

## Ex-Ante Evaluation(for Japanese ODA Loan)

South Asia Division I, South Asia Department

Japan International Cooperation Agency

### 1. Name of the Project

- (1) Country: India
- (2) Project: Mumbai Metro Line 11 Project (I)
- (3) Loan Agreement: March 24, 2026

### 2. Background and Necessity of the Project

- (1) Current State and Issues of the Transportation Sector/Area and the Priority of the Project in India

India has experienced rapid urbanization in recent years. As the number of registered motor vehicles has surged—from 67 million in 2003 to 320 million in 2020—road traffic demand has expanded significantly, while the development of public transport infrastructure has not kept pace. As a result, major metropolitan areas are facing severe traffic congestion, leading to considerable economic losses, environmental deterioration caused by vehicle emissions (such as air pollution and noise), and associated health risks. To address these challenges, the Government of India, under the Metro Rail Policy (latest revision in 2017), set a target of developing metro systems in 27 cities by 2025. The policy promotes the development of public transport systems—such as metro rail, conventional rail, and buses—emphasizing safety and energy efficiency. In major cities, metro development is particularly encouraged as it enables mass transit without placing further pressure on existing road capacity.

The Mumbai Metropolitan Region (MMR), with a population of approximately 18 million and a density of about 20,000 persons/km<sup>2</sup> (as of 2011), is one of the world's largest metropolitan areas. As India's financial and commercial hub, Mumbai is also known for its entertainment and service industries and for its historical heritage sites dating back to British colonial rule. Furthermore, Mumbai hosts the largest concentration of Japanese companies in India, with 332 Japanese corporate offices located within the city and 817 in the state of Maharashtra (out of 5,205 nationwide). As such, the region plays an important role in Japan–India economic relations.

As in the rest of India, the number of registered vehicles in Mumbai has increased dramatically—from 1.01 million in 2001 to 3.53 million in 2018—resulting in worsening congestion, with the average vehicle speed on major roads falling to about 15 km/h (2017; by comparison, Tokyo averages 19.3

km/h). Additionally, out of the Mumbai Metropolitan Region's total CO<sub>2</sub> emissions of 23.42 million tons, the transport sector is responsible for approximately 20%, second only to the power sector (Mumbai Climate Action Plan, 2019).

Against this backdrop, the Government of Maharashtra formulated the Mumbai Metro Master Plan in January 2004 to alleviate traffic congestion and address air pollution. The plan initially outlined the development of nine metro corridors totaling 147.4 km as a Mass Rapid Transit System. The 2017 revised version expanded this to 14 corridors totaling 337.4 km. The Mumbai Metro Line 11 Project (hereafter "the Project"), linking the central city with the southern tip of Mumbai, is positioned as a priority initiative expected to ease congestion and support economic growth.

The Project area—the southern port district—has also been the focus of major redevelopment initiatives. These include the ODA Loan-financed Mumbai Trans-Harbour Link Project, which connects Mumbai with Navi Mumbai across the bay, and the Development of the Eastern Waterfront planned by the Mumbai Port Authority (MbPA). Redevelopment of the densely populated Dharavi area is also planned. These initiatives are expected to result in approximately 400,000 new residents and 500,000 new jobs, positioning the district as a future commercial hub. Metro Line 11 is expected to function as a core transport mode within this revitalized area and contribute to Transit-Oriented Development (TOD).

Furthermore, the Project aligns with India's Nationally Determined Contribution (NDC) under the Paris Agreement, which aims to reduce greenhouse gas emissions by 45% from 2005 levels by 2030.

(2) Japan's and JICA's Policy Cooperation Policy and Operations in the Urban Transportation Sector/Area (especially in relation to key foreign policies such as the Free and Open Indo-Pacific Partnership (FOIP))

Japan's Country Development Cooperation Policy for India (November 2023) identifies the enhancement of "multi-layered connectivity" through the development of transport infrastructure as one of its priority areas. With the aim of removing infrastructure bottlenecks that hinder investment and growth, the policy emphasizes the need to strengthen connectivity within major industrial and economic zones across India—particularly through the development of railways, including high-speed rail and metro systems.

The Project contributes to the low-carbon and decarbonization agenda within

the urban transport sector of the Mumbai Metropolitan Region. It is therefore aligned with Japan's country cooperation policy for India, as well as with the "New Plan for a Free and Open Indo-Pacific (FOIP)", particularly its pillar on "Addressing Regional Challenges in the Indo-Pacific (Climate and Environment)."

According to JICA's Country Analysis Paper for India (March 2025), strengthening connectivity within major industrial and economic hubs—while giving due consideration to environmental and social impacts—is essential for alleviating infrastructure bottlenecks that constrain investment and growth. The Paper highlights the need for support in developing transport hubs and networks, including rail systems such as MRTs. Likewise, JICA's Global Agenda for Transport promotes low- and zero-carbon transport systems, safe mobility, and improved maintenance and operational capacity. The Project is fully consistent with these policies and analytical findings.

This project is considered to contribute to SDG Goal 8 (Inclusive Economic Growth), Goal 9 (Building Resilient Infrastructure, Promoting Inclusive and Sustainable Industrialization, and Fostering Innovation), Goal 11 (Developing Inclusive Cities and Establishing Sustainable Transport Systems), and Goal 13 (Climate Action).

In the railway sector, Japan has an extensive record of ODA Loan support to India. As of the end of December 2025, a cumulative total of 91 projects amounting to JPY 4,654.4 billion had been committed in the transport sector, of which 58 projects (JPY 3,860.3 billion) were for railway-related initiatives. These include metro systems in Delhi, Mumbai, Kolkata, Chennai, Bengaluru, Ahmedabad, and Patna.

### (3) Other Donors' Activities

The World Bank's Country Partnership Framework (FY2018–2022) listed the improvement of connectivity and logistics as key areas of engagement. In the railway sector, it has supported projects such as the Mumbai Urban Transport Project (approved in 2002 and 2010; total USD 972 million) and the Dedicated Freight Corridor – Eastern Corridor (approved between 2011 and 2022; total USD 2.97 billion).

The Asian Development Bank (ADB), under its Country Partnership Strategy (2023–2027), focuses on three pillars: enhancing industrial competitiveness, promoting climate-resilient green growth, and advancing social inclusion. ADB supports regional connectivity and low-carbon transport. In the railway sector, it

has financed the Jaipur Metro (approved in 2014; USD 176 million) and co-financed, together with the New Development Bank (NDB), Mumbai Metro Lines 2A, 2B, and 7 (ADB: USD 926 million, NDB: USD 260 million).

Other donor support includes the following:

- NDB: Mumbai Metro Line 6 (approved in 2019; USD 241 million)
- KfW (Germany): Mumbai Metro Lines 4 & 4A (approved in 2020; USD 241 million)
- AIIB: Mumbai Metro Line 5 (approved in 2024; USD 200 million)

All donor agencies commonly recognize the development of public transportation systems that mitigate urban congestion as a priority area in India. No cofinancing is envisaged for the Project.

### 3. Project Description

#### (1) Project Objective

The Project aims to construct a mass rapid transit system in the Mumbai Metropolitan Region (MMR), the capital region of Maharashtra State, in order to meet increasing transport demand. By alleviating traffic congestion and reducing vehicle-related pollution, the Project is expected to contribute to regional economic development, urban environmental improvement, and ultimately climate change mitigation.

#### (2) Project Site / Target Area

Mumbai Metropolitan Region, Maharashtra State

#### (3) Project Beneficiaries (Target Group)

Direct Beneficiaries: Passengers using the metro line (approx. 664,000 passengers per day, forecasted for 2034—two years after completion)

Ultimate Beneficiaries: Approximately 18 million residents of the MMR who will benefit from reduced congestion, fewer traffic accidents, and improved air quality

#### (4) Project Components

- a) Civil and Building Works:
  - Total length approx. 17.51 km
  - 14 underground stations
- b) Trackwork and Procurement
- c) Electrical and Mechanical Works
- d) Signaling and Telecommunications Systems
- e) Automatic Fare Collection (AFC) System
- f) Installation of Ventilation Systems for Underground Sections

- g) Installation of Elevators and Escalators
- h) Rolling Stock Procurement (including data integration platform; 102 cars)
- i) Other Works:
  - Construction of a maintenance depot
  - Procurement of safety equipment for stations
- j) Consulting Services:
  - Design review
  - Tender assistance
  - Construction supervision

(5) Estimated Project Cost

Total project cost: JPY 403.571 million(ODA Loan portion under this tranche: JPY 92,400 million)

(6) Schedule (Cooperation Period)

- April 2026 – March 2034 (96 months, including defect liability period).
- The Project will be considered complete when all facilities are put into service (August 2032)

(7) Project Implementation Structure

- 1) Borrower: President of India
- 2) Guarantor: N/A
- 3) Executing Agency: Mumbai Metro Rail Corporation Limited (MMRC)
- 4) Operation and Maintenance System : MMRC (some functions will be outsourced to external entities)

(8) Collaboration and Sharing of Roles with Other Donors

1) Japan's Activity

The Mumbai Metro Line 3 (currently under construction with JICA ODA Loan) will connect with Line 11 at Chhatrapati Shivaji Maharaj Terminus (CSMT), generating synergies in transport demand and development along the corridor.

Further, the ODA Loan-financed Mumbai Trans-Harbour Link Project creates a direct connection between central Mumbai and Navi Mumbai, where new town development is underway. The western landing point of the sea bridge is located close to one of the stations of Line 11, enhancing network connectivity and contributing to broader economic development in the metropolitan region.

2) Other Donors' Activity

As stated in Section 2(3).

(9) Environmental and Social Consideration/Cross-Sectoral Issues/Gender Category

1) Environmental and Social Consideration

- ① Category: A
- ② Reason for Categorization: The Project falls into the railway sector under the JICA Guidelines for Environmental and Social Considerations (hereinafter referred to as JICA Environmental Guidelines) (promulgated in January 2022).
- ③ Environmental Permit: Although not required under Indian domestic law, an Environmental Impact Assessment (EIA) was prepared by MMRC in December 2024. A supplemental EIA, addressing JICA Guideline requirements, was approved and disclosed in November 2025.
- ④ Anti-Pollution Measures: During construction, mitigation measures will be taken regarding air quality, water quality, waste, soil contamination, noise, and vibration (e.g., water spraying, diaphragm walls, spoil management, noise barriers). During operation, measures include wastewater treatment, oil traps at depots, elastic sleepers, and regular maintenance.
- ⑤ Natural Environment: Although some nearby areas are Key Biodiversity Areas (KBA), the Project alignment is entirely underground and does not intersect with protected zones. Flora and fauna surveys identified no endangered species (except one non-wild vulnerable species). About 1,905 trees will be felled, but compensatory afforestation will be conducted in accordance with Maharashtra State law (2023), similar to Metro Line 3.
- ⑥ Social Environment: Land acquisition: Approx. 5 hectares of private land  
Involuntary resettlement: 692 households (2,362 people). Economic displacement: 102 households. Procedures will follow the supplemental SIA aligned with JICA Guidelines (January 2025), with completion expected by September 2027. As a result of MMRC providing an explanation of the compensation policy and contact information for future inquiries, no major objections were raised during stakeholder consultations. The Project area includes UNESCO World Heritage properties;
  - a) Indian Railways' CSMT station

b) Victorian Gothic and Art Deco Ensembles of Mumbai  
MMRC will follow advice from the Mumbai Heritage Conservation Committee (MHCC) and obtain necessary permissions.

- ⑦ Others/Monitoring: MMRC will monitor land acquisition and resettlement; contractors, under MMRC supervision, will monitor noise, vibration, soil, air quality, water quality, waste, and landscape/heritage considerations during construction. After opening, MMRC will conduct monitoring of noise, vibration, air quality, water quality, and other related factors.

## 2) Cross-Sectoral Issues

- a) Climate Change / Biodiversity: Modal shift induced by the Project is expected to reduce GHG emissions. In addition, in the country's Nationally Determined Contribution (NDC), which aims to achieve net-zero greenhouse gas emissions by 2070, the utilization of high-speed transportation systems is emphasized as one of the key mitigation strategies. This project is therefore considered to contribute to the country's NDC By 2034 (two years after completion), CO<sub>2</sub> reduction is estimated at approx. 49,311 t-CO<sub>2</sub>/year. Flood-resilience measures (e.g., elevated station entrances) will support climate adaptation.
- b) Disability Considerations: Stations and rolling stock will comply with Indian standards for universal access (elevators, accessible toilets, audible announcements, tactile paving, wheelchair space).
- c) HIV/AIDS and Infectious Disease Measures: Large civil packages will include contractor obligations for worker awareness programs.

## 3) Gender Category: ■ GI (S): Gender Informed (Significant)

During the preparatory survey, Focus Group Discussion with female users identified concerns regarding harassment and safety. To address this, women-only cars will be introduced, and gender-related indicators such as train-kilometers of women-only cars (thousand km / day) will be monitored.

## (10) Other Important Issues

MMRC has confirmed that it has a strong interest in promoting its own digital transformation (DX) and in building a transportation data integration platform centered on the Mumbai Metro, and has assigned DX personnel to this effort. As part of JICA's research initiative for promoting digital utilization and external co-creation (JICA DXLab), JICA is currently implementing a Proof of Concept

(PoC) from November 2024 to December 2026 (planned) to support MMRC in formulating its data strategy and to realize the above-mentioned transportation data integration platform and open data framework. Through this initiative, MMRC will be able to organize, efficiently collect, and centrally manage data in its operations, thereby facilitating smoother metro operations. Furthermore, equipment contributing to the planned data integration platform will be procured as part of the main ODA loan under the Project.

#### 4. Targeted Outcomes

##### (1) Quantitative Effects

###### 1) Outcomes (Operation and Effect Indicators)

Indicator	Baseline (Actual value in 2026)	Target (2034) (2 years after project completion]
Rolling Stock Availability Rate (%/year)*	-	89
Train-kilometers (thousand km/day)	-	31.50
Train-kilometers of Women-only Cars (thousand km/day)	-	5.25
Number of Train Services (one-way, per day)	-	158
Passenger Transport Volume (million passenger-km/day)	-	5.04
Fare Revenue (million INR/day)	-	15.1

\*Calculated as:(Annual operational days of procured rolling stock ÷ Number of trains procured × (Operating days – average inspection downtime)) × 100%

##### (2) Qualitative Effects

Mitigating automobile-related pollution in the Mumbai Metropolitan Region, reducing traffic congestion, addressing climate change, improving convenience by ensuring punctuality of travel, promoting the economic development of the Mumbai Metropolitan Region, and advancing the social participation of women and persons with disabilities.

##### (3) Internal Rate of Return

Based on the assumptions listed below, the economic internal rate of return (EIRR) for the Project is 13.67%,and the financial internal rate of return (FIRR) is 1.49%.

**【EIRR】**

Cost : Project cost, operation and maintenance (O&M) expenses, excluding taxes

Benefit : Travel time savings, vehicle operating cost savings, fuel cost reductions, fewer traffic accidents, reduced air pollution, reduced road maintenance costs

Project Life : 40years

**【FIRR】**

Cost : Project cost, O&M expenses (including taxes)

Benefit : Fare revenue + non-fare revenue (assumed at 10% of fare revenue)

Project Life : 40years

<b>5. External Factors and Risk Control</b>
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(1) Preconditions: None

(2) External Factors: None

<b>6. Lessons Learned from Past Projects</b>
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Ex-post evaluations of the Delhi Mass Rapid Transport System Project (and Phase 2), for which ODA Loans were provided and evaluations conducted in 2010 and 2015, identified the need to improve accessibility around metro stations. The evaluations noted that coordination with other transport operators—such as feeder buses—was vital to ensure convenient intermodal connectivity.

In line with these lessons, the present Project incorporates planned interchanges with bus routes operated by the Brihanmumbai Electric Supply and Transport (BEST) Connections with Mumbai Metro Line 4 (currently under construction).

Each station under Line 11 will also feature transport hubs and station plazas designed in accordance with Transit-Oriented Development (TOD) principles. Additionally, consulting services will support stakeholder coordination and capacity development to promote TOD.

<b>7. Evaluation Results</b>
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The Project is expected to contribute significantly to balanced economic development in the Mumbai Metropolitan Region by alleviating traffic congestion and reducing vehicular pollution. It aligns with India's development challenges and policies, and is fully consistent with Japan's and JICA's cooperation policies.

Furthermore, since this project is considered to contribute to SDG Goal 8

(Inclusive Economic Growth), Goal 9 (Building Resilient Infrastructure, Promoting Inclusive and Sustainable Industrialization, and Fostering Innovation), Goal 11 (Developing Inclusive Cities and Establishing Sustainable Transport Systems), and Goal 13 (Climate Action), the need to support the implementation of the Project is high..

## **8. Plan for Future Evaluation**

### (1) Indicators to be Used

As indicated in Sections 4.

### (2) Future Evaluation Schedule

Ex-post evaluation: 2 years after the Project completion

END

Appendix: Map of Mumbai Metro Line 11 Project (I)

Appendix

Map of Mumbai Metro Line 11 Project (I)

