal trips as well as exchange trips are not increased, since it is assumed that population in Mumbai will mostly remain the same.

8.5 The table below outlines the daily ridership for the Project and the Program for key years.

Table 8: Daily Metro Passenger Ridership (Thousands)

Line	2026	2028	2031	2041
Project: Phase 1	122.3	126	131.6	162.5
Program: Phase 1 + Phase 2	-	278	302.6	404.9

Source: Detailed Project Report for Mumbai Metro Line 5, updated by MMRDA Transport Economics Department

C. Economic Costs

8.6 Economics costs cover civil works, acquisition of rolling stock and metro systems equipment, along with operational and maintenance (O&M) costs. Costs on account of contingencies, taxes and resettlement and rehabilitation have been excluded from the costs while costs borne for land acquisition have been included. All the costs are in 2022 prices. A Standard Conversion Factor of 0.83, as prescribed by the MoHUA Appraisal Guidelines for Metro Rail Project Proposals, has been used to convert financial costs into economic prices. The economic costs comprise of the of the following:

- (i) **Capital expenditure.** The construction period for Mumbai Metro Line 5 is assumed to be 6 years, starting at 2021 and ending in 2026 for Phase 1, and from 2023 to 2028 for Phase 2. The upfront capital expenditure on construction is assumed to follow the following routine:

Table 9: Distribution of capital expenditure over the implementation period

	2021	2022	2023	2024	2025	2026	2027	2028
Phase 1: civil works	15%	20%	20%	20%	20%	5%		
Phase 1: RS & equipment				25%	40%	25%	10%	
Phase 2: civil works			10%	20%	20%	20%	20%	10%
Phase 2: equipment						25%	55%	20%

As per the DPR, the upfront capital expenditure for the Project is INR43.73 billion in 2022 prices, from which we exclude taxes. For the Program, the total cost is INR75.23 billion in 2022 prices. The economic value of the cost is obtained by using standard conversion factors. Furthermore, incremental capital expenditure is required for renewal and replacement of equipment due to wear and tear during the Project's lifetime. This includes additional investment to renew traction and power supply (25 percent of the initial cost) and signaling and telecom (50 percent of the initial cost) in the 20th year of operation.

- (ii) **O&M costs.** As per the DPR, O&M cost includes staff wages, energy, and maintenance costs. The escalation factor used for staff costs is 1.6 percent per annum to provide for both escalation and growth in salaries. The

escalation factor is 1.6 for maintenance and energy costs. These escalation growths are similar to those observed on similar projects (Delhi...). In 2026 (Project – Phase 1), these costs add up to INR1.0 billion, while for the entire Program (Phase 1 + Phase 2) in 2028, O&M costs are estimated at INR1.8 billion.

- (iii) **Salvage value.** As per the MoHUA guidelines on Economic Appraisal of Metro Projects, salvage value is considered as 20 percent of economic cost at the end of analysis period. This is treated as a negative cost.

D. Economic Benefits

8.7 The project will yield numerous tangible and intangible benefits. The key quantifiable benefits include value of time (VOT) savings of people switching from other modes to Metro Line 5 as well as due to lower congestion on the road, vehicle operating cost (VOC) savings, benefits arising from reduction in GHG emissions and air pollution, and savings from reduced accidents.

- (i) **Travel time Savings (VOT Savings).** The Mumbai Metro Line 5 will be significantly faster than alternate-road based transport modes and will result in travel time savings for passenger who shift from slower alternative modes to the metro. The scheduled operating speed of the metro is 33 km per hour compared to average car running speed of 20 km per hour on roads in Mumbai Metropolitan Area. The VOT considered for the economic evaluation are detailed below:

Table 10: Value of Time per mode (INR)

Mode	VOT (INR/passenger.hour)
Car	97.51
Taxi	97.51
3-Wheeler	73.13
2-Wheeler	65.01
Bus	40.63
MRTS	40.63

Source: Detailed Project Report for Mumbai Metro Line 5, updated by MMRDA Transport Economics Department

An additional benefit accruing because of passengers shifting to metro emanates from reduced congestion on road, which allows the remaining vehicles on the road to ply at a higher speed. According to the DPR, the speed for various vehicle categories will increase by 5 to 10 Km per hour with the introduction of metro services. However, a further assumption is taken that owing to congestion, the speed of the vehicles will reduce at the rate of 1 km per hour every year due to addition of new vehicles. After the initial 10 years it is assumed that the difference in speed between “with-project” and “without-project” scenarios would be negligible.

Table 11: Average speed with and without the Project

Mode	Average speed (km/hour)	
	Without the Project	With the Project
Car	15	20
Taxi	15	20
3-Wheeler	13	17
2-Wheeler	15	25
Bus	10	12
MRTS	-	33

Source: Detailed Project Report for Mumbai Metro Line 5, updated by MMRDA Transport Economics Department

- (ii) **Savings in Vehicle Operating Costs (VOC):** Savings in VOC occurs as passengers shift from buses, cars, two-wheelers, and three-wheelers to the metro. This leads to lower congestion on road and reduced demand for vehicles. VOC is a function of vehicle type, speed, road roughness and other road characteristics. Vehicle Operating Costs with and without Metro Line 5 were calculated based on the number of trips, average vehicle occupancy rate, and vehicle-KM per day. Unit costs are presented in the table below:

Table 12: Vehicle Operating Cost (VOC) per mode (INR) and Average Vehicle Occupancy

Mode	VOC (INR/veh.km)	Average Vehicle Occupancy
Car	26.89	3.91
Taxi	26.89	4.60
3-Wheeler	12.56	3.02
2-Wheeler	9.01	1.54
Bus	91.60	29.24

Source: Detailed Project Report for Mumbai Metro Line 5, updated by MMRDA Transport Economics Department

The VOC savings were converted to Economic Savings by using a SCF of 0.9, as prescribed by the MoHUA guidelines, and an escalation rate of 5 percent per year is considered. The VOC savings estimated in this analysis are conservative and do not consider savings in VOC arising as the remaining vehicles on the road achieve higher speed and better efficiency due to reduced congestion after the introduction of Metro Line 5.

- (iii) **Benefits of Air Pollution Savings:** As a result of fewer vehicles on the road due to modal shift and an increase in speed of the remaining vehicles due to lower congestion, the project will cause significant reduction in the air pollution. The DPR assumes the following parameters:

Table 13: Air Pollution Parameters

Modes	Fuel consumption (Liter/Km)	Reduction in fuel consumption due to the decongestion effect (Liter/Km)	Pollution Emissions (Kg/1000 Liters)
Car	0.11	0.040	309.11
Taxi	0.11	0.040	309.11
3-Wheeler	0.08	0.027	303.24
2-Wheeler	0.04	0.014	326.11
Bus	0.39	0.096	85.89

Source: Detailed Project Report for Mumbai Metro Line 5, updated by MMRDA Transport Economics Department

- (iv) **Benefits of GHG Emission Savings:** Although the initial DPR does not assess the reduction in the Green House Gas (GHG) emission, the project will have a significant impact on it, for the same reasons mentioned for air pollution savings. Emission rates used for the assessment are those used for Chennai Metro Rail Project, assuming similar characteristics of the road vehicle fleet (in terms of fuel type, average vehicle age, etc.). Emission rates for bus is 787.72g/km, car is 139.52g/km, 2-wheeler is 28.58g/km and 3-wheeler is 77.89g/km. For carbon pricing, the mid-point of the Stiglitz-Stern recommendation was used until 2035, after which the price of carbon is estimated to grow at 2.25 percent per year. These benefits are conservatively estimated as it ignores the benefits from reduction from other gases.
- (v) **Savings on Cost of Accidents:** The modal shift to the Metro Line 5 system is expected to reduce accident in the catchment area by reducing the number of vehicles. The assumptions for accident savings are based on costs of fatal and major accidents and cost of damage of vehicles, detailed in the DPR, and based on MoHUA prescription. An estimate of the number of accidents was also provided in the DPR.

Table 14: Number of accidents

Type of accident	Number of accident/10 ⁷ veh.km
All	1.82
Fatal	0.22

Source: Detailed Project Report for Mumbai Metro Line 5, updated by MMRDA Transport Economics Department

8.8 In addition to these there are several other benefits that have not been quantified due to lack of appropriate data. These include (a) saving on road maintenance, (b) uptick in economic activity in the catchment area due to improved connectivity, and (c) increased access to health and education facilities for people in nearby areas.

E. Economic Viability

8.9 Based on above costs and benefits the Economic Internal Rate of Return for Metro Line 5 Project is computed as 14.87 percent while the NPV is estimated at INR 15.10 billion at 12 percent discount rate. Moreover, the EIRR and NPV of the Program is computed as 18.92 percent and INR 95.24 billion. Thus, both the Project and the Program are deemed as economically viable. These estimates tend to be on the conservative side because of the various assumptions made in the analysis including (a) excluding the VOC saving arising from lower congestion on the roads, (b) excluding the savings in GHG emissions other than CO₂ and (c) excluding other savings such road maintenance savings.

Table 15: Economic Evaluation Base Case Scenario

Metro Line 5	EIRR (%) Base Case	ENPV at 12% (INR Billion)
Project	14.87	15.10
Program	18.92	95.24

8.10 The tables below summarize the economic costs and benefits (undiscounted) for the Project and the Program.

Table 16: Annual Costs and Benefits (undiscounted) – Project (in INR Billions)

Year	Economic Costs		Economic Benefits					Net Benefits
	Capital Costs	O&M Costs	Vehicle Operating Costs (in RS)	Time Savings (in RS)	Road Safety	Air Pollution (in Rs)	GHG Emissions	
2021	(2.51)	-	-	-	-	-	-	(2.51)
2022	(3.35)	-	-	-	-	-	-	(3.35)
2023	(3.35)	-	-	-	-	-	-	(3.35)
2024	(8.24)	-	-	-	-	-	-	(8.24)
2025	(11.17)	-	-	-	-	-	-	(11.17)
2026	(5.73)	(1.02)	1.73	3.21	0.01	0.47	0.09	(1.25)
2027	(2.36)	(1.04)	1.84	3.13	0.01	0.51	0.09	2.18
2028	-	(1.06)	1.96	2.97	0.01	0.55	0.10	4.52
2029	-	(1.07)	2.09	2.89	0.01	0.59	0.10	4.61
2030	-	(1.09)	2.23	2.75	0.01	0.63	0.10	4.63
2031	-	(1.11)	2.37	2.67	0.01	0.68	0.11	4.73
2032	-	(1.13)	2.53	2.80	0.01	0.73	0.11	5.06
2033	-	(1.15)	2.70	2.92	0.01	0.79	0.12	5.40
2034	-	(1.16)	2.87	3.05	0.01	0.85	0.13	5.74
2035	-	(1.18)	3.06	3.16	0.02	0.91	0.13	6.10
2036	-	(1.20)	3.26	3.26	0.02	0.98	0.14	6.46
2037	-	(1.22)	3.48	3.48	0.02	1.05	0.14	6.95
2038	-	(1.24)	3.70	3.72	0.02	1.13	0.15	7.48
2039	-	(1.26)	3.95	3.96	0.02	1.22	0.16	8.05
2040	-	(1.28)	4.21	4.23	0.02	1.31	0.17	8.66
2041	-	(1.30)	4.48	4.51	0.02	1.41	0.17	9.30
2042	-	(1.32)	4.77	4.82	0.02	1.52	0.18	10.00
2043	-	(1.34)	5.09	5.14	0.03	1.64	0.19	10.74
2044	-	(1.36)	5.42	5.49	0.03	1.76	0.20	11.53
2045	-	(1.39)	5.78	5.86	0.03	1.90	0.21	12.38
2046	(2.32)	(1.41)	6.15	6.25	0.03	2.05	0.22	10.97
2047	-	(1.43)	6.56	6.67	0.03	2.21	0.23	14.26
2048	-	(1.45)	6.99	7.12	0.03	2.38	0.24	15.31
2049	-	(1.48)	7.45	7.60	0.04	2.56	0.25	16.42
2050	-	(1.50)	7.93	8.12	0.04	2.76	0.26	17.61
2051	-	(1.52)	8.45	8.66	0.04	2.97	0.27	18.88
2052	-	(1.55)	9.01	9.25	0.04	3.21	0.27	20.23
2053	-	(1.57)	9.60	9.87	0.05	3.46	0.28	21.69
2054	-	(1.60)	10.23	10.54	0.05	3.73	0.29	23.24
2055	-	(1.62)	10.90	11.26	0.05	4.02	0.29	24.90
2056	-	(1.65)	11.61	12.02	0.06	4.34	0.30	26.68
2057	-	(1.68)	12.37	12.84	0.06	4.68	0.31	28.58
2058	7.80	(1.70)	13.18	13.71	0.07	5.05	0.32	38.42

Table 17: Annual Costs and Benefits (undiscounted) – Program (in INR Billions)

Year	Economic Costs		Economic Benefits					Net Benefits
	Capital Costs	O&M Costs	Vehicle Operating Costs (in RS)	Time Savings (in RS)	Road Safety	Air Pollution (in Rs)	GHG Emissions	
2021	(2.51)	-	-	-	-	-	-	(2.51)
2022	(3.35)	-	-	-	-	-	-	(3.35)
2023	(5.61)	-	-	-	-	-	-	(5.61)
2024	(12.77)	-	-	-	-	-	-	(12.77)
2025	(15.71)	-	-	-	-	-	-	(15.71)
2026	(11.13)	(1.02)	1.73	3.21	0.01	0.47	0.09	(6.65)
2027	(8.80)	(1.04)	1.84	3.13	0.01	0.51	0.09	(4.26)
2028	(2.96)	(1.80)	4.77	5.89	0.02	0.84	0.17	6.94
2029	-	(1.82)	5.15	6.14	0.03	0.91	0.18	10.58
2030	-	(1.85)	5.56	6.35	0.03	0.98	0.19	11.26
2031	-	(1.88)	6.01	6.64	0.03	1.06	0.20	12.05
2032	-	(1.91)	6.49	6.90	0.03	1.14	0.21	12.86
2033	-	(1.94)	7.01	7.20	0.03	1.23	0.22	13.76
2034	-	(1.97)	7.58	7.74	0.04	1.33	0.23	14.95
2035	-	(2.01)	8.19	8.32	0.04	1.44	0.24	16.23
2036	-	(2.04)	8.85	8.93	0.04	1.55	0.26	17.61
2037	-	(2.07)	9.57	9.59	0.05	1.68	0.27	19.09
2038	-	(2.10)	10.35	10.29	0.05	1.82	0.29	20.69
2039	-	(2.14)	11.19	11.13	0.06	1.96	0.30	22.50
2040	-	(2.17)	12.11	12.03	0.06	2.12	0.32	24.47
2041	-	(2.21)	13.10	13.02	0.07	2.30	0.33	26.60
2042	-	(2.24)	14.17	14.08	0.07	2.48	0.35	28.91
2043	-	(2.28)	15.33	15.24	0.08	2.69	0.37	31.42
2044	-	(2.31)	16.59	16.49	0.08	2.90	0.39	34.14
2045	-	(2.35)	17.96	17.85	0.09	3.14	0.41	37.09
2046	(2.32)	(2.39)	19.44	19.32	0.10	3.40	0.43	37.98
2047	-	(2.43)	21.04	20.91	0.10	3.68	0.45	43.77
2048	(0.58)	(2.47)	22.78	22.65	0.11	3.98	0.48	46.96
2049	-	(2.51)	24.67	24.52	0.12	4.31	0.51	51.63
2050	-	(2.55)	26.72	26.56	0.13	4.67	0.53	56.07
2051	-	(2.59)	28.94	28.77	0.14	5.05	0.55	60.87
2052	-	(2.63)	31.35	31.17	0.16	5.47	0.57	66.09
2053	-	(2.67)	33.97	33.77	0.17	5.93	0.59	71.75
2054	-	(2.71)	36.81	36.59	0.18	6.42	0.61	77.89
2055	-	(2.76)	39.89	39.65	0.20	6.95	0.63	84.57
2056	-	(2.80)	43.24	42.98	0.22	7.53	0.65	91.81
2057	-	(2.84)	46.87	46.59	0.23	8.16	0.67	99.67
2058	13.15	(2.89)	50.81	50.51	0.25	8.84	0.69	121.36

F. Sensitivity Analysis – Economic Analysis

8.11 The robustness of the Project and Program economic viability is assessed through a sensitivity analysis, testing alternate assumptions about the costs and benefits. The Project is found to be economically viable if (a) costs increase by 10 percent, (b) benefits decline by 10 percent and (c) both (a) and (b) occur. The results are outlined in the table below:

Table 18: Sensitivity Analysis

	Project		Program	
	EIRR (%)	NPV (INR Billion)	EIRR	NPV (INR Billion)
Baseline	14.87	15.10	18.92	95.24
Increase Costs by 10%	13.95	11.07	17.91	87.13
Decrease Benefits by 10%	13.68	8.62	17.67	75.74
Increase Costs by 10% and Decrease Benefits by 10%	12.83	4.60	16.73	67.62

8.12 Across all the scenarios, the EIRR for both the Project and the Program is well above the discount rate of 12 percent indicating that the Project remains viable even under these adverse conditions.

G. Financial Analysis

8.13 **Scope.** Similarly to the economic analysis, the initial DPR (2016) included a financial analysis of the entire Line 5 as a whole. The Bank Project team updated the analysis to consider the change in the project phasing, timeline and costs. Two financial analyses are performed: to assess the financial viability of the Project and the Program. The post-tax Financial Rate of Return (FIRR) is used as the value measure for the analysis of financial sustainability. It is based on costs (investment and O&M costs, including taxes), and revenues (farebox revenues, property development, advertising...), over a period of 36 to 38 years, including 30 years of operation (+2 years for the Program, considering Phase 2 is commissioned 2 years after Phase 1) and 6 years of construction.

8.14 **Financial costs.** Costs cover civil works, acquisition of rolling stock and metro systems equipment, along with operational and maintenance (O&M) costs (see economic analysis for figures). All the costs are in 2022 prices. Taxes are added on capital costs as followed:

Table 19: Detail of Taxes and Duties

Tax item	Custom Duties	GST (Good & Service Tax)
General	Exempted	18.00%

Source: Updated as per applicable taxation for funded projects

8.15 **Farebox revenue.** The farebox revenue is the main revenue source for the Project, and the fare system is distance-based. The DPR assumes an annual escalation to the base fare structure for the Project.

Table 20: Fare structure for the project (commissioning year – 2026)

Trip Length (km)	Fare (INR)	Trip Length (km)	Fare (INR)
0-3	13	20-25	33
3-8	16	25-30	37
8-12	20	30-35	41
12-15	24	>35	46
15-20	30		

8.16 **Non-fare revenue.** According to the DPR, other revenues from property development and general advertisement have been estimated at 10 percent of the farebox revenues during the first five years of operations, and thereafter at 20 percent of the farebox revenues. Apart from property development on metro stations and depot, other resources would be raised through rental of commercial spaces, advertising on trains, within stations and parking lots, on viaducts and platform screen doors. This is estimated to represent between 3 and 6 percent of the farebox revenues.

8.17 **Outcome of the financial analysis.** Based on the assumptions mentioned above, calculations for post-tax FIRR were carried out. The analysis was done in real (or constant) terms, without factoring escalations for the costs. The evaluation results show that the Project has an estimated post-tax real FIRR of 2.45 percent; the Program has an estimated post-tax real FIRR of 5.98 percent, which is acceptable. Operation and Maintenance costs are covered by fare box revenues throughout the assessment period. Given that fare box revenue is the main benefit stream from the project investment, the fare escalation and ridership projections will have crucial impact on the FIRR. The analysis is summarized in the table next pages.

H. Sensitivity Analysis – Financial Analysis

8.18 Post-tax real FIRR of the Project and Program are assessed through a sensitivity analysis, testing alternate assumptions about the costs and revenues: (a) costs increase by 10 percent, (b) revenues decline by 10 percent and (c) both (a) and (b) occur. The results are outlined in the table below:

Table 21: Sensitivity Analysis

	FIRR (%)	
	Project	Program
Baseline	2.53	6.26
Increase Costs by 10%	-	5.80
Decrease Revenues by 10%	1.77	5.50
Increase Costs by 10% and Decrease Revenues by 10%	-	5.06

Table 22: Annual Costs and Revenues – Project (in INR Billions)

Year	Financial Costs			Revenues	Net Benefits
	Capital Costs	Taxes	O&M Costs		
2021	(3.02)	(0.51)	-	-	(3.54)
2022	(4.03)	(0.69)	-	-	(4.72)
2023	(4.03)	(0.69)	-	-	(4.72)
2024	(9.92)	(1.72)	-	-	(11.65)
2025	(13.46)	(2.35)	-	-	(15.81)
2026	(6.90)	(1.21)	(1.02)	1.39	(7.75)
2027	(2.36)	(0.42)	(1.04)	1.55	(2.27)
2028	-	-	(1.06)	1.57	0.51
2029	-	-	(1.07)	1.59	0.52
2030	-	-	(1.09)	1.82	0.73
2031	-	-	(1.11)	1.97	0.86
2032	-	-	(1.13)	2.01	0.89
2033	-	-	(1.15)	2.29	1.15
2034	-	-	(1.16)	2.34	1.18
2035	-	-	(1.18)	2.39	1.21
2036	-	-	(1.20)	2.71	1.51
2037	-	-	(1.22)	2.77	1.55
2038	-	-	(1.24)	2.83	1.59
2039	-	-	(1.26)	3.20	1.94
2040	-	-	(1.28)	3.27	1.99
2041	-	-	(1.30)	3.34	2.04
2042	-	-	(1.32)	3.77	2.45
2043	-	-	(1.34)	3.85	2.51
2044	-	-	(1.36)	3.94	2.58
2045	-	-	(1.39)	4.49	3.10
2046	(2.79)	(0.42)	(1.41)	4.59	(0.03)
2047	-	-	(1.43)	4.69	3.26
2048	-	-	(1.45)	5.35	3.90
2049	-	-	(1.48)	5.47	4.00
2050	-	-	(1.50)	5.60	4.10
2051	-	-	(1.52)	6.33	4.81
2052	-	-	(1.55)	6.48	4.93
2053	-	-	(1.57)	6.63	5.06
2054	-	-	(1.60)	7.58	5.98
2055	-	-	(1.62)	7.76	6.13
2056	-	-	(1.65)	7.94	6.29
2057	-	-	(1.68)	9.00	7.32
2058	-	-	(1.70)	9.22	7.51

Table 23: Annual Costs and Revenues – Program (in INR Billions)

Year	Financial Costs			Revenues	Net Benefits
	Capital Costs	Taxes	O&M Costs		
2021	(3.02)	(0.51)	-	-	(3.54)
2022	(4.03)	(0.69)	-	-	(4.72)
2023	(6.76)	(1.17)	-	-	(7.93)
2024	(15.39)	(2.68)	-	-	(18.07)
2025	(18.93)	(3.31)	-	-	(22.23)
2026	(13.41)	(2.36)	(1.02)	3.28	(13.51)
2027	(10.12)	(1.79)	(1.04)	3.71	(9.24)
2028	(3.57)	(0.63)	(1.80)	3.82	(2.18)
2029	-	-	(1.82)	3.93	2.10
2030	-	-	(1.85)	4.53	2.68
2031	-	-	(1.88)	4.66	2.78
2032	-	-	(1.91)	4.80	2.89
2033	-	-	(1.94)	5.89	3.95
2034	-	-	(1.97)	6.07	4.09
2035	-	-	(2.01)	6.24	4.24
2036	-	-	(2.04)	7.13	5.10
2037	-	-	(2.07)	7.35	5.28
2038	-	-	(2.10)	7.56	5.46
2039	-	-	(2.14)	8.63	6.49
2040	-	-	(2.17)	8.88	6.71
2041	-	-	(2.21)	9.15	6.95
2042	-	-	(2.24)	10.42	8.18
2043	-	-	(2.28)	10.74	8.46
2044	-	-	(2.31)	11.07	8.75
2045	-	-	(2.35)	12.72	10.37
2046	(2.79)	(0.42)	(2.39)	13.11	7.51
2047	-	-	(2.43)	13.52	11.09
2048	(0.69)	(0.10)	(2.47)	15.54	12.27
2049	-	-	(2.51)	16.03	13.52
2050	-	-	(2.55)	16.53	13.98
2051	-	-	(2.59)	18.86	16.27
2052	-	-	(2.63)	19.45	16.83
2053	-	-	(2.67)	20.07	17.40
2054	-	-	(2.71)	23.13	20.41
2055	-	-	(2.76)	23.87	21.11
2056	-	-	(2.80)	24.64	21.84
2057	-	-	(2.84)	28.14	25.30
2058	-	-	(2.89)	29.06	26.17

9. Annex 4: Gender Equality and Social Inclusion

A. Assessment of gender equality in Mumbai Metropolitan Region

9.1 Gender equality is enshrined in the Indian Constitution - in its Preamble, Fundamental Rights, Fundamental Duties and Directive Principles. Upholding and safeguarding rights of all citizens irrespective of caste, creed, religion, gender, or any other identity is the core responsibility of the government. Both Union and state governments are empowered to develop and implement laws, policies and programs promoting gender equality. The Government of India and State Governments have prioritized Gender, Disability and Social Inclusion in all infrastructure related projects implemented in India. In particular, the State Policy on Women 2014 outlines the processes for gender responsive policies and programs: “Gender budgeting is essential so that the principles of man-woman equality, eradication of gender-based discrimination and gender equality are reflected boldly in the planning of all departments of the state”.

9.2 However, gender inequality in India is significant. The World Economic Forum has ranked India 135 (score of 0.629 with parity being 1.0) among 146 countries in the 2022 Global Gender Gap Report. One of the major factors for India’s poor performance is the large gender gap in economic opportunities and participation (score of 0.350, ranked 143 out of 146). Low level women participation in the labor market and wage disparity for similar work are the two major attributes for the large economic opportunity and participation gap. With respect to Gender Based Violence, 42.2 percent of ever married women aged 18-49 experienced spousal violence³.

9.3 The State of Maharashtra, which has the highest Gross State Domestic Product (GSDP) in India, has taken major steps towards empowering women since 1994, when the Maharashtra’s first policy for empowering women was released. The second policy was brought in 2001 and thereafter another one in 2014. These social reforms aimed to enhance women’s role and participation in social, economic, and political development. Maharashtra State Policy for Women 2014 covers different thematic areas, and specifically presents a concrete action plan for Gender Inclusive in Infrastructure, including transport, housing, and WASH (water, sanitation and hygiene)⁴.

9.4 The Gender Inclusive Infrastructure area of this policy states that “access to safe, clean, affordable and reliable transportation for women, girls and transgender persons will be provided both in peak and off-peak hours across urban and rural areas. Ease of travel for persons with disabilities, pregnant women, women with infants and other vulnerable groups will be prioritized across various modes”. To achieve this objective, this policy sets out ten main actions in the transport sector. The station services are specifically covered in two of these ten actions, which aim to (i) provide gender and disabled friendly transport hubs with provision of ramps, railing, escalators, changing rooms, feeding rooms, etc. following maintaining standard hygiene, and (ii) ensure safety and security of women and transgender persons in public and private transport systems including provision of CCTV cameras, GPS trackers of public transport vehicles, emergency helpline numbers prominently displayed, etc.

³ National Family Health Survey-5 (2019-21)

⁴ Maharashtra State Policy and Action Plan for Gender Equality and Women’s Empowerment, 2022, <http://www.bamu.ac.in/Portals/0/GEWE-Policy.pdf>

9.5 In addition, Maharashtra is one of the few states in India that have enacted laws to ensure equal representation of women in the elected wing of city governments, and as presidents of councils. At the community level also, there is representation of women through the women's self-help groups (SHGs), which are mostly composed of women from low-income and marginalized groups. Maharashtra is one of the few states in India which has a strong SHG network.

9.6 However, Maharashtra ranks quite low in terms of indicators on gender compared to other states. The female working population ratio for the age group 15 years and above in Maharashtra is significantly higher than the national average (37.2 percent in Maharashtra vs. 28.7 percent at the national level, 2019-2020)⁵, but this is largely due to the rural female participation. If considering only the urban female working population (16.7 percent in 2017-18), it is almost similar to the national trends (14.9 percent in 2017-18)⁶, which shows that women in urban areas remain outside employment opportunities. In addition, the demographic indicators for women and girls are far lower than in other states. The state has a sex ratio of 958 females per 1000 males, ranking 16th among all states⁷, and the child sex ratio is even lower at 894 girls per 1000 boys⁸. Almost one in three ever-married women have experienced spousal physical or sexual violence in Maharashtra, a proportion higher than in 15 other Indian states⁹.

9.7 The continuous decline in the sex ratio and the declining female employment participation in Maharashtra (female participation in urban areas has decreased from 27 percent to 16.7 percent between 2004 and 2017), together with the rise in gender-based crimes and sexual harassment, reveal the remaining gender inequalities in the state.

9.8 Public transport system plays an important role in the social and economic growth of the city especially in a city like Mumbai which is facing rapid urbanization and traffic congestion on roads due to increased numbers of private vehicles. The Mumbai Metro network can contribute to addressing the inequalities challenges and empowering greater gender equality, as public transportation enables access to social and economic activities. A survey conducted by World Bank in Mumbai in 2019 pointed out that 4 percent of the surveyed women indicated that transport was a commuting barrier for work.

B. MMRDA Gender Equality and Social Inclusion (GESI) Framework

9.9 With a view to identify and provide a gender sensitive approach to MMRDA's various actions to be taken in Metro Line 5 (Phase-I) project implementation, a Gender Equality and Social Inclusion (GESI) framework is prepared and proposed for incorporation in MMRDA's responses in various activities. The GESI provides a range of activities which are integrated within the project design and include:

- (i) gender responsive and socially inclusive design features across all infrastructure.

⁵ Ministry of Labour and Employment, India, <https://pib.gov.in/PressReleasePage.aspx?PRID=1805783>

⁶ Annual Report, PLFS 2017-18.

⁷ Annual Report, PLFS 2017-18

⁸ Census 2011

⁹ National Family Health Survey Round -2 and 3

- (ii) affirmative measures to enhance women's safe mobility such as 'women only coaches', mobile applications for women's security, instruction boards with helpline numbers and color-coded directional signs.
- (iii) designing and piloting special initiatives such as priority e-ticketing counters for the elderly and differently abled, separate ticketing counters and vending machines for women, reporting desks to address incidents of harassment, assigned quota allocated for commercial spaces in metro stations for enterprises owned by or operated by women and establishment of an all-women staff metro station.

9.10 A gender-inclusive agency, Maha Mumbai Metro Operations Company Ltd. (MMMOCL), with attention to women's equitable employment, GESI aspects and the transformative impacts of its operations has been established. The project will be guided by multi-stakeholder GESI Advisory Committee and will support the development of a GESI policy for MMOCL. An impact study to evaluate the socio-economic impact of the Project on the lives of at least 2,000 Mumbai residents (including 40 percent women) will be conducted towards project completion. A GESI expert will be recruited for overall implementation, coordination, and reporting progress of the GESI action plan progress, while a national organization with strong GESI expertise will support MMRS in the timely and effective implementation of GESI action plan. Chief Engineer (Operations & Maintenance) will be designated GESI focal point for the monitoring of the GESI action plan.

Table 24: Gender Equality and Social Inclusion Framework - Metro Line 5

ACTIVITY	INDICATOR / TARGETS	RESPONSIBILITY	TIMELINE
Output 1: Rolling Stock Operational			
1.1 Ensure that the design of train carriages of Line 5 integrates international quality design features addressing the needs of EWCD	1. Dedicated carriage(s) for women commuters allocated with consideration on height of carriage racks and grab handles for standing passengers.	MMMOCL PIU, Project Director	Year1-5
	2. Dedicated seat in each carriage for EWCD commuters allocated		
	3. Space for wheelchairs in trains allocated		
	4. CCTV installed to monitor the security of women passengers inside carriages		
	5. Information on mobile phone-based application for security of women commuters disseminated through at least one signage inside the carriage		
	6. Gender specific messaging, information, and helpline numbers inside carriages		
Output 2: Signaling, Train Control and Telecommunication Systems Operational			
2.1 Ensure metro stations of Line 5 follow international standards and address gender-specific safety and public health concerns, with focus on the needs of EWCD	7. CCTV facilities provided at each metro station	MMMOCL PIU, Project Director	Year1-5
	8. Glow signages for EWCD provided at each metro station		
	9. Instruction boards with helpline numbers and color-coded directional signs indicating the direction to dedicated carriages for women passengers and EWCD-dedicated spaces strategically placed at each metro station		

	10. Platform level boarding, lifts, hirkani kaksh (nursing and breastfeeding room) and waiting area (weather shelter) included in all stations		
	11. Illuminated nonmotorized transport lanes with sidewalks having accessibility ramps included in all stations		
Output 3: Institutional Support for Mumbai Metro Operations Organization and last mile connectivity provided			
3.1 Establish a gender-inclusive agency, the MMMOCL, with attention to women's equitable employment, GESI aspects, and the transformative impacts of its operations	12. At least 10 percent of technical staff and 20 percent of nontechnical staff recruited in MMMOCL O&M are women (Baseline 2018: 0; Source: MMRDA)	MMMOCL PIU, Project Director GESI consultant and consulting firm/NGO	Year1-5
	13. At least 10 percent of MMMOCL PIU staff are women (Baseline 2018: 2 percent, Source: MMRDA)		
	14. Dedicated GESI expert available full-time at the MMMOCL PIU to ensure the timely and effective implementation of the GESI Action Plan		
	15. Chief Engineer (O&M) or other senior staff nominated as gender focal point in the MMMOCL PIU overseeing the GESI Action Plan implementation.		
	16. At least one childcare center in the MMMOCL PIU established, based on needs assessment on terms, timing and modalities endorsed by management		
3.2 Develop MMMOCL GESI policy as per the Government of India and GOM directives with inputs provided by a GESI advisory committee	17. Multistakeholder GESI Advisory Committee - with representation from civil society, women's organization, academia, GESI and transport experts, police-chaired by a (senior) MMMOCL staff established, with quarterly meetings held		
	18. MMMOCL GESI policy developed and approved by MMRDA management		

<p>3.3 Develop an MMMOCL GESI training and multimedia modules</p>	<p>19. MMMOCL GESI training module prepared and at least one annual training/refresher training conducted for staff directly interfacing with customers (1/year on Years 2-5[4])</p>		
	<p>20. At least three types of multimedia information campaign demonstrating ease of access, safety, comfort, and other advantages, as well as "zero tolerance" for sexual and other forms of harassment experienced by EWCD, developed and disseminated</p>		
<p>3.4 Build international standard public urinals and toilets</p>	<p>21. Separate hygienic urinals and toilets for men and women (e.g. urinals and sensor-operated flush valve coupled with manual override features toilets, vandal, and neglect-resistant appliances, with waterproof non-slip surfaces) built at each metro station and operating during metro schedule, with dedicated urinals for children, sanitary pad dispensing machine, and dustbins with covers operated without hand contact</p>		
<p>3.5 Pilot-test additional gender design elements in metro stations of Line 5</p>	<p>22. Pilot-test additional gender design features in one station of Line 5, such as (a) priority e-ticketing counters for the elderly and differently abled and separate ticketing counters and vending machines for women; (b) reporting desks to address incidents of harassment of women, children, differently abled, and other offences; and (c) at least 15 percent of allocated commercial spaces in metro stations owned by women or operated by women employees; and (d) daycare center at selected metro station</p>		
	<p>23. Pilot-test establishment of all-women staff station (1) in Line 5, building on the practice of Mumbai Suburban Railway (local trains), which include the stations controller, customer care operators at ticket counters, station security staff, and housekeeping staff (target: 100 percent women)</p>		

10. Annex 5: Paris Alignment

10.1 The Bank has committed to fully align its operations with the goal of the Paris Agreement (PA) by July 1, 2023. As the Program is intended to commence implementation after this deadline, it is important to capture the potential climate considerations of the Program. The Joint MDB Assessment Framework for Paris Alignment for Direct Investment Operations (the Framework) and AIIB's PA methodology under development for the road sector provides an approach to assess the mitigation (labeled BB1, in the Joint MDB methodology) and adaptation (labeled BB2, in the Joint MDB methodology) alignment of the Program. To be considered fully aligned with PA, the Program must meet both PA's climate mitigation and adaptation goals.

A. BB1: PA Alignment in Climate Mitigation

10.2 The proposed Program is a rail infrastructure, which falls under the Framework's 'universally aligned' list of BB1 activities in the AIIB PA methodology in development.

B. BB2: PA Alignment in Climate Adaptation

10.3 The Joint MDB methodology for assessing the investment's climate adaptation alignment with the PA consists of three steps:

- (i) Step 1: Climate risk and vulnerability assessment: identify and assess physical climate risk to determine whether the road infrastructure, its ancillary facilities and its users are vulnerable to climate hazards.
- (ii) Step 2: Climate adaptation and resilience measure definitions: Propose measures to address the identified physical climate risks and contribute to build climate resilience; and
- (iii) Step 3: Consistency with broader and national context for climate resilience: Ensure that the project is consistent with the policies/strategies/plans for climate adaptation and resilience at the national, regional, local, city, level as considered relevant and/or with private sector or community-driven priorities.

10.4 **Step 1: Climate risk and vulnerability assessment.** The climate risk and vulnerability assessment was prepared as part of the ESDD and EIA. Nevertheless, the Bank conducted its own climate risk and vulnerability assessment (using the Aware tool) and similarly, found that the Project area is highly exposed to increased precipitation, flooding, and sea level rise.

10.5 There are two distinct climates in the district of Thane, one on the western coastal plains and the other on the eastern slopes of Sahyadri mountain range (Western Ghat). The climate on the western coastal plains of Thane city is tropical, very humid, and warm. The climate on the plains at the foot of the slopes (Kalyan, Bhiwandi...) is comparatively less humid. The district has four seasons. Winter is from December to February, followed by summer from March to June. The southwest monsoon season is from June to September. October and November months constitute the post-monsoon season, which is hot and humid in the coastal areas. Project alignment traverses through the western part of the district and thus experience tropical climate.

10.6 Global climate projections, given inherent uncertainties, indicate several changes in India's future climate. India is already experiencing a warming climate. Unusual and unprecedented spells of hot weather are expected to occur far more frequently and cover much larger areas. Under 4°C warming, the west coast and southern India are projected to shift to new, high-temperature climatic regimes with significant impacts on agriculture. A decline in monsoon rainfall since the 1950s has already been observed. The frequency of heavy rainfall events has also increased. 2°C rise in the world's average temperatures will make India's summer monsoon highly unpredictable. At 4°C warming, an extremely wet monsoon that currently has a chance of occurring only once in 100 years is projected to occur every 10 years by the end of the century. An abrupt change in the monsoon could precipitate a major crisis, triggering more frequent droughts as well as greater flooding in large parts of India. India's northwest coast to the southeastern coastal region could see higher than average rainfall. Dry years are expected to be drier and wet years wetter.

10.7 Mumbai faces two major climate challenges – urban flooding and increasing heat. Mumbai and surrounding coastal districts have the world's largest population exposed to coastal flooding and riverine flooding, with large parts of the city built on reclaimed land, below the high-tide mark. Rapid and unplanned urbanization further increase the risks of sea water intrusion. Sea-level rise and storm surges would lead to saltwater intrusion in the coastal areas, impacting agriculture, degrading groundwater quality, contaminating drinking water. According to the Maharashtra State Adaptation Action Plan on Climate Change (SAPCC) 2014 (TERI, 2014), which provides state, regional and city level climate vulnerability context, 40 percent of Maharashtra's geographic area is drought prone, and 7 percent is flood prone, with deficient rainfall reported once every five years.

10.8 Mumbai experiences high temperatures not only during summer but also in the post monsoon months when humidity levels increase heat stress. Low-income households and informal settlements are at a higher risk given the limited access to water and sanitation services and nature of their living environment (metal roofs and tarpaulin roofs exacerbate heat risks). Heat stress also impacts productivity and thereby livelihoods and the economy. According to National Oceanic and Atmospheric Administration (NOAA) projections, 60 percent of Mumbai's year will comprise high heat days by 2040, where temperatures can exceed 32°C.

10.9 Project site lies in Mumbai city and thus is vulnerable to such risks. Mumbai in recent past has been experiencing the floods due to heavy rains. The city is then susceptible to landslides as a result of heavy rain that causes many fatalities and physical damage every monsoon. Torrential rainfall leading to floods also happens also due to cyclones in the Arabian Sea. Mumbai ranks fifth among the world's cities which are prone to flooding, recording annual losses amounting to USD 284 million¹⁰. Floods are severe and lead to inundation of most of the city leading to disruption of the day-to-day activity and cause loss of property and life. Mumbai is among the top 10 world's cities in terms of population and assets exposure to flooding. Floods are severe and lead to inundation of most of the city leading to disruption of the day-to-day activity and cause loss of property and life.

¹⁰ Ranking of the world's cities most exposed to coastal flooding today and in the future, OECD, 2007.

10.10 **Step 2: Climate adaptation and resilience measure definitions.** To limit the impact of a potential precipitation increase, urban flooding and landslides, MMRDA has integrated climate change considerations into the Project design (Phase 1) to address the need for adaptation, including:

- (i) Increased precipitation: provision of rainwater harvesting system to harvest rain water.
- (ii) Sea level rise: Design of all structures above High Flood Level of the nearby rivers.
- (iii) Flood: Piers at waterbody crossings designed so that they will occupy minimum space in the riverbed. Modelling studies are carried out to assess the impact of construction of riverbanks/beds. This will minimize the impact on the carrying capacity of the water bodies and will not aggravate the flooding.

10.11 Technical specifications of each system will have climate tolerances that will have to be ensured by the systems' designers. These tolerances are tailored to most severe climate parameters likely to be encountered during the codal life of the systems. This will ensure that the systems designed and installed under the project are resilient to climate changes.

10.12 **Step 3: Consistency with broader and national context for climate resilience.** As stated in the National Determined Contribution (NDC) of India, adaptation is inevitable and imperative for the country's development process. Indian's NDC indicates that the development of the adaptation actions are under state action plans on climate change, and should focus in sectors like agriculture, water, Himalayan ecosystems, forestry, capacity building and knowledge management.

10.13 The State of Maharashtra developed the Maharashtra State Adaptation Action Plan on Climate Change (MSAAPCC, 2014), outlining broad and ambitious strategies for building a climate resilient future. In the energy and infrastructure sectors, the MSAAPCC set out three main recommendations: (i) promotion of cleaner forms of energy; (ii) shifting to energy efficient systems to conserve energy; (iii) climate-proofing of new public infrastructure. This last recommendation shall be translated into incorporating additional ranges of temperature, rainfall, and sea level rise into design specifications. MSAAPCC also outlines that waste-to-energy technologies should be actively promoted.

10.14 In addition to the MSAAPCC, to respond to the growing climate vulnerability of Mumbai, the Municipal Corporation of Greater Mumbai (MCGM) has developed a Mumbai Climate Action Plan (MCAP, 2022), covering six sectors and delivering on both climate mitigation and adaptation. In the energy and building sector, MCAP emphasizes the need to promote low-carbon buildings and set out four sectoral action priorities: (i) increasing the proportion of clean energy in Mumbai's energy mix; (ii) switching to clean fuels and ensuring energy and water efficiency in all buildings; (iii) promoting low-carbon buildings through ECBC compliance and green building certification; (iv) integrating passive design strategies to make buildings climate-resilient. In the sustainable mobility sector, under the priority of enhancing public transport, MCAP presents an action plan which includes as a key action establishing a commuter helpline to address grievances around public transport safety, access, reliability, etc.

10.15 As the Project incorporates adequate climate adaptation measures into the design and ensured that the implementation is aligned and consistent with national and state strategies on climate adaptation, the Project shall meet all three steps under the joint methodology. As such, together with the mitigation measures previously discussed, it is assessed that the Project is fully aligned under PA.

11. Annex 6: Member and Sector context

11.1 **Indian Economy.** India is a lower-middle-income country, with a GDP per capita at USD 2379.2 and a population of ~1.4 billion in 2022.¹¹ Prior to the pandemic India enjoyed a decade of robust economic performance growing at an average annual rate of 7.0 percent between FY2010 and FY2019. India's GDP contracted by 5.8 percent in FY2020 (year ending March 2021) on account of COVID-19 induced stringent lockdown restrictions imposed during the first half of the year. With increased mobility and favorable base effect, the Indian economy grew by 9.1 percent in FY2021 even with the Omicron wave happening in January 2021. Growth moderated to 6.8 percent in FY2022 due to geopolitical tensions, rise in commodity prices and monetary tightening in advanced economies.

11.2 Inflation, after moderating from around 10 percent in FY2010 to below 5.0 percent in FY2019 have picked up in recent years, first due to supply disruptions and subsequently due to elevated global commodity prices. Retail inflation averaged 6.7 percent in FY2022, well above the 4±2 percent inflation targeting band which triggered the central bank to raise the policy rate by a cumulative 250 basis points between May 2022 and February 2023.

11.3 Public debt rose rapidly in FY2020 to 88.5 percent of GDP after remaining between 65 and 75 percent of GDP in the previous decade. The rise was driven by a sharp fall in revenue due to a decline in economic activity, rise in various social welfare expenditure, and a contraction of the economy in FY2020. Public debt has moderated to around 83 percent of GDP by FY2022.

11.4 Going forward growth is expected to average around 6.0 percent in the medium term amid higher oil prices, weaker external demand, and tighter financial conditions. Inflation is expected to moderate gradually reflecting some moderation in global commodity prices and impact of monetary tightening. Public debt will only gradually decline from current elevated levels reflecting slow pace of fiscal consolidation, moderation in near term growth and high interest rates.

11.5 The economic contraction in FY2020 had a significant impact on the vulnerable sections of the economy and reversed many of the impressive socioeconomic gains made by India over the last two decades. Between 2004 and 2011, poverty rates fell from 39.9 in 2004 to 22.5 percent in 2011-12, and further to 10 percent in 2019. The World Bank estimates that the Covid-19 pandemic has resulted in an increase in the overall poverty rate by around 2.5 percentage points in 2020. As of 2021, the poverty rate declined to 13.8 percent which is still higher than the pre-pandemic level. Given the elevated inflation levels and normalization of fiscal support, poverty reduction is expected to follow a slower than expected trajectory.¹²

11.6 The Covid-19 induced restrictions had a severe impact on employment. Unemployment rate (UR) shot up to 23.5 percent in April-2020, from a pre-pandemic average of 7 percent. As the restrictions started being lifted in June-2020, the UR improved and averaged 7.2 percent between July-2020 and March-2021. The localized restrictions on account of the second wave pushed up the UR to 11.8 percent in May-2021. With decreasing daily cases and increase in

¹¹ The income group classification for fiscal year 2020 is based on World Bank criteria. Data from WEO, April 2023.

¹² [Macro Poverty Outlook, 2023, World Bank.](#)

mobility from June-2021 onwards, the UR has improved to around 7.4 percent during the Sep-Dec-2021 period, comparable to the pre-pandemic level. Despite the third wave, the UR came down to 6.6 percent in January 2022. The UR started increasing from February 2022 onwards and has remained sticky around the 7.5 percent mark during the recent months, mainly due to an increase in urban unemployment.¹³

11.7 India roughly spends 4.5 percent of GDP on infrastructure, of which investment in roads and railways comprise of 54 percent and 41 percent respectively.¹⁴ Earlier in FY2021, the government allocated USD 52 billion under the National Infrastructure Pipeline (NIP), apart from the traditional sources like the budgetary and extra-budgetary resources as well as private sector investment. The government unveiled a National Monetization Pipeline (NMP) to unlock the value of investments in public sector assets by tapping private sector capital and efficiencies. The FY2023 Union Budget continued the stimulus to the infrastructure sector by increasing capital expenditure in infrastructure investment by 33 percent. Projects in the real estate sector, connectivity, smart cities are expected to benefit from the proposed budgetary allocations.

11.8 **State of Maharashtra.** Maharashtra is the largest state in India contributing to ~13 percent to the GDP, while it is the second largest state in terms of population. The state has the Arabian sea on the West and shares borders with six other states: Gujarat, Madhya Pradesh, Chhattisgarh, Karnataka, Telangana, and Goa. The state is subdivided into 36 administrative zones called districts. Estimates suggest a 6.8 percent growth in FY2022, similar to the all-India growth rate. The agricultural sector has been leading the growth momentum followed by industry and services. Services comprise of 60 percent of Gross State Domestic Product (GSDP) followed by industry (26.1) and agriculture and allied activities (13 percent). As of 2021-22, the per-capita state income is USD 2,690 which is higher than the all-India average.¹⁵ The state has also been one of the top FDI-receiving states in India. Between 2000 and 2022, the state received 28.5 percent of total inflows in India. During the period June 2020 to December 2022, the state has attracted investment proposals of USD 34.2 billion.

11.9 Infrastructure in Maharashtra is relatively more developed compared to the rest of India. As per the 2011 census, Maharashtra was the third most urbanized state of India, behind Tamil Nadu and Kerala, with 45.22 percent of the population living in urban areas. Given the primacy of the state in India's economic performance it is imperative for the state to have a well-developed transport system to sustain efficient movement of freight and people. Currently, Maharashtra has 6,242 km of railway route 323,873 km of roads and 34 million motor vehicles. The state has the highest share of installed capacity of electricity generation in India with an installed renewable capacity of 11,400 MW. Some of recent impactful ongoing projects in the state are Navi Mumbai International Airport, Mumbai Coastal Road project and Delhi-Mumbai Industrial Corridor. Multiple metro lines in the city of Mumbai are being constructed with metro network also commissioned in the city of Pune and, Navi Mumbai and Nagpur. However, a more efficient multimodal transport system is required to release the stress on the infrastructure. As the state is responsible for about a fourth of India's total exports, efficient

¹³ Unemployment data from Centre for Monitoring the Indian Economy.

¹⁴ [Global Infrastructure Hub](#). Accessed on May 04, 2023.

¹⁵ At current exchange rate of INR 80=1 USD

logistics and transport system will help drive the cost of operations down and will boost export competitiveness.

11.10 Mumbai. Mumbai is the capital of State of Maharashtra and is known as the financial capital of India. It is the second most populous city in India with a population of 20 million in 2018 and expected to rise to 24.7 million by 2025.¹⁶ The city of Mumbai is a part of the Mumbai Metropolitan Region (MMR), which includes Mumbai suburban district, parts of Thane district (Thane, Bhiwandi, Kalyan and Ulhasnagar tehsils, Vasai tehsil), and parts of Raigad district (Uran tehsil, Panvel, Karjat, Khalapur, Pen and Alibaug tehsil). The MMR covers an area of 4,355 sq. km and is considered as one of the most densely populated areas in the world. The entire area is overseen by the Mumbai Metropolitan Region Development Authority (MMRDA), a Maharashtra State Government organization in charge of town planning, development, transportation, and housing in the region. The region accounts for nearly 40 percent of Maharashtra's output. Two important ports viz. the Mumbai Port Trust and Jawaharlal Nehru Port Trust in the region handle more than 30 percent of the maritime trade.¹⁷ The city of Mumbai (Mumbai city and Mumbai Suburban) contributes to 20 percent of total district GDP in Maharashtra. The COVID-19 pandemic has a huge impact on Mumbai's economy as growth declined to -10 percent in FY2020, much higher than the decline of -5.8 percent of India's GDP. The local economy bounced back in FY2021 and grew by 8.7 percent with the relaxation of COVID-related restrictions.¹⁸ The economy is expected to grow at a steady rate in FY2023 and FY2024 subject to no major disruptions.

11.11 Public transport infrastructure in Mumbai comprises of rail and road network. But in Mumbai, the suburban railway network remains as the major mode of transport. Currently, there are multiple railway projects under development. During FY2021 when in COVID, the suburban railway network (comprising of Western and Central Railway) operated 229 local trains daily ferrying 34.5 lakh passengers, which is substantial lower than the ridership of 85 lakh before the Pandemic. Evidently, the Mumbai suburban railway system is extremely overloaded and is prone to accidents. As of 2022, 1689 railway injuries and 2078 fatalities were reported on the Mumbai suburban railway route.¹⁹ Mumbai roads are also extremely congested as the city is ranked fourth globally in terms of congestion. Currently, the multiple projects are underway to develop the metro network in Mumbai which may prove to be a complement to the existing public transport infrastructure network.

¹⁶ The World's Cities in 2018, United Nations.

¹⁷ Comprehensive Mobility Plan (CMP) for Greater Mumbai, LEA Associates South Asia Pvt. Ltd., India

¹⁸ [Economic Survey of Maharashtra, 2022-23](#)

¹⁹ Same as above.

12. Annex 7: Sovereign Credit Factsheet

A. Recent Economic Development

12.1 India is a lower-middle-income country, with a GDP per capita at USD 2277.4 and a population of 1.39 billion in 2021.²⁰ India's economy grew at an average annual rate of 7.4 percent between FY2014 and FY2018 but slowed down in the years before the pandemic following disruptions due to demonetization, rollout of goods and services tax, rural distress and stress in the financial sector.^{21,22} According to IMF, India's GDP contracted by 5.8 percent in FY2020 (year ending March 2021) on account of stringent lockdown restrictions imposed during the first half of the year. Even though the second wave (April-June 2021) of the pandemic was more severe than the first wave (April-June 2020), the government opted for localized restrictions. With increased mobility and favorable base effect, the Indian economy grew by 9.1 percent in FY2021 even with the Omicron wave happening in January 2021. However, with waning of the pent-up demand from the lockdown, weakening of exports and tighter fiscal and monetary policy impacting aggregate demand, the economy is expected slowdown and grow at 6.8 percent and 5.9 percent in FY2022 and FY2023 respectively.

12.2 Inflation averaged 6.2 percent in FY2020, primarily driven by food inflation due to supply side disruptions. As a response to the pandemic, the Reserve Bank of India (RBI) reduced key policy rates and introduced measures to reduce the borrowing cost, bolster liquidity, and improve credit flow to the productive sectors. Policy rates remained unchanged with the RBI maintaining an accommodative stance between August 2020 and April 2022. Retail inflation averaged 6.7 percent in FY2022, well above the 4±2 percent inflation targeting band. Elevated food and fuel prices have contributed significantly to the rise in inflation. Responding to higher inflation, the RBI raised the repo rate by a cumulative 250 basis points between May 2022 and February 2023 which now stands at 6.5 percent. RBI expects inflation to moderate at ~5 percent in FY2023 due to easing of commodity prices. In April 2023, it decided to pause the tightening cycle while indicating a gradual withdrawal of the accommodative stance so that inflation comes down to the target band of 4±2 percent.

12.3 A downturn in revenue due to economic slowdown and higher spending on the stimulus package resulted in the fiscal deficit widening significantly to 12.8 percent of GDP in FY2020. Overall deficit moderated to 10 percent in FY2021 on the back of strong revenue collection, that allowed capital expenditure to overshoot its target. The deficit in FY2022 is expected to be similar to FY2021 with both revenue and expenditure growing at over 13 percent. A decline in federal government deficit in FY2022 was offset by an increase in the deficit of the states. A moderation in the deficit and pickup in economic activity helped public debt to decline to 83.5 percent of GDP in FY2022.

12.4 After posting a surplus in FY2020, the current account reverted to a deficit of 1.2 percent of GDP in FY2021 as merchandise imports surged while services exports remained stagnant. Private transfer, including remittances, remained strong with net inflow of USD 81.2 billion in FY2021. Net FDI inflows remained robust at USD 38.5 billion. During the first half of FY2022,

²⁰ The income group classification for fiscal year 2020 is based on World Bank criteria.

²¹ Data are based on fiscal years. Fiscal year 2021 (FY2021) begins on 1 April 2021 and ends on 31 March 2022.

²² On Nov. 8, 2016, India's government announced withdrawal of the legal tender of INR500 and INR1,000 notes, which accounted for 86 percent of the value of currency in circulation, and introduction of new INR500 and INR2,000 notes.

the current account deficit widened to 3.3 percent of GDP mainly due to the widening of trade deficit. Although remittances and net FDI inflows remained robust, foreign portfolio investment recorded net outflows. External debt stood at USD 613.1.5 billion (19.1 percent of GDP) in December 2022. India's reserve holdings declined by 9 percent between January and December 2022 as the central bank aimed to reduce currency volatility. Since November 2022, reserves have increased and stands at USD 586.4.7 billion as of April 14, 2023. Reserves remain adequate according to conventional measures.

12.5 In December 2022, Fitch affirmed India's outlook to stable in line with Moody's and S&P, while retaining the BBB- rating. In June 2020, Moody's downgraded India's rating to Baa3 with a negative outlook but revised the outlook to stable in October 2021 and retained the same rating and outlook in September 2022. In July 2022, S&P retained India's rating at BBB- with a stable outlook.

B. Economic Indicators

Table 25: Selected Macroeconomic Indicators (2019-2022)

Economic Indicators	FY2019	FY2020	FY2021	FY2022*	FY2023*
Real GDP growth	3.9	-5.8	9.1	6.8	5.9
CPI Inflation (average, % change)	4.8	6.2	5.5	6.7	4.9
Current account balance (% of GDP)	-0.9	0.9	-1.2	-2.6	-2.2
General government overall balance (% of GDP)	-7.6	-12.8	-9.6	-9.6	-8.9
General government gross debt (% of GDP)	75.0	88.5	84.7	83.1	83.3
Public gross financing needs (% of GDP)	11.6	18.7	15.6	16.2	15.3
External debt (% of GDP)	19.7	21.5	19.5	19.6	19.8
Gross international reserves (USD billions) 1/	475.6	579.3	617.6	586.4	
Exchange rate (INR/USD, EOP) 1/	75.4	73.5	75.8	81.9	

Note: FY 2020 ran from April 1, 2020, to March 31, 2021

* denotes projected figures

1/Reserves and exchange rate are sourced from RBI and pertain to mid-April 2023.

Source: IMF World Economic Outlook April 2023, Reserve Bank of India, and IMF Country Report 22/386.

C. Economic Outlook and Risks

12.6 The economy is expected to grow at 6.8 percent and 5.9 percent in FY2022 and FY2023 respectively, according to IMF. A weakening of the global economy and further monetary tightening as a response to fighting domestic inflation would curb demand in FY2023. Private consumption will be affected as higher inflation erodes away purchasing power. The government's subsidized food, fertilizer and gas distribution will help offset some of the effects of high inflation. High policy rates may constrain investment spending. Agriculture growth may be subdued due to uneven monsoon and lower sown area while higher borrowing cost and commodity prices may impact manufacturing sector.

12.7 Overall inflation is expected to moderate to 4.9 percent in FY2023 due to easing of commodity prices and softening of growth. In May 2022, the RBI indicated withdrawal of its

accommodative stance in response to sustained inflation and has maintained the same stance as of April 2023. Persistent domestic inflation and the fear of imported inflation through strengthening of the dollar may push the RBI to further raise interest rates in FY2023.

12.8 General government fiscal deficit in FY2023 is expected to moderate slightly to 8.9 percent of GDP as tax revenues increase on the back of improved economic activity. Central government deficit is projected to moderate to 5.9 percent of GDP. Fiscal pressures could strengthen due to rising subsidy burden and as hikes in policy rate increase the cost of borrowing.

12.9 Public debt is expected to remain around 83 percent of GDP in FY2023, similar to FY2022. In an environment of moderating nominal growth and higher interest rates, fiscal consolidation will be key to reduce public debt. Despite being high, India's public debt remains sustainable given favorable aided by having a long and medium maturity, being denominated in domestic currency, and primarily held by residents. India's external debt is expected to remain stable.

12.10 The current account deficit is projected at 2.6 percent of GDP for FY2022 owing to a slower than expected export growth due to the global slowdown and a higher import bill. Remittances may remain strong as a depreciating rupee makes remittances more lucrative. Waning of global commodity price pressures and impetus to exports from some of the ongoing schemes would help current account deficit to moderate to 2.2 percent in FY2023.