ASIAN INFRASTRUCTURE INVESTMENT BANK

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Sep 26, 2019

Project Document
of the Asian Infrastructure Investment Bank

Sovereign-backed Financing

Republic of India
Mumbai Urban Transport Project 3

Currency Equivalents
(As at April 26, 2019)

Currency Unit – Indian Rupee (INR)
INR1.00 = USD0.01428
USD1.00 = INR70.00

Borrower's Fiscal year
April 1 – March 31

Abbreviations

AIIB (or the Bank)	Asian Infrastructure Investment Bank
AC	air-conditioned
CAAA	Controller of Aid Accounts and Audit
CMD	Chairman and Managing Director
CR	Central Railway
CTS	Comprehensive Transport Study
EA	environmental assessment
EIRR	economic internal rate of return
ENPV	economic net present value
ESMP	Environmental and Social Management Plan
ESP	Environmental and Social Policy
ESS	Environmental and Social Standards
FOB	foot over bridge
GC	general consultant
GDP	gross domestic product
GHG	greenhouse gas
GoI	Government of India
GoM	Government of Maharashtra
GRM	Grievance Redress Mechanism
GST	goods and services tax
INR	Indian Rupee
IR	Indian Railways
LARRA	Land Acquisition, Rehabilitation and Resettlement Act
MDB	multilateral development bank
MMR	Mumbai Metropolitan Region
MMRDA	Mumbai Metropolitan Region Development Authority
MoR	Ministry of Railways
MRVC	Mumbai Railway Vikas Corporation
MUTP	Mumbai Urban Transport Project
O&M	operation and maintenance
PIR	Procurement Instructions for Recipients
PIU	Project Implementation Unit
PPM	Project-affected People's Mechanism

RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
SIA	Social Impact Assessment
TSS	traction substations
WA	Withdrawal Applications
WR	Western Railway
VOC	vehicle operating cost

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1. Summary Sheet

Republic of India
Mumbai Urban Transport Project 3 (MUTP 3)

Project No.	000228
Borrower	Republic of India
Project Implementing Entity	Mumbai Railway Vikas Corporation (MRVC)
Sector/Subsector	Transport/Rail
Project Objective	The objective of the Project is to improve the network capacity, service quality and safety of Mumbai's suburban railway system.
Project Description	The planned activities under the proposed Project are: - Component A: Quadrupling of Virar-Dahanu Road Corridor (64 kilometers [km]). - Component B: New Suburban Railway Corridor between Panvel and Karjat (28 km). - Component C: Midsection Trespass Control. - Component D: Institutional Strengthening, Capacity Building and Technical Assistance.
Implementation Period	Start Date: Dec. 1, 2019 End Date: Nov. 30, 2024
Expected Loan Closing Date	May 31, 2025
Cost and Financing Plan	Project cost: USD997.00 million <u>Financing Plan</u>: AIIB Loan: USD500.00 million (50.1%) Ministry of Railway (MoR): USD187.00 million (18.8%) Government of Maharashtra (GoM): USD310.00 million (31.1%)
Size and Terms of AIIB Loan	USD500.00 million with a final maturity of 30 years, including a grace period of five years, at AIIB's standard interest rate for sovereign-backed variable spread loans.
Cofinancing (Size and Terms)	None
Environmental and Social Category	A
Risk (Low/Medium/High)	High
Conditions for Effectiveness	(i) MRVC's subsidiary loan agreement with the GoM, acceptable to AIIB, has been executed and is binding on the parties. (ii) The Project operation manual including financial management manual has been prepared by MRVC and approved by AIIB.
Key Covenants	(i) All counterpart funds required for the timely and effective implementation of the Project to be made available, including any shortfall of funds or cost overrun, through providing annual budget allocations and releasing applicable funds in a timely manner.

	(ii) Implementation of the Project in accordance with applicable design and technical specifications and construction norms satisfactory to AIIB, and performance of construction supervision, quality control and contract management in accordance with international standards. (iii) Implementation of the Project in accordance with the safeguard documents–Environmental Assessment (EA), Social Impact Assessment (SIA), Environmental and Social Management Plan (ESMP) and Resettlement Policy Framework (RPF).
Retroactive Financing (Loan % and dates)	All eligible expenditures under the Project, incurred in compliance with AIIB's procurement policies and guidelines and in respect of which payments were made not more than 12 months prior to the date of the loan agreement, up to an amount of USD100 million (20% of the amount of the Loan).
Policy Assurance	The Vice President, Policy and Strategy, confirms an overall assurance that AIIB is in compliance with the policies applicable to the Project.

President	Jin Liqun
Vice President, CIO	D.J. Pandian
Director General, IO I	Supee Teravaninthorn
Manager, IO I	Gregory Liu
Team Leader	Soon-Sik Lee, Senior Investment Operations Specialist
Team Members	Gregor Herda, Young Professional Jessana A Yanuario, Finance Officer Julius Thaler, Senior Counsel Jurminla Jurminla, Procurement Specialist (Operations) Konain Khan, Technical Consultant Mirza Nadia Bashnin, Young Professional Ning Wu, Financial Management Consultant Rupa Banerjee Pravin, Social Consultant Somnath Basu, Principal Social Development Specialist Vaideeswaran S, Environmental Consultant Xiao Zhang, Project Assistant Zhixi Zhu, Environmental Specialist

2. Project Description

A. Rationale

1. **Country and state priority.** India's growth in urban population over the past few decades has led to considerable strain on its transport infrastructure, leading to severe congestion, pollution and safety concerns. With a population of 22.8 million in 2011, Mumbai Metropolitan Region (MMR) is the most populous metropolitan region in India and is expected to reach 29.3 million by 2031 and 32.1 million by 2041.[1] This population growth represents the core driver behind Mumbai's urban expansion, compelling the state of Maharashtra to prioritize sound urban and infrastructure planning which balances economic activities, mobility as well as the optimization of environmental and social outcomes. The regional plan for MMR[2] proposes to augment public transit across the region and extend suburban rail connectivity to MMR's periphery. The proposed Project is consistent with the regional plan and the Comprehensive Transport Study (CTS) prepared by Mumbai Metropolitan Region Development Authority (MMRDA).

2. **Challenges of the Mumbai suburban railway network.** Around 86 percent of Mumbai commuters rely on public transport. However, supply has not kept pace with rising travel demand. The Mumbai suburban railway network, which carries three quarters of all motorized travel (78 percent of passenger km or eight million passengers per day) increasing at three percent annually, suffers from some of the most severe overcrowding in the world. User experience is further compromised by low amenity of carriages, substandard stations and station access, and serious safety concerns. Between 2002-2012, there were more than 36,152 fatalities (on average, 9.9 fatalities per day) and 36,688 injuries on the Mumbai suburban railway network. A key reason for accidents and deaths is trespassing at or between stations as well as overcrowding of both stations and train cars.

3. **Strategic fit for AIIB.** The Project aligns with the Bank's strategies as follows:

(i) Transport Sector Strategy: by providing necessary transport capacity or removing transport bottlenecks between major urban centers or key economic areas, and reducing carbon emissions by shifting passengers from high-carbon transport modes to a lower-carbon mode.
(ii) Sustainable Cities Strategy: by prioritizing investments in enhancing urban mobility.
(iii) Energy Sector Strategy: by promoting transport sector initiatives that improve carbon and energy efficiency outcomes.

4. The project is also aligned with the United Nation's Sustainable Development Goals, specifically Goal 9 on building resilient infrastructure and Goal 11 on sustainable cities and communities.

[1] MMRDA 2016. Draft Mumbai Metropolitan Regional Plan 2016-2036 (September 2016).
[2] See footnote 1.

5. **Value addition by AIIB.** The Bank's participation has already added value during Project preparation and will continue to do so during implementation in the following ways:

(i) AIIB's environmental and social safeguards specialists closely guided the implementing entity, to improve the EA study, RPF and prepare Resettlement Action Plans (RAPs) for complex land acquisition and entitlement issues.
(ii) AIIB supported the implementing entity in creating an effective supervision mechanism with the use of unmanned airborne vehicles. Continued support to the implementing entity's digitization efforts through the adoption of a bespoke project management software will further strengthen its project management capacity.
(iii) AIIB provided substantive inputs to enhance station design and maintenance, with gender responsiveness of station facilities to be monitored and evaluated through a pre-project baseline survey and dedicated gender related Project Objective Indicator.
(iv) AIIB will contribute to enhancing the implementing entity's technical, environmental and social safeguards and project management capacity through trainings and targeted technical assistance subcomponents identified by the Bank.
(v) AIIB will support private sector involvement in the suburban railway system, such as by exploring the rolling stock leasing market through technical assistance.

6. **Value addition to AIIB.** AIIB's participation in the Project expanding one of the busiest railway networks will enhance the Bank's expertise in the railway sector, particularly with regards to commuter rail. It will further strengthen the Bank's capacity to finance broad-based sustainable rail infrastructures that are in high demand in other areas of India and in the region.

7. **Lessons learned from previous phases of MUTP.** The Project has been built on lessons learned as well as outputs produced during MUTP 1 and 2. The implementation arrangement has been streamlined in accordance with lessons learned under MUTP 1, avoiding an overly ambitious involvement of multiple implementing agencies. In addition, the midsection trespass control (Project Component C) is a direct result of a 2014 study financed under MUTP 2, with its baseline data directly informing the Results Framework of the Project. More fundamentally, the implementation of previous phases of MUTP has allowed MRVC to build its own capacity in the comprehensive management of complex urban and suburban transport projects in the MMR. This expertise will mitigate a large number of implementation risks. Further details regarding lessons learned from previous phases are presented in Annex 2.

B. Project Objective and Expected Results

8. **Project objective.** The objective of the Project is to improve the network capacity, service quality and safety of Mumbai's suburban railway system.

9. **Expected results.** The Results Framework presented in Annex 1 will be used to monitor and evaluate the achievement of the proposed Project Objective Indicators. These include:

(i) Number of passengers carried (unit: number).

(ii) Journey time (unit: minute).
(iii) Reduction in accidents caused by trespassing in selected locations (unit: percentage).
(iv) Percentage of female passengers neutral toward, satisfied or very satisfied with station facilities and services (unit: percentage).

10. The Project's Intermediate Results Indicators will be measured periodically during Project implementation to ensure that the Project is progressing in accordance with the implementation plan. Detailed information on the indicators is available in Annex 1.

11. **Expected beneficiaries.** Along the Project corridors, the primary beneficiaries, of which approximately 22 percent are female, are existing rail passengers who will benefit from improved safety and quality of service. New rail passengers will benefit from faster, more reliable and higher quality transport services compared to road-based transport. There will be direct safety benefits to passengers and the public through introduction of trespass control measures. The secondary beneficiaries are residential and commercial establishments along the new corridors who will benefit from improved accessibility and connectivity as well as increasing economic opportunities.

C. Description and Components

12. **Overview**. The Project consists of four components as described below.[3] A detailed project description is presented in Annex 2.

13. **Component A: Quadrupling of Virar-Dahanu Road Corridor.** The existing double track of the 64 km corridor will be quadrupled, providing a dedicated double track for suburban railway services. This expansion will serve growing suburban areas and improve their connectivity with Mumbai. The existing double track will then exclusively serve long-distance passenger and freight services. Nine existing stations will be expanded with additional facilities.

14. **Component B: New Suburban Railway Corridor between Panvel and Karjat.** A 28-km suburban railway corridor will be constructed to cater to the demand of commuters in this rapidly urbanizing area of MMR while reducing the journey time between Mumbai CSTM and Karjat. Five existing stations will be redeveloped.

15. **Component C: Midsection Trespass Control.** The component will provide trespass control measures on 36 priority sections of existing lines, including track segregation and improved pedestrian connectivity through foot over bridges (FOBs) and underpasses, with the objective of reducing the number of pedestrian injuries and fatalities.

16. **Component D: Institutional Strengthening, Capacity Building and Technical Assistance.** The component will provide capacity building, training, and technical assistance to the implementing entity, including preparatory studies for the Project and future investments into

[3] The MUTP 3 project proposed by the Government of India (GoI) includes two other components, namely the procurement of rolling stock and a new suburban corridor link between Airoli and Kalwa. These expenditures will not be financed by AIIB but will instead be covered by the MoR, GoM and Indian Railway Finance Corporation.

the suburban rail network with the objective of enhancing suburban rail operations and strategic planning. Areas of focus include, but are not limited to, network expansion, station development, fleet migration to air-conditioned (AC) services, operational and maintenance capacity enhancement, resource-efficiency benchmarking, and rolling stock leasing arrangements.

D. Cost and Financing Plan

17. The Project is estimated to cost USD997 million. The indicative project cost and financing plan is presented in Table 1.

Table 1: Cost and Financing (USD million, rounded)

Item	Cost*	Financing					
		AIIB		MoR		GoM	
		Amount	Share	Amount	Share	Amount	Share
A. Quadrupling of Virar-Dahanu Road Corridor	511.00	278.00	54%	116.50	23%	116.50	23%
B. New Suburban Railway Corridor between Panvel and Karjat	397.00	182.00	46%	46.00	11.5%	169.00	42.5%
C. Midsection Trespass Control	74.50	28.50	38.2%	23.00	30.9%	23.00	30.9%
D. Institutional Strengthening, Capacity Building and Technical Assistance	8.75	5.75	66%	1.50	17%	1.50	17%
Front-end Fee and Commitment Fee	5.75	5.75	100%	0.00	0%	0.00	0%
Total Costs	**997.00**	**500.00**	**50.1%**	**187.00**	**18.8%**	**310.00**	**31.1%**

*Counterpart funds from MoR and GoM will finance taxes and duties.

18. **Financing terms.** Final maturity of 30 years, including a grace period of five years, at AIIB's standard interest rate for sovereign-backed variable spread loans.

E. Implementation Arrangements

19. **Implementation period.** The Project is expected to be implemented from December 2019 to November 2024.

20. **Implementation management.** MRVC[4] will be the Project implementing entity. MRVC has a well-defined organizational management structure, with clear roles and responsibilities. The Chairman and Managing Director (CMD) heads MRVC. To support the CMD, there are Directors for Projects; Finance; Technical; Resettlement and Rehabilitation; and Infrastructure and Commercial Development, each with their respective teams. A Chief Vigilance Officer assists the

[4] MRVC, a special purpose company set up in 1999, is responsible for managing capital investment of the suburban railway network. MRVC is owned in shares of 51:49 by the MoR and GoM. Both shareholders will provide the funding for capital investment. Once MRVC has completed implementation of infrastructure and/or procurement of rolling stock, the ownership, operation and maintenance of physical assets reverts to two divisions of Indian Railways: Western Railways (the Western Line) and Central Railways (the Central and Harbour Lines).

CMD in handling complaints from any source, including those related to allegations of corruption. External consultants will be deployed as required to assist MRVC to prepare engineering designs, supervise the construction, undertake independent audits and implement institutional strengthening initiatives.

21. **Project Implementation Units (PIUs).** Three PIUs have been set up and will be responsible for Project components A, B and C. A PIU is headed by a Chief Project Manager, will be assisted by a Deputy Chief Project Manager and staffed by adequate personnel. PIUs will be responsible for (i) planning project activities and supervision of works, (ii) coordination with other units and agencies, (iii) preparation of budget estimates, (iv) monitoring implementation progress and quality of works and (v) compliance of environmental and social safeguards requirements.

22. **General Consultant (GC).** A GC will be mobilized to provide high quality technical, environmental and social advice and project management services to MRVC. The GC will also provide day-to-day contract administration, procurement support, supervision of construction and environmental and social management activities, and quality assurance. The GC will ensure quality of workmanship and compliance with the contracts.

23. **Monitoring and evaluation.** The overall responsibility for monitoring Project results will be with MRVC, supported by the GC which will produce monthly progress reports. Data on Project Objective Indicators will be collected by MRVC.

24. **Reporting.** During Project implementation, a quarterly progress report will be prepared by MRVC and shared with the Bank. This report will form one of the main means of monitoring implementation of the Project. It will highlight the status of achievement of agreed targets for various monitoring indicators and detail the implementation progress of all aspects of the Project, including procurement status, physical progress against plans, disbursements, compliance of environmental and social safeguards requirements, key implementation issues and solutions, and updated implementation and procurement plans for the next 12 months. MRVC will submit a project completion report within six months after Project completion.

25. **AIIB's implementation support.** The Bank will conduct two field visits per year to monitor progress. Given the Project's complexity and large geographical coverage, AIIB may conduct more than two field visits as required, especially during the initial years. In addition to the biannual visits, AIIB will engage local consultants for technical, environmental and social aspects to carry out more frequent supervision of the design, construction, and environmental and social management activities on the ground. Quarterly remote supervision by both MRVC and the Bank will be supported by unmanned airborne vehicles. AIIB will carry out a midterm review between 24 and 30 months following the implementation start date.

26. **Procurement.** Procurement will be conducted in accordance with the provision of the Bank's Procurement Policy, January 2016, and Section II of Interim Operational Directives: Procurement Instructions for Recipients (PIR), June 2016. The procurement of works and goods 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 the Government of India (GoI)'s central e-tendering platform www.eprocure.gov.in. Any contracts estimated to cost more than USD40 million for works; USD3 million for goods and USD2 million for services will be subject to prior review by AIIB.

27. **Financial management.** The project financial management will follow MRVC's prevailing financial management practice. The Project's annual budget will be part of MRVC's annual budget with a project annual budget statement prepared and sent to the Bank for review within one month after budget approval. The approval and signing of contracts will follow MRVC's Schedule of Powers while payments to contractors will be approved by the deputy chief project manager of the PIU. The Project funds received, and expenditures incurred will be presented following the accrual basis. The unaudited project financial statements will be submitted to the Bank within 30 days after the end of each quarter. The audited annual project financial statements will be submitted to the Bank within 6 months after the end of each fiscal year. The audit of the project account will be carried out by the Comptroller and Auditor General of India.

28. **Fund flow and disbursement.** The proceeds from AIIB loan will be disbursed to the account of Controller of Aid Accounts & Audit (CAAA) of the Ministry of Finance, maintained with the central bank of India, through the reimbursement method. The funds will be further transferred by CAAA to the accounts of MoR and GoM and then to MRVC following the government's standard procedures for external aid. The counterpart funding from MoR and GoM will be provided to MRVC following the standard procedures for budget allocation.

29. All withdrawal applications (WA) will be prepared by MRVC and submitted to CAAA. CAAA will approve all WAs and submit applications to the Bank.

30. The disbursement arrangements have been finalized and documented in the disbursement letter. All disbursements will be made in accordance with the terms and conditions contained in the disbursement letter.

3. Project Assessment

A. Technical

31. **Selection of technology and engineering design.** Specifications for civil works including structures, tracks, traction power, signaling and telecommunications, as well as trespass control measures are based on Indian Railways (IR)[5] standards, which are service-proven and fit for purpose. Sufficient expertise in the chosen technologies is available in the market and with the implementing entity. Further design and construction details are presented in Annex 2.

32. **Resilience to climate change.** All infrastructure financed under the Project has been designed to withstand extreme temperatures as well as rain and flood events with a return period of 50 years. Impacts from extreme winds, earthquakes and corrosion have also been accounted for in the design. AIIB is of the view that these provisions are adequate for ensuring the system's resilience to potential climate change impacts during the service life of the assets.

33. **Station design for safety, convenience and accessibility.** The stations under Project Components A and B will incorporate gender informed design including sufficient female restrooms, waiting rooms for female passengers with adequate seating, as well as signage clearly marking the position of women's coaches. Station access will be improved with disabled-friendly access ramps and elevators, escalators and wide stairs to accommodate peak hour passenger flows, nonslippery walkways and clear signage. Station safety, especially for female passengers, will be enhanced through closed-circuit television cameras, sufficient lighting at platforms, FOBs and station approaches, and clearly visible displays for the emergency hotline. AIIB is of the view that these enhancements will ultimately increase women ridership, safety and comfort of travel.

34. **Project implementation period.** The Project is expected to be implemented from December 2019 to November 2024. Though MRVC plans to complete the Project by September 2023, the Bank anticipates a longer implementation period due to complexity of construction adjacent to the existing tracks under operation, interdepartmental coordination within MRVC and potentially unforeseen ground conditions for the underground and tunneling works. The GC will prepare and update a detailed implementation program to be regularly reviewed by the Bank during Project implementation.

35. **Quality and performance monitoring.** The Bank is satisfied with both MRVC's quality assurance plan and quality monitoring system as well as the quality requirements included in the civil tender documents. In addition, an independent third-party quality monitoring consultant will be engaged to ensure overall compliance with the supply contract requirements.

36. The performance of contractors will be measured through the contractor's weekly and monthly progress reports and regular management review meetings to ensure their progress meets the overall Project program. The reports will be verified by the GC and reviewed by PIUs.

[5] IR is India's national railway system operated by the MoR.

The monthly reports will include progress status, updated construction program, deployment of material, equipment and manpower. It will also include a recovery plan if any activity falls behind by more than one month.

37. **Commissioning, operation and maintenance (O&M).** After completion of the Project, all assets will be handed over to the Mumbai divisions of Central Railway (CR) and Western Railway (WR) under IR, as the sole operators. The Bank team assessed the O&M capacity of both CR and WR through discussions and a review of the operational plan for the proposed Project. Both organizations have experienced staff, proven systems and adequate facilities to operate and maintain the assets financed under the Project.

38. **Ridership forecast**. Ridership for the Virar-Dahanu Road corridor is driven by industrial growth and urban development in the area. It is expected that the expanded suburban rail services[6] will induce a modal shift from road to suburban rail. No metro line is being planned adjacent to the corridor. In addition, further densification of the road network along the corridor is limited due to its perforated coastal geography. Population growth in the area is assumed at two to four percent per year between 2021 and 2045. Daily ridership is estimated to grow at an average rate of 5.3 percent per year until 2035, before reducing to 4.9 percent until 2045. It is assumed that ridership will stay flat after 2045.

39. Ridership for Panvel-Karjat corridor was estimated based on a travel demand model for MMR updated in 2019.[7] The model took into consideration both demographics and transport projects planned in the MMR, particularly the effect of the Navi Mumbai Airport Influence Notified Area (NAINA). Between 2021 and 2045, population growth is estimated to reach between three to four percent per year within Panvel's area of influence, and one to 2.5 percent in Karjat and surrounding areas. These projections provide reasonable assurance that both Panvel and Karjat will exert a strong enough pull factor for the corridor to be viable. Most importantly, the corridor will shorten the travel distance between the city of Mumbai and Karjat by up to 30 minutes, in addition to inducing a modal shift from road to rail. Ridership projections for both corridors are shown in Table 2. These projections form the basis for the Project's main Project Objective Indicator. Average trip length, which strongly impacts fare box revenue, is expected to remain stable and has also been incorporated into the Results Framework.

Table 2: Daily Ridership Projection on Project Corridors

	2025	**2029**	**2035**	**2045**
Virar-Dahanu Road	467,368	574,354	782,459	1,265,768
Panvel-Karjat	238,000	300,000	425,000	571,000

[6] From presently 17 to 198 services per day in the first year of operation.
[7] The travel demand model was updated by IIT Bombay in 2019. The model, developed under CTS 2008, uses the CUBE Voyager platform. The CTS is the key urban transport planning document for MMRDA. An update of the CTS is expected to be completed in 2019.

B. Economic and Financial Analysis

40. **Costs and benefits**. A cost-benefit analysis was carried out to assess the economic viability of the Project on a with- and without-project basis over a period of 35 years. The economic benefits quantified are time savings for existing rail passengers and passengers shifted from other modes, savings in vehicle operating costs (VOCs) due to trips shifted from road-based modes, avoided negative externalities on health and the environment generated from road-based transport, avoided road maintenance costs, and avoided greenhouse gas (GHG) emissions. The Project costs comprise costs associated with civil works, rolling stock, electrical, signaling and telecommunications, as well as O&M. Financial costs are converted to economic costs at a standard conversion factor of 0.9.

41. **Economic analysis**. Under the base case scenario without social carbon price, the economic internal rate of return (EIRR) for the Virar-Dahanu Road corridor is 13.32 percent with an economic net present value (ENPV) at a 12 percent discount rate of USD65.36 million. The EIRR for the Panvel-Karjat corridor is 17.11 percent and ENPV of USD184.85 million. The EIRRs for both corridors are above the social discount rate of 12 percent and the Project is considered economically viable. The base case EIRR including GHG benefits is 13.44 and 17.20 percent for the Virar-Dahanu Road and Panvel-Karjat corridor, respectively. A sensitivity analysis was carried out to test the robustness of EIRR by varying the economic costs and benefits. Further details of the economic analysis, including the sensitivity analysis, are presented in Annex 3.

42. An economic analysis of Component C was also conducted. The quantified economic benefit includes avoided losses due to the disruption of train services. Economic costs include capital costs and O&M costs. Based on these assumptions, the EIRR for Component C is 16.5 percent. It is expected that the trespass control measures will reduce the annual average number of accidents, including both injuries and fatalities, along the identified locations by 70 percent.

43. **Financial analysis**. The financial analysis focused primarily on the operating ratio (operating expenses/total revenue) to determine whether revenues are sufficient to cover operating expenses incurred along the Project corridors. In the base case scenario with 75 percent AC train services provided along the Project corridor,[8] the total operating ratio (total operating expenses/total revenue) over 30 years will slightly exceed 100 percent for both corridors. Given CR and WR's plan for complete migration to AC services in the near future, it can be assumed that the base case will become more conservative in the outer years, leading to a positive total net operating cash flow. If AC train services can be provided at 100 percent, the total operating ratio will decrease to below 100 percent in both corridors. The analysis suggests that if fare escalation keeps pace with inflation and/or AC train services are fully run on the Project corridors, revenue will be adequate to cover O&M expenses. Otherwise, operating subsidies will be required. The results of the analysis are provided in more detail in Annex 3.

[8] The base case assumption is in line with MRVC's broad projection of the average share of AC train services to be provided in the Mumbai Suburban Rail system in the next five to seven years.

44. **Suburban rail as a network**. The economic and financial analysis carried out on the corridor-basis has some limitations in quantifying all positive externalities attributable to the Project, as it constitutes a section of a larger transport network with long-term benefits and possible spillover effects. AC coaches procured under MUTP 3 will be used interchangeably on other corridors based on real operating needs. Also, revenue collected along a corridor will not directly pay for operating expenses of that corridor but rather will be consolidated into IR's central budget. As such, the present Project-level analysis should be seen to complement a network-level perspective of the Project's expected benefits.

C. Fiduciary and Governance

45. **Procurement.** A dedicated procurement unit has been established within MRVC. The procurement unit, with qualified staff familiar with multilateral development banks (MDBs) procurement requirements and GC's assistance, will liaise closely with the other departments in tender process.

46. A project delivery strategy has been prepared by MRVC and agreed with the Bank. The project delivery strategy outlines procurement arrangements including the tendering and contracting strategies, capacity assessment, procurement risk and proposed mitigation measures, prior review thresholds.

47. MRVC has proposed a procurement approach that entails the use of IOCT and NCT for contracts based on cost estimate, risk and complexity. Both methods will follow a single-stage, two-envelop system without prequalification. MRVC will use an MDB's standard procurement document modified to suit the Bank's provisions and tendering requirements. A review of the procurement procedures proposed in the project delivery strategy has confirmed that AIIB's Core Procurement Principles and Standards are met as detailed in Annex 5.

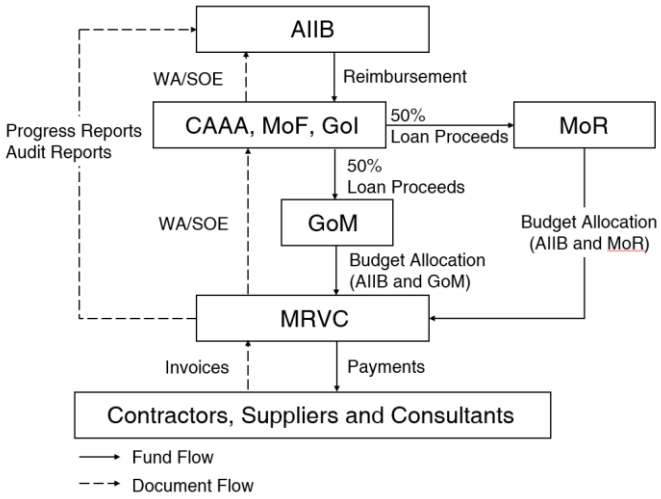
48. The Project, in line with other MDB-financed projects, will utilize GoI's e-tendering platform which will enhance efficiency, economy and transparency of the procurement process. AIIB deems it a proven, secure and robust system. Based on the outcome of the overall assessment of the procurement process, the procurement risk for the Project has been rated as medium.

49. **Retroactive financing.** All eligible expenditures under the Project, incurred in compliance with the Bank's procurement policy and PIR paragraph 8.2 and in respect of which payments were made not more than 12 months prior to the date of the loan agreement, up to an amount of USD100 million (20 percent of the amount of the Loan), may be financed retroactively.

50. **Financial management.** MRVC has experience working with MDBs and has established an efficient financial management system. MRVC is audited by different agencies regularly every year. Internal audits are performed quarterly, statutory audits are conducted twice a year, and an annual audit is carried out by the Comptroller and Auditor General of India. MRVC has been graded "excellent" as per the scoring criteria specified for corporate governance by the Department of Public Enterprises, GoI.

51. **Fund flow arrangements.** The GoI will make the proceeds of the loan available to MRVC in accordance with its standard arrangements for development assistance to the states of India. The subsidiary financing agreement will be entered into between MRVC and GoM to pass through the proceeds of the Bank loan. The fund flow is presented in Figure 1.

Figure 1: Fund Flow



52. **Disbursements.** The loan proceeds will not finance the taxes levied on the Project. Reimbursement will be the main disbursement method. The estimated disbursement plan is shown in Table 3.

Table 3: Indicative Disbursement Plan (USD million)

Year	2020	2021	2022	2023	2024	2025
Annual Disbursement	60	120	150	100	50	20
Cumulative Disbursement	60	180	330	430	480	500
% of Total	12%	36%	66%	86%	96%	100%

53. **Governance and Anti-corruption.** AIIB is committed to preventing fraud and corruption in the projects it finances. It places the highest priority on ensuring that projects it finances are implemented in strict compliance with AIIB's Policy on Prohibited Practices (2016). Implementation will be monitored regularly by AIIB staff. The Bank reserves the right to investigate, directly or indirectly through its agents, any alleged corrupt, fraudulent, collusive, coercive or obstructive practices, and misuse of resources and theft or coercive practices relating to the project and to take necessary measures to prevent and redress any issues in a timely manner, as appropriate. Detailed requirements and reference to AIIB's Policy on Prohibited Practices will be specified in the Loan Agreement and the project tender documents. AIIB will monitor the work related to tender preparation and evaluation under Bank financing.

54. **Institutional capacity.** MRVC has established a proven track record of implementing donor-funded programs. Nevertheless, the Project retains a significant degree of complexity. Following AIIB's recommendation, a senior environmental expert and senior social expert with MRVC and an interface manager with the GC will therefore be recruited to further strengthen MRVC's safeguards and coordination capacity. With these added positions, MRVC will have suitable capacity for Project implementation. Previously unexplored areas of engagement, such as leasing of rolling stock, gender responsive station design, resource-efficiency benchmarking, or technology-assisted quality control, will be supported through capacity development and technical assistance under Component D.

55. **Reporting and monitoring.** MRVC, with the support of the GC, has adequate capacity to perform the agreed monitoring, evaluation and reporting practices, to track progress toward Project outcomes and objectives and intermediate indicators. A gender-related indicator is included to ensure that the needs of female passengers are addressed. As this is one of the areas in which MRVC does not have extensive experience, AIIB will provide additional support to MRVC to monitor gender-related outcomes of the Project.

D. Environmental and Social

56. **Environmental and social policy (including standards) and categorization.** The Project has been prepared consistent with AIIB's Environmental and Social Policy (ESP), which includes the Environmental and Social Standards (ESSs) and Environmental and Social Exclusion List. Following environmental and social due diligence during Project preparation, it was determined that ESS 1 (Environmental and Social Assessment and Management) and ESS 2 (Involuntary Resettlement) are applicable to the Project. The anticipated environmental and social risks and impacts of the Project may be substantial due to land acquisition, potential physical displacements and resettlement of both land owners and encroachers, disturbance to communities and impacts on ecologically sensitive areas near the alignments. The Project has therefore been assigned to Category "A," in accordance with the ESP.

57. **Instruments.** As required by the ESP for a Category A project, an Environmental Assessment (EA) and Social Impact Assessment (SIA) have been prepared by MRVC for each of the three Project components, namely, 1) Virar-Dahanu section, 2) Panvel-Karjat section and 3) Midsection trespass control. The EA reports are accompanied by Environmental and Social Management Plans (ESMPs). A Resettlement Policy Framework (RPF) has been prepared to address issues of land acquisition, and physical and economic displacements, whether of a temporary or permanent nature. All EAs and SIAs, including local language translations of their executive summaries, have been disclosed by MRVC and AIIB.

58. **Environmental aspects**. The Virar-Dahanu Road corridor traverses a coastal ecosystem including the Dahanu Eco-sensitive Zone. However, it is anticipated that the incremental impact on the ecosystem will be limited, since the railway tracks will align with the existing double tracks separating the coastal and agri-urban ecosystems. A section of the Panvel-Karjat corridor will pass through the Merathan Eco-sensitive Zone. The ecological impact assessments have been

strengthened accordingly in the respective EA reports for Virar-Dahanu and Panvel-Karjat. Based on these assessments, the corresponding management plans have also been updated, especially regarding the cutting of mangroves and other trees. Noise impacts to receptors along the alignments are anticipated during both construction and operations. Thus, a noise study including more detailed baseline monitoring and noise modeling will be carried out by MRVC. The study will be reviewed by the AIIB team and finalized before the commencement of construction.

59. Other negative impacts of the Project during the construction phase will be temporary and reversible. These include solid waste disposal, water use and potential water contamination, air pollution, impacts on borrow areas and disturbance to communities and public utilities. The ESMPs delineate the mitigation measures for the identified risks and impacts. The ESMPs include the reporting mechanisms for the responsible agencies and the monitoring plans during the construction and postconstruction phases. The budget for implementing the ESMPs has also been developed. Occupational health and safety manuals, and management plans for labor camps, construction sites, traffic and solid waste, have been included in the ESMPs. These management plans provide guidance for site-specific ESMPs to be prepared by the contractors. The comprehensive ESMPs have been incorporated, along with other Environmental, Social, Health and Safety requirements, into the tender documents. MRVC will ensure the integration of Environmental, Social, Health and Safety requirements in future tender documents and supervise the preparation and implementation of site-specific ESMPs by contractors.

60. **Climate change risks and opportunities.** The major climate change risks identified in the Mumbai area include an increase in average annual temperature and extreme precipitation and floods. MRVC has integrated climate change considerations into the Project design to address the need for adaptation, including: 1) improving adaptability to seasonal thermal variations in the stations through the use of large open spaces for unrestricted air movement, cross-ventilation and ensuring that enclosed areas are well ventilated; 2) designing for better adaptability to rising sea level/high tide/heavy flooding through the use of higher plinth levels and check valves for sewer lines in flood-prone areas and the use of resilient materials that can get wet and then dry out with minimal damage; 3) using solar panels on station buildings and roofs to reduce the extensive use of grid-generated electricity supplied to the station for its operation and maintenance and 4) through better station roof design, providing for rainwater harvesting by channeling rainwater through gutters and pipes to either harvesting pits in the ground or to recharge groundwater.

61. During extreme climate-induced events, stormwater is the greatest threat to a railway track. In both the Virar-Dahanu and Panvel-Karjat sections, adequate design, including the elevation of the embankment levels, has been incorporated to ensure that the tracks are not adversely affected during extreme precipitation and flooding events.

62. **Social aspects.** Key social risks associated with the two corridors are related to land acquisition and displacements. The SIA studies considered a 15- to 30-meter (m) right of way. Land for the Project will be procured on the basis of the “willing buyer-willing seller” approach,

following the GoM policy[9] on direct purchase of land. Under this policy, land sellers are entitled to a flat 25 percent increase on land compensation determined by provisions in the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (LARRA 2013). The provisions of the GoM policy for direct purchase were compared with provisions in LARRA 2013 and found to be higher in value. If GoM fails to negotiate with the landowners on the basis of the GoM policy on direct purchase, the LARRA 2013 will be applied to acquire land.

63. In the Virar-Dahanu Road corridor, 48.69 hectares (ha) will be acquired, of which 33.22 ha are private land involving 278 landowners. In the process, 131 structures, of which 127 are privately owned, will be affected. In the Panvel-Karjat corridor, 65 ha will be acquired, of which 57 ha are private land involving 417 landowners. In this corridor, 84 private structures and 12 other structures will be affected. Hence, in total 695 landowners will be affected due to acquisition of 90.22 ha of private land for the two alignments. These are preliminary figures that will be finalized following the Joint Measurement[10] and legal search process, which will determine the actual measure of land to be affected and the total number of affected families. The micro plans for compensation for land acquisition will be prepared based on the updated figures on land acquisition.

64. The social impact of the Project is lower than that of MUTP 1 or 2, since the Project is located in suburban areas, compared to the densely populated locations of the previous phases. Nonetheless, all measures have been taken to ensure that the affected households are adequately consulted, and the provisions of the RPF are adequately disseminated. A plan for continued community engagement will be formulated for the construction and implementation phases.

65. The RPF contains an entitlement matrix indicating the compensation and benefits that will accrue to affected households or persons. The entitlement matrix contains a comparative analysis of the national legislation (LARRA 2013), the Government of Maharashtra's Policy for Direct Purchase of Land and provisions of AIIB's ESS2 on Involuntary Resettlement. This analysis indicates that the national legislation and the State's Policy are aligned with the requirements of ESS2. MRVC's decision to apply the State Government's Policy for Direct Purchase, which as mentioned above is higher than the national standard, is thus considered appropriate and aligned with Bank policy. The RPF has guidelines on preparation of the resettlement action plans (RAPs), institutional arrangements, process of implementation of the RAPs and provisions for establishment and operation of Grievance Redress Mechanisms (GRM).

66. **Gender aspects.** Over 1,000 female passengers were interviewed to assess their satisfaction with existing station facilities along both the Virar-Dahanu Road (85 percent of respondents) and Panvel- Karjat corridor (15 percent). The survey revealed low satisfaction with

[9] The Government Decision No. SANKIRNA-03/2015/Para. Kra. 34/A-2 dated May 12, 2015, Revenue & Forest Department, GoM.

[10] Joint Measurement is conducted by a team comprising of the client (MRVC) and the competent authority for land acquisition, i.e., the Office of the District Administration.

accessibility, safety and cleanliness. Challenges include crowded station approaches; slippery stairs, which are often too high or without proper railing; no escalators and only a few ramps; ladies compartments which are far from seating areas, washrooms, the exit from the station area, and/or the security office; lack of nursing rooms; and insufficient lighting. The respondents also indicated that basic facilities like drinking water and hygienic toilets were missing. Forty-six percent of surveyed female passengers reported having witnessed or experienced harassment while commuting.[11] Panic buttons are not currently available. Awareness of the Women Safety Helpline is low (26 percent) while its limited number of users found the helpline's service quality lacking. Overall, only 13.5 percent of respondents were satisfied or very satisfied with station facilities and services, while 45.5 percent were dissatisfied or very dissatisfied.

67. The survey results have been reflected in the design of station expansions under Project Components A and B, as outlined in paragraph 33 and Annex 2. It is expected that female passengers' satisfaction with station amenities is likely to increase due to these improvements. A Project Objective Indicator on the overall satisfaction of female passengers with station amenities and services has been included in the Results Framework.

68. **Stakeholder engagement, consultation and information disclosure.** Consultations were held in phases during the preparation of the EAs and following the completion of the draft SIA. Further consultations are planned after the completion of the Joint Measurement process in each of the affected settlements where land will be acquired. The draft EA and SIA along with the final RPF reports and their executive summaries in Marathi have been disclosed on MRVC and AIIB websites. Based on the comments during the subsequent public consultation, the EAs and SIAs will be finalized and disclosed.

69. **Project GRM and AIIB's Project-affected People's Mechanism (PPM).** The existing mechanisms for addressing project-related complaints have been reviewed. MRVC will establish a two-tier GRM for the Project in accordance with the requirements of AIIB's ESP, which will be operational soon after effectiveness. The GRM includes a procedure to receive and facilitate resolution of Project-affected peoples' concerns, complaints and grievances about application of the ESMPs and RPF. The GRM would not preempt legal access to the courts or the PPM for resolution of grievances. The GRM's two-tier operation is as follows: (a) a local-level grievance redress committee will receive and respond to grievances from Project-affected people and seek to resolve minor grievances; (b) if the grievance cannot be resolved at the field level, it will be referred to the Project-level grievance redress committee based in MRVC Headquarters, Mumbai. The GRM process is outlined in more detail in the EA reports and RPF.

70. The PPM was established by AIIB to provide an opportunity for an independent and impartial review of 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

[11] Fifty percent of respondents in this group reported harassment to have occurred on platforms while 75 percent reported harassment to have occurred on the train. Multiple responses were possible.

concerns cannot be addressed satisfactorily through the Project-level GRM or AIIB Management's processes.[12]

71. **Monitoring and supervision arrangements**. The Project's environmental and social issues will be monitored by the environmental and social professionals engaged by MRVC and the GC. A third-party monitoring agency will be engaged to monitor the implementation of the ESMPs and RAPs. The third-party agency, AIIB and its local consultants will monitor the Project on a quarterly basis for the first two years and on a biannual basis from the third year onward.

E. Risks and Mitigation Measures

72. AIIB assigns a High overall risk rating to the proposed Project, as summarized in Table 4. The Bank will monitor the implementation of the mitigation measures during Project implementation through the progress reports from MRVC, AIIB's consultants and supervision missions.

Table 4: Summary of Risks and Mitigating Measures

Risks	Assessment	Mitigating Measures
Environment and Social (E&S). Insufficient implementation of RAPs and ESMP.	High	(i) The RAP implementation will be monitored by an external monitoring consultant and implemented in accordance with a robust RPF. Community consultations will be continued during the construction and implementation phase. (ii) ESMP has been included in the bidding documents for contractors. Requirements on supervision of implementation of ESMP has been included in the bidding documents for the GC. (iii) Third-party monitoring and evaluation will be conducted periodically to ensure effective implementation of ESMP and RAPs and produce quarterly monitoring report for the first two years.
Implementation Capacity. Inadequate MRVC staffing for Project implementation, due to additional responsibility.	Medium	MRVC will maintain adequate staffing to oversee the Project along with GC's support. AIIB will closely monitor the MRVC's staffing plan and allocation to ensure adequate staffing capacity.
Technical. Delay of Project execution due to technical challenges, such as major structures and tunneling works.	High	GC's technical assistance and experts will be provided to enhance MRVC's implementation capacity, particularly with regards to major structures and tunneling works. Detailed geotechnical investigations and surveys were carried out.

[12] For information on the PPM, including how to make submissions, please visit https://www.aiib.org/en/policies-strategies/operational-policies/policy-on-the-project-affected-mechanism.html

Risks	Assessment	Mitigating Measures
Technical. Lack of coordination between engineering, land acquisition and procurement, leading to delays.	High	The GC will prepare an integrated work program with key milestones for engineering, land acquisition and procurement activities to properly sequence and coordinate the activities to avoid any delays in construction. CMD of MRVC will oversee interdepartmental coordination.
Implementation. Delay in handing over of existing lines by CR and WR for modifications and less availability of time for work on operational routes.	High	Regular coordination meetings between MRVC, CR and WR at working and coordination levels. The GC will closely monitor liaison with CR and WR for preparatory activities, handing over sites for modification works and effective usage of permitted work time.
Implementation. Delay in work due to monsoons and system vulnerability to flooding during monsoon seasons.	Medium	Monsoon seasons will be factored into work programs of contractors. Provisions to take care of flooding have been ensured in the design and specifications. The GC will ensure that these provisions are duly accounted during implementation.
Procurement. Delay caused by the complexity of the Project and large number of contracts.	Medium	The GC will deploy an adequate number of experts to enhance MRVC's procurement capacity.
Overall rating	High	

Annex 1: Results Monitoring Framework

Project Objective:	**To improve the network capacity, service quality and safety of Mumbai's suburban railway system.**									
Indicator Name	**Measurement Unit**	**Baseline (2019)**	**Cumulative Target Values**					**End Target (target year)**	**Frequency**	**Respon -sibility**
			YR1 2020	**YR2 2021**	**YR3 2022**	**YR4 2023**	**YR5 2024**			
Project Objective Indicators:										
1. Average daily ridership										
Virar-Dahanu Road	Number of passengers	95,100	N/A	N/A	N/A	N/A	N/A	467,000 (2025)	First year of operation	MRVC
Panvel-Karjat	Number of passengers	0	N/A	N/A	N/A	N/A	N/A	238,000 (2025)	First year of operation	MRVC
2. Reduced journey time										
Virar-Dahanu Road	Minutes	80	N/A	N/A	N/A	N/A	N/A	76 (2025)	First year of operation	MRVC
CSTM-Karjat[1]	Minutes	139	N/A	N/A	N/A	N/A	N/A	110 (2025)	First year of operation	MRVC
3. Reduction in accidents caused by trespassing in selected locations[2]	Percentage	0	N/A	N/A	N/A	N/A	70	70 (2024)	Annual	MRVC
4. Percentage of female passengers neutral toward, satisfied or very satisfied with station facilities and services	Percentage	54.8	N/A	N/A	N/A	N/A	N/A	80[3] (2025)	First year of operation	MRVC

[1] The new suburban service between Panvel and Karjat will provide a direct link between CSTM and Karjat, replacing the existing, significantly longer connection via Kalyan.
[2] Reduction will be assessed within one year of commissioning through a separate study by MRVC.
[3] Postconstruction survey will be carried out to assess female passengers' satisfaction with the station facilities.

Intermediate Results Indicators										
1. Construction of Quadrupling of Virar-Dahanu Road	Percentage	0	5	20	45	70	100	100 (2024)	Semi-annually	MRVC
2. Construction of Panvel – Karjat corridor	Percentage	0	5	20	45	70	100	100 (2024)	Semi-annually	MRVC
3. Construction of trespass control measures	Location	0	0	0	12	36	36	36 (2023)	Semi-annually	MRVC
4. Average trip length										MRVC
Virar-Dahanu Road	km	30	N/A	N/A	N/A	N/A	N/A	30 (2025)	First year of operation	MRVC
Panvel-Karjat	km	0	N/A	N/A	N/A	N/A	N/A	26 (2025)	First year of operation	MRVC

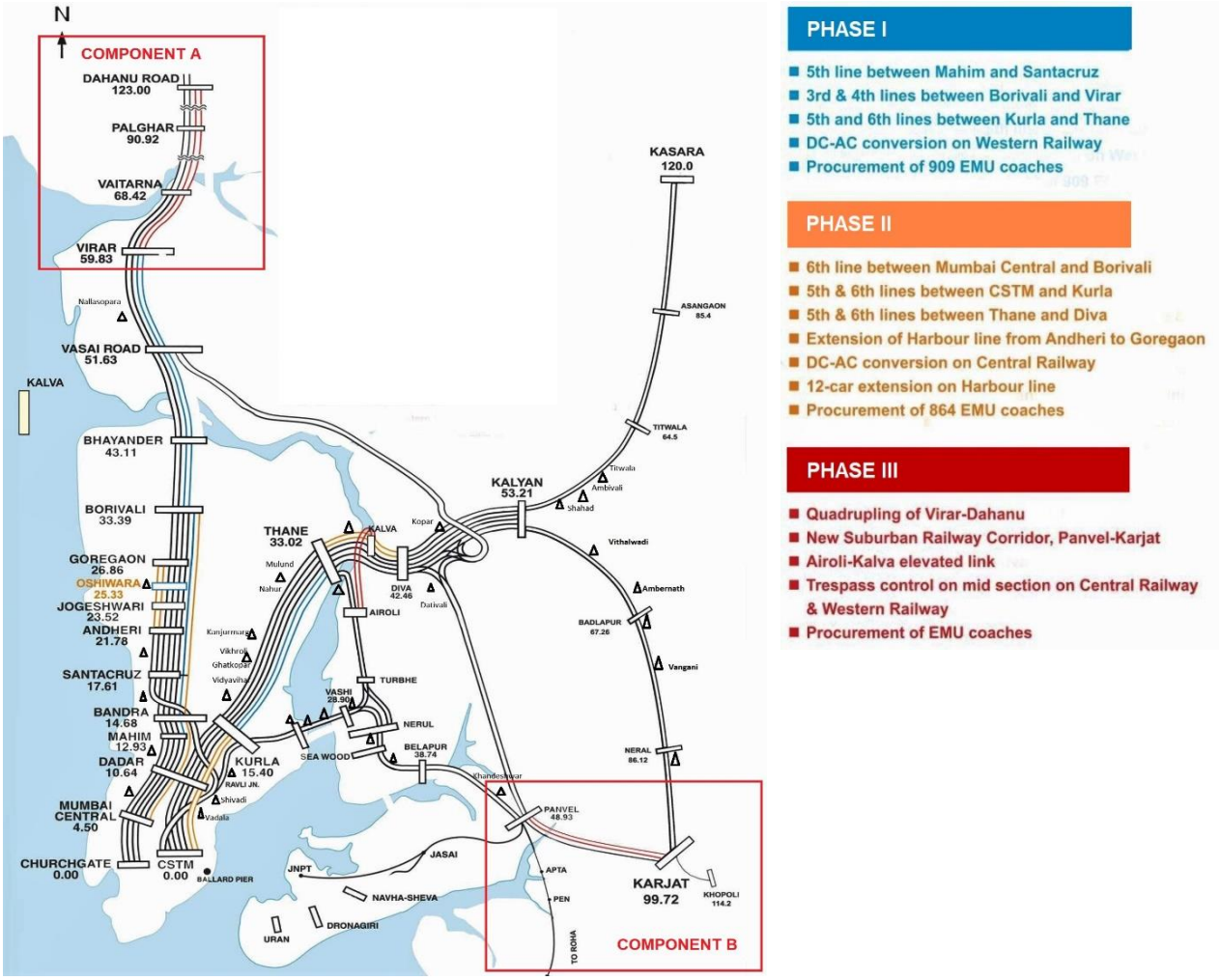
Annex 2: Detailed Project Description

A. Mumbai's Suburban Railway Network

1. The Mumbai suburban railway network, consisting of 376 route km and 119 stations, is the backbone of public transport in the MMR. The MMR is served by two of India's zonal railways, WR and CR, operating four main lines in total. WR operates the Western Line from Churchgate to Dahanu Road, whereas CR operates the Central Line (CSTM–Kasara and CSTM to Khopoli), the Harbour Line (CSTM to Panvel and CSTM to Andheri), and the Trans-Harbour Line (Thane to Vashi and Thane to Nerul).

2. MUTP 1 and 2 have significantly improved both network capacity and energy efficiency of Mumbai's suburban rail services. The Project will further expand capacity of the Western Line while extending the Harbour Line toward Karjat. The past and present expansion of the network, undertaken under MUTP is presented in Figure A2.1.

Figure A2.1: Mumbai Suburban Railway Network and MUTP Phasing (Source: MRVC)



3. **Lessons learned from previous phases of MUTP.** The Project has been built on numerous lessons learned from previous phases of MUTP. In particular, MUTP 1 implementation was prolonged due to large-scale resettlement, ambitious involvement of multiple implementing agencies, and institutional weakness of MRVC as a new implementing entity created for the suburban railway projects. Salient lessons incorporated into MUTP 3 planning include the following:

(i) All social impact and resettlement measures have been carefully designed at the field level to address the complex social risks and impacts from the wide range of Project sites. The measures have been designed from earlier experience with the previous phases. In addition, the Project is located in suburban areas, compared to the densely populated locations of the previous phases.

(ii) The Project focuses on the suburban railway network capacity and safety improvement, as opposed to targeting multiple transport mode improvements under the previous phase, which included both rail and road-based transport components and concerned five implementing agencies without an effective coordination mechanism. Therefore, an ambitious involvement of multiple implementing agencies will not be necessary for the Project, which will preempt previous coordination challenges.

(iii) MRVC, supported by the GC, will prepare an integrated work program to properly sequence and coordinate all the activities related to the Project. The lack of MRVC's internal coordination resulting in inadequate synchronization of resettlement with civil works was a challenge in the previous phases.

4. **Institutional reform.** In April 2017, IR adopted a new policy on its suburban rail systems. The policy proposed "an institutional structure for project implementation and operating the suburban rail system of a special purpose vehicle with equal equity participation from respective State Governments and Indian Railways." Such a reform would have implied a new governance model whereby MRVC or a new company, equally-owned by GoM and MoR, would become responsible and accountable for the service quality and financial sustainability of an identifiable, Mumbai-branded suburban rail system. However, these policy changes, institutional reforms, the establishment of a new local regulatory authority, and the creation of a new special purpose vehicle, require the political will and long-term commitment of both central and local governments, and a significant investment of time and resources. As sanctioned, GoI decoupled MUTP 3 and 3A from such a reform initiative, given the time and resource requirements at the local level and the urgent need for Mumbai suburban railway capacity enhancements. Nevertheless, both the central and state governments should continue deliberating on a plan forward.

B. Detailed Description of Project Components

5. **Component A: Quadrupling of Virar-Dahanu Road Corridor.** The existing two-track corridor between Virar and Dahanu Road (64 km) currently serves long-distance passenger and freight trains running between Mumbai and Ahmedabad/Delhi, as well as a few suburban and

shuttle train services. Under Component A, a third and fourth track will be added and dedicated to suburban rail services. The alignment will be at-grade and generally follow the route west of the existing tracks.

6. **Civil works.** Component A will require around 1.5 million cubic meters of earthwork for embankments and cuttings, and the construction of two important bridges, 16 major bridges and 67 minor bridges, one road-over-bridge and four road-under-bridges following IR's classification.[1]

7. **Stations and yards.** Under Component A, new platforms will be constructed for the existing nine stations. Existing station buildings at seven stations except Vaitarna and Saphale stations will be expanded. Major yard remodeling will be required at Virar station, and minor modifications to various degrees at other stations.

8. **Component B: New Suburban Railway Corridor between Panvel and Karjat.** Presently, a single 28-km track connects Panvel and Karjat serving mainly freight and a few long-distance passenger trains. Under this component, a new double line corridor will be constructed that will be used mainly for suburban services. The proposed alignment runs in parallel to the existing alignment.

9. **Civil works.** Component B will require around 1.45 million cubic meters of earthwork for embankments and cuttings, and the construction of six major bridges, 37 minor bridges, five road-over-bridges, 15 road-under-bridges and two flyovers. Three tunnels of at most 2,692 m in length will be constructed along the corridor. Two of these tunnels will run parallel to the existing tunnels.

10. **Stations and yards.** New platforms will be constructed for the existing five stations, with the same specifications as Component A. No major yard modifications are required for this corridor.

11. **Station improvement.** The stations along both corridors will feature improved circulating areas, pedestrian walkways, underpasses and traffic integration with other modes of transport. In addition, station design will ensure unobstructed movement of passengers through signages as per international standards, electronic train indicator boards, spacious areas in front of ticket offices, and waiting areas at deck level. To improve safety of passengers and accessibility of passengers with disabilities, the stations are planned to have anti-slip flooring, contrasting colors for stair risers, guard rails, proper lighting, warning strips at platform edges, ramps, elevators and use of CCTV cameras at strategic locations.

12. **Gender-responsive station design and approaches.** Recommendations to increase the security of women at station and FOB approaches have been considered in the design. These recommendations include unimpeded approach path with good visibility from all angles with adequate lighting with power backup, help points and dedicated three-digit helpline number responding to women in distress, integrated CCTV system with video analytics applications to

[1] See, for instance, IR Safety Circular No. 04 / 2010-11 for more information: https://cr.indianrailways.gov.in/uploads/files/1300261232620-Safety%20Circular%20no%204%20-2010%20eng.pdf

automatically alert the security authorities and security related signage. In addition, regular patrolling of the area by security personnel will enhance the security.

13. **Track.** The ballasted track will adopt a broad gauge of 1,676 mm with track center distance of 5300 mm, 20-ton maximum axle load capacity and a maximum speed of 160 kilometers per hour (kph). Head hardened UIC-60 rails will be installed per international practice. Turnouts on main line will be one in 12 with switch expansion joints.

14. **Power supply.** Both corridors will be fully integrated with the existing power supply system, running on 25 kV AC overhead traction with power fed from traction substations (TSS) located along the track. The design will be based on the standards approved by the Research Design and Standardization Organization (RDSO). The Virar-Dahanu Road corridor will be fed from three TSS and Panvel-Karjat corridor from two TSS, with power supplied by Maharashtra State Electricity Distribution Company Limited (MSEDCL) through their grid substations and line-in-line-out substations.

15. **Signaling and telecommunications.** The signaling system will be an automatic block working system with solid state interlocking, multiple aspect color light signals and train detection through track circuiting or digital axle counters. The system will also use an auxiliary warning system which is a form of cab signaling, which is compatible with the existing suburban lines. The system is engineered as per safety integrity level 4 standards and is a service-proven system. The telecommunication system will be a fiber optic system.

16. **Component C: Midsection Trespass Control.** This component will provide trespass control measures at 36 priority locations throughout the Mumbai suburban railway network identified by a 2014 MRVC study. The priority locations include CSTM to Kasara, Kalyan to Karjat, including Ambernath and Badlapur, Churchgate to Virar, and Sewri to Panvel. The control measures include track segregation, reinforced concrete wall, concrete pathway with fencing along tracks, FOBs and pedestrian underpasses. As described in paragraph 12 in this Annex, FOBs and pedestrian underpasses have been designed in consideration of easy access and security and safety measures.

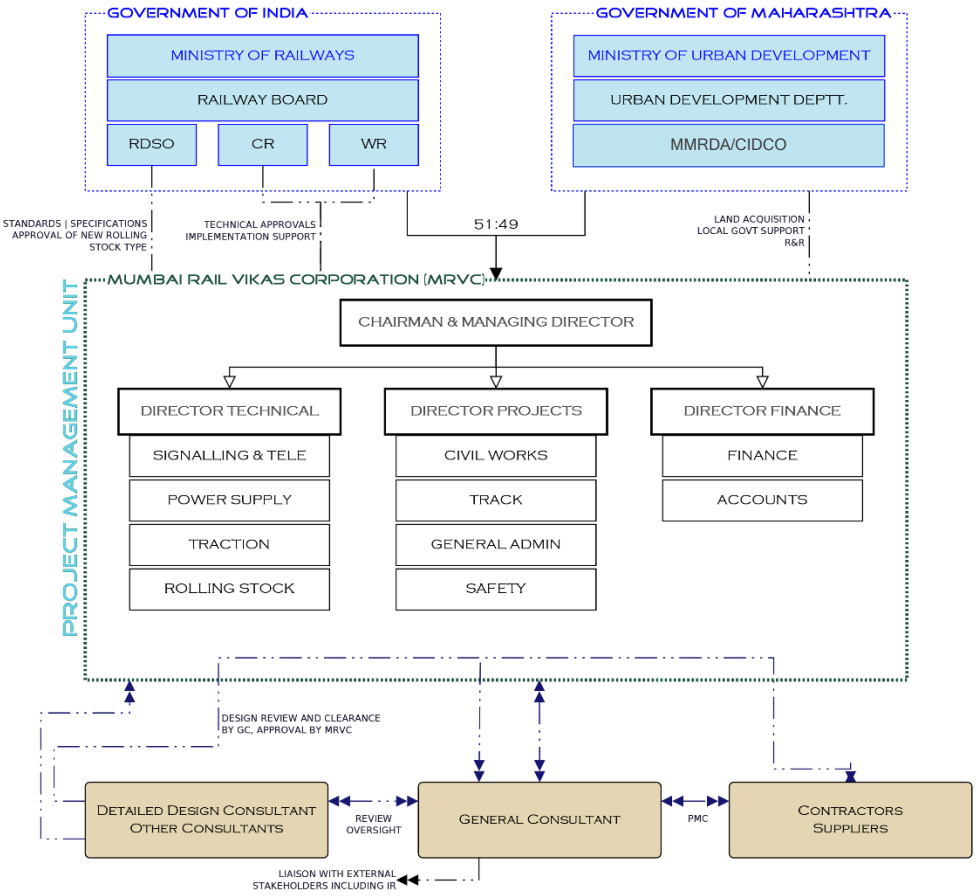
17. **Component D: Institutional Strengthening, Capacity Building and Technical Assistance.** This component will provide capacity building and technical assistance to MRVC through various activities consisting of four main areas:

(i) Increasing operational and maintenance capacity of the network as well as future network expansion, including feasibility and environmental and social studies.
(ii) Exploring the rolling stock leasing market and preparing the complete migration strategy to an AC-only fleet.
(iii) Business planning, strategic studies, project management capacity building and staff training for MRVC and IR.
(iv) Station development and/ or redevelopment.

C. Implementation arrangement and schedule

18. **Implementation arrangement.** MRVC will be the Project implementing entity overseeing three PIUs. Other agencies involved are CR and WR for approvals, O&M and asset ownership; the GoM for land acquisition and local government coordination; the GC for bid management, project management and reporting; detailed design consultants and other subject-specific consultants, as well as contractors and suppliers. The organizations involved and their relationship is shown in Figure A2.2.

Figure A2.2: Organogram of the Project



19. **Implementation schedule.** MRVC plans to complete the Project by September 2023, as presented in Figure A2.3. However, AIIB anticipates a longer implementation period due to complexity of construction adjacent to the existing tracks under operation, interdepartmental coordination within MRVC and potentially unforeseen ground conditions for the underground and tunneling works. It is expected that the Project will be complete by November 2024. The GC will prepare and update a detailed implementation program in consideration of technical challenges, monsoon season, and internal and external coordination, to be regularly reviewed by the Bank during Project implementation.

Figure A2.3: MRVC Project Implementation Schedule

Component		2020					2021				2022				2023				2024			
		Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
A Virar-Dahanu Road	**Civil Works**																					
	System																					
B Panvel-Karjat	**Civil Works**																					
	System																					
C Midsection Trespass Control																						
D Institutional Strengthening, Capacity Building and TA																						

D. O&M

20. **Operation.** The train operation plan is based on the projected Peak Hour Peak Direction Traffic (PHPDT), as summarized in Table A2.1. All trains will have 12 cars. The scheduled speed for Virar-Dahanu Road and Panvel-Karjat corridors are 55 kph and 45 kph, respectively.[2]

Table A2.1: Operational Plan for Virar-Dahanu Road Corridor and Panvel-Karjat Corridor

	Virar-Dahanu Road Corridor			Panvel-Karjat Corridor		
	2025	**2031**	**2041**	**2025**	**2031**	**2041**
Headway (minutes)	9	7	4	8	7	5
PHPDT	21,369	29,122	47,436	24,519	29,178	38,728
Trains per hour during peak hour	7	9	15	8	9	12
Train services per day	198	254	404	208	220	336

21. **Maintenance.** CR and WR, the operators of the Mumbai suburban railway network, will be responsible for maintenance of the railway assets. Maintenance responsibilities within CR and WR lie with the departments of civil, electrical, signaling and telecommunication, rolling stock and mechanical. Special maintenance is conducted prior to the monsoon season.

[2] The higher average speed for the Virar-Dahanu Road corridor is due to the longer distance between stations compared to Panvel-Karjat.

Annex 3: Economic and Financial Analysis

A. Economic Analysis

I. Introduction

1. A cost-benefit analysis was conducted to calculate the EIRR and ENPV of the proposed extension of suburban rail service in two corridors (Components A and B), and the installation of trespass control measures (Component C). The extension will expand the capacity of suburban rail services to serve growing demand in Mumbai suburban areas, encourage a modal shift from road to rail, improve the urban environment, reduce GHG emissions, and improve passenger safety.

II. Methodology and Assumptions

2. The analysis covers a period of 35 years, assuming construction and operation periods of five years and 30 years, respectively. The standard conversion factor of 0.9[1] generally used for infrastructure projects in India was used to convert financial costs to economic costs. A social discount rate of 12 percent was considered for the analysis. All costs and benefits are estimated in constant 2019 prices with an average exchange rate of INR70/USD.

3. The costs and benefits are incremental. In the without-Project scenario, it is assumed limited suburban services will continue to run on the Virar-Dahanu Road corridor but will not be adequate to serve the growing demand in the area, as projected by the MMR Plan. Road vehicle speeds will range between 15 kph and 30 kph and decrease further. Along the Panvel-Karjat corridor, congestion will increase as passengers will mostly rely on road-based transport. The existing suburban rail passengers will continue to rely on the longer CSTM-Kalyan-Karjat connection.[2]

III. Estimating Economic Benefits

4. **Savings in passenger travel time***.* Savings in travel time for existing rail passengers and passengers shifted from other modes are one of the main benefits of the Project. For Virar-Dahanu Road, savings in travel time for existing rail passengers will be due to increasing train speeds from 45 kph to 55 kph. For the Panvel-Karjat corridor, the new suburban service will provide a direct link between CSTM and Karjat, reducing travel time by about 30 minutes. For passengers shifting from road-based modes, the suburban rail will lead to reduction in travel time given lower average speeds of buses (15 kph), cars and two-wheelers (30 kph). The modal shift is estimated to account for 35 percent of daily passengers for Virar-Dahanu Road and 45 percent for Panvel-Karjat.[3]

[1] Comprehensive Transportation Study for Mumbai Metropolitan Region 2008.
[2] Presently, the existing single track serves mainly freight and a few long-distance passenger trains.
[3] For Virar-Dahanu Road, 28 percent of total ridership is estimated to come from passengers shifting from buses, and 3.5 percent each from cars and two-wheelers, respectively. For Panvel-Karjat, passengers shifting from buses, cars and two-wheelers to suburban rail are estimated to account for 36, 4.5 and 4.5 percent of ridership, respectively.

5. For Virar-Dahanu Road corridor, the average trip length is assumed to be 30 km based on the existing trip pattern. For Panvel-Karjat, the average trip length is assumed to be 28 km given the relatively short distance of the corridor and over 95 percent of passengers expected to travel the whole route.[4] The value of time is based on the CTS 2008 study and adjusted to 2019 price using the Reserve Bank of India's Customer Price Index (CPI).[5]

6. **Savings in vehicle operating cost (VOC).** With the shift from road to rail, the Project will result in savings in VOCs. The avoided vehicle-km for buses, cars and two wheelers are calculated by multiplying the number of passenger trips shifted, the vehicle load factor[6] and average trip length. The VOC per vehicle-km is also based on CTS 2008 data and has been similarly adjusted to 2019 prices.[7]

7. **Savings in road maintenance cost.** The shift from road-based modes will also result in avoided budget that needs to be spent on road maintenance as well as investment in new roads. To be conservative, only road maintenance cost is quantified at INR0.5 per vehicle-km.

8. **Avoidance of non-GHG-related negative externalities.** The shift from road to rail will result in a reduction in several negative externalities generated from urban road transport including congestion, air pollution, accidents and noise.[8]

9. **Savings in GHG emissions.** The Project is expected to result in net GHG emissions reduction due to the shift from road to rail. Road transport relies on high carbon intensity fuels while the suburban rail will apply the less carbon intensive energy mix of electricity. The emissions factor for suburban rail adopted in the analysis is 7.976 gCO_2 per passenger-km,[9] compared to 64.9 gCO_2 for cars, 20.38 gCO_2 for two-wheelers, and 11.74 gCO_2 for buses.[10]

10. GHG emissions in the with- and without-Project scenarios were calculated. The net GHG emission reduction over the Project life is estimated at 1.05 million tons of CO_2 for Virar-Dahanu Road corridor and 0.61 million tons of CO_2 for Panvel-Karjat corridor, totaling 1.66 million tons of CO_2. Both a low and high social price of carbon (starting at USD44 and 87 per ton of CO_2 in 2024, respectively) were applied to estimate the value of total GHG emissions reduction. Both carbon prices increase at a rate of 2.25 percent per year.[11]

[4] Based on boarding/alighting information at each station in the ridership study.
[5] INR37.1 per hour for buses; INR56.4 per hour for rail; INR108.4 per hour for cars; and INR69.8 for two-wheelers. Value of time is expected to grow in real terms in line with income growth assumed at three percent per year.
[6] Based on CTS 2008: 57 passengers for buses, 2.3 for cars, and 1.4 passengers for two-wheelers.
[7] As per Indian Road Congress (2009) recommendation on Economic Evaluation of Highway Projects in India. The VOCs used in the analysis are: INR28.89 per vehicle-km for buses; INR5.40 for cars; and INR2.11 for two wheelers.
[8] Sen, Tiwari and Upadhyay (2010), Estimating Marginal External Costs of Transport in Delhi. The combined marginal cost of negative externalities per vehicle km as an average of peak and off-peak adopted here are: INR28.99 for buses; INR4.5 for cars; and INR2.3 for two-wheeler (All at 2010 prices and subsequently adjusted to 2019 prices).
[9] WRI India GHG Program (2015), India Specific Rail Transport Emission Factors for Passenger Travel and Material Transport.
[10] Prabhu and Pai (2011) Buses as Low Carbon Mobility Solutions for Urban India.
[11] According to the World Bank Guidance Note for Shadow Price of Carbon in Economic Analysis.

11. **Nonquantitative benefits.** In addition to the quantifiable Project benefits considered in the economic analysis, the expected nonquantitative benefits of the Project include: (i) economic stimulation in the microregion; (ii) facilitation of better planning and upgrading of the Project area and (iii) enhanced safety and security, in particular for women passengers.

IV. Estimating Economic Costs

12. **Capital costs.** Capital costs include land cost, civil, electrical, signaling and telecommunication works, rolling stock, and project management. Taxes, price contingencies and financing charges are excluded.

13. **O&M costs.** The O&M costs were estimated according to the train operation plan of each corridor. The number of services will gradually increase in line with the ridership estimates. O&M unit cost per train operating-km was derived from IR's O&M expenditures. The O&M cost of AC coaches is assumed to be 10 percent higher than for non-AC coaches based on IR's experience.

V. Summary of Results and Sensitivity Analysis

14. The base case without social carbon price, the EIRRs and ENPVs at a 12 percent discount rate for each corridor is as follows:

- Virar-Dahanu Road Corridor: EIRR of 13.32 percent and ENPV of USD65.36 million.
- Panvel-Karjat Corridor: EIRR of 17.11 percent and ENPV of USD184.85 million.

15. The EIRRs for both corridors are above the social discount rate of 12 percent. The investment is thus economically justified. The base case EIRR with the lower bound social carbon benefits is 13.44 and 17.20 percent for Virar-Dahanu Road and Panvel-Karjat corridor, respectively. A sensitivity analysis was conducted by varying the Project costs and benefits. The analysis suggests that reduction in ridership and delay in commencement of operation will have the highest impact. The results of the sensitivity analysis are shown in Table A3.1 and the detailed cash flows of the EIRR calculations are shown in Table A3.2.

Table A3.1: Economic Analysis Results and Sensitivity Analysis

	Scenarios	EIRR (%) Virar-Dahanu Road	EIRR (%) Panvel-Karjat
1	Base case	13.32	17.11
1.1	Base case with Social Carbon Price (Low)	13.44	17.20
1.2	Base case with Social Carbon Price (High)	13.55	17.29
2	Ridership decline by 20%	10.12	14.20
3	Construction cost increases by 20%	11.88	15.35
4	O&M cost increases by 20%	12.02	16.41
5	Delay in commencement of operation by 2 years	11.38	14.41
6	Worst Case Scenario (4+5+6)	7.26	10.25

Table A3.2: EIRR Calculations for Virar-Dahanu Road corridor and Panvel-Karjat corridor (USD million)

Year	Virar Dahanu Road										Panvel-Karjat									
	Cost			Benefit							Cost			Benefit						
	Capital Cost	O&M Expenditures	Total Costs	Savings in Value of Time	Savings in VOC	Savings on Avoided Cost of Externalities	Savings on Road Maintenance	Savings in GHG Emissions - Low	Total Savings	Net Cash Flow	Capital Cost	O&M Expenditures	Total Costs	Savings in Value of Time	Savings in VOC	Savings on Avoided Cost of Externalities	Savings on Road Maintenance	Savings in GHG Emissions - Low	Total Savings	Net Cash Flow
2019 - 20	(47.1)	-	(47.1)	-	-	-	-	-	-	(47.1)	(38.0)	-	(38.0)	-	-	-	-	-	-	(38.0)
2020 - 21	(94.9)	-	(94.9)	-	-	-	-	-	-	(94.9)	(75.0)	-	(75.0)	-	-	-	-	-	-	(75.0)
2021 - 22	(58.3)	-	(58.3)	-	-	-	-	-	-	(58.3)	(64.1)	-	(64.1)	-	-	-	-	-	-	(64.1)
2022 - 23	(148.3)	-	(148.3)	-	-	-	-	-	-	(148.3)	(81.5)	-	(81.5)	-	-	-	-	-	-	(81.5)
2023 - 24	(190.8)	-	(190.8)	-	-	-	-	-	-	(190.8)	(86.9)	-	(86.9)	-	-	-	-	-	-	(86.9)
2024 - 25	-	(42.9)	(42.9)	52.6	18.3	17.7	1.5	0.1	90.2	47.3	-	(20.9)	(20.9)	43.5	11.2	10.8	0.9	0.1	66.5	45.6
2025 - 26	-	(59.1)	(59.1)	57.1	19.2	18.6	1.6	0.1	96.6	37.6	-	(27.1)	(27.1)	47.5	11.8	11.5	1.0	0.1	71.8	44.7
2026 - 27	-	(59.1)	(59.1)	61.9	20.3	19.6	1.7	0.1	103.6	44.5	-	(27.1)	(27.1)	51.9	12.5	12.1	1.0	0.1	77.6	50.5
2027 - 28	-	(59.1)	(59.1)	67.1	21.3	20.7	1.7	0.1	111.0	51.9	-	(27.1)	(27.1)	56.6	13.3	12.9	1.1	0.1	83.9	56.8
2028 - 29	-	(59.1)	(59.1)	72.8	22.5	21.8	1.8	0.1	119.0	59.9	-	(27.1)	(27.1)	61.8	14.1	13.6	1.1	0.1	90.7	63.6
2029 - 30	-	(59.1)	(59.1)	78.9	23.7	22.9	1.9	0.1	127.6	68.5	-	(27.1)	(27.1)	67.4	14.9	14.5	1.2	0.1	98.1	71.0
2030 - 31	-	(75.8)	(75.8)	85.6	24.9	24.1	2.0	0.2	136.8	61.1	-	(28.7)	(28.7)	73.6	15.8	15.3	1.3	0.1	106.1	77.4
2031 - 32	-	(75.8)	(75.8)	92.8	26.2	25.4	2.1	0.2	146.8	71.0	-	(28.7)	(28.7)	80.3	16.8	16.2	1.4	0.1	114.8	86.1
2032 - 33	-	(75.8)	(75.8)	100.7	27.6	26.7	2.3	0.2	157.5	81.7	-	(28.7)	(28.7)	87.7	17.8	17.2	1.4	0.1	124.2	95.5
2033 - 34	-	(75.8)	(75.8)	109.2	29.1	28.2	2.4	0.2	169.0	93.2	-	(28.7)	(28.7)	95.7	18.8	18.2	1.5	0.1	134.4	105.7
2034 - 35	-	(75.8)	(75.8)	118.4	30.6	29.6	2.5	0.2	181.4	105.6	-	(28.7)	(28.7)	104.5	20.0	19.3	1.6	0.1	145.5	116.8
2035 - 36	-	(75.8)	(75.8)	128.0	32.1	31.1	2.6	0.2	194.0	118.3	-	(28.7)	(28.7)	110.8	20.5	19.9	1.7	0.1	153.1	124.4
2036 - 37	-	(75.8)	(75.8)	138.3	33.7	32.6	2.7	0.2	207.6	131.9	-	(28.7)	(28.7)	117.6	21.2	20.5	1.7	0.2	161.1	132.4
2037 - 38	-	(75.8)	(75.8)	149.5	35.4	34.3	2.9	0.3	222.2	146.5	-	(28.7)	(28.7)	124.7	21.8	21.1	1.8	0.2	169.6	140.9
2038 - 39	-	(75.8)	(75.8)	161.5	37.1	35.9	3.0	0.3	237.9	162.1	-	(28.7)	(28.7)	132.3	22.5	21.7	1.8	0.2	178.5	149.8
2039 - 40	-	(75.8)	(75.8)	174.6	38.9	37.7	3.2	0.3	254.7	178.9	-	(28.7)	(28.7)	140.4	23.1	22.4	1.9	0.2	188.0	159.3
2040 - 41	-	(75.8)	(75.8)	188.7	40.8	39.6	3.3	0.3	272.8	197.0	-	(43.8)	(43.8)	148.9	23.8	23.1	1.9	0.2	197.9	154.1
2041 - 42	-	(120.5)	(120.5)	203.9	42.9	41.5	3.5	0.3	292.1	171.6	-	(43.8)	(43.8)	158.0	24.5	23.8	2.0	0.2	208.5	164.6
2042 - 43	-	(120.5)	(120.5)	220.4	45.0	43.6	3.7	0.4	313.0	192.5	-	(43.8)	(43.8)	167.6	25.3	24.5	2.1	0.2	219.6	175.8
2043 - 44	-	(120.5)	(120.5)	238.2	47.2	45.7	3.8	0.4	335.3	214.8	-	(43.8)	(43.8)	177.8	26.0	25.2	2.1	0.2	231.4	187.5
2044 - 45	-	(120.5)	(120.5)	257.4	49.5	48.0	4.0	0.4	359.4	238.9	-	(43.8)	(43.8)	188.6	26.8	26.0	2.2	0.2	243.8	200.0
2045 - 46	-	(120.5)	(120.5)	265.1	49.5	48.0	4.0	0.4	367.1	246.6	-	(43.8)	(43.8)	194.3	26.8	26.0	2.2	0.2	249.5	205.6
2046 - 47	-	(120.5)	(120.5)	273.1	49.5	48.0	4.0	0.4	375.1	254.6	-	(43.8)	(43.8)	200.1	26.8	26.0	2.2	0.2	255.3	211.5
2047 - 48	-	(120.5)	(120.5)	281.3	49.5	48.0	4.0	0.5	383.3	262.8	-	(43.8)	(43.8)	206.1	26.8	26.0	2.2	0.2	261.3	217.5
2048 - 49	-	(120.5)	(120.5)	289.7	49.5	48.0	4.0	0.5	391.7	271.2	-	(43.8)	(43.8)	212.3	26.8	26.0	2.2	0.3	267.5	223.7
2049 - 50	-	(120.5)	(120.5)	298.4	49.5	48.0	4.0	0.5	400.4	279.9	-	(43.8)	(43.8)	218.7	26.8	26.0	2.2	0.3	273.9	230.0
2050 - 51	-	(120.5)	(120.5)	307.4	49.5	48.0	4.0	0.5	409.4	288.9	-	(43.8)	(43.8)	225.2	26.8	26.0	2.2	0.3	280.5	236.6
2051 - 52	-	(120.5)	(120.5)	316.6	49.5	48.0	4.0	0.5	418.6	298.1	-	(43.8)	(43.8)	232.0	26.8	26.0	2.2	0.3	287.2	243.4
2052 - 53	-	(120.5)	(120.5)	326.1	49.5	48.0	4.0	0.5	428.1	307.6	-	(43.8)	(43.8)	239.0	26.8	26.0	2.2	0.3	294.2	250.3
2053 - 54	-	(120.5)	(120.5)	335.9	49.5	48.0	4.0	0.5	437.9	317.4	-	(43.8)	(43.8)	246.1	26.8	26.0	2.2	0.3	301.3	257.5
Total	**(539.3)**	**(2,738.0)**	**(3,277.3)**	**5,451.3**	**1,111.9**	**1,077.0**	**90.7**	**9.0**	**7,740.0**	**4,462.7**	**(345.4)**	**(1,057.5)**	**(1,402.9)**	**4,211.2**	**643.7**	**623.5**	**52.5**	**5.2**	**5,536.1**	**4,133.2**
EIRR										**13.44%**										**17.20%**

VI. Trespass Control

16. Economic analysis of the trespass control component (Component C) was conducted. Economic benefits quantified are avoided losses to IR due to disruption in train services from trespassing. According to operation statistics, it was estimated that about 2.2 percent of train services will experience disruption due to trespassing. Average loss of time for each disruption is approximately 10 minutes. Each minute of service disruption will cost IR approximately INR7,000. The capital cost of trespass control is USD79 million which was converted to economic cost. The O&M cost is assumed to be one percent of the capital cost. The economic benefits of avoided fatalities and accidents are not quantified due to complexity in valuing human life. Based on the assumptions, the EIRR for trespass component is 16.5 percent.

B. Financial Analysis

I. Methodology and Assumptions

17. The financial analysis was conducted using current prices, covering a period of 35 years. The analysis focused primarily on the operating ratio to determine whether revenues are sufficient to cover operating expenses incurred along the Project corridors. Loan repayment will be fully covered through a dedicated surcharge levied on top of all base fare revenue in the network.[1]

II. Revenue

18. **Fare revenue.** The main source of revenue for the suburban rail is fare revenue. The fare revenue structure comprises single and season tickets (monthly and quarterly), as well as first- and second-class tickets.[2] In addition, AC train services charging a higher fare are also being introduced. The fare system is distance-based, starting from INR5 (USD0.07) for a single journey ticket to INR100 (USD1.43) for monthly season tickets. The most popular ticket type is the monthly season ticket which is highly affordable for frequent commuters.

19. Due to its political complexity and affordability for users, fare escalation has historically fallen well below inflation, averaging around two percent per year. The analysis adopted the same rate of increase. Based on the composition of trip distributions for first and second class as well as season and single tickets, the fare structure for the average trip distance of 28-30 km is provided in Table A3.3.[3]

[1] The average surcharge collected for 2017-2018 totaled 17 percent of revenue. From 2020-21 average surcharge is expected to reach 25 percent for non-AC (first and second class) and 12 percent on AC services.
[2] Monthly season tickets are estimated to be used on average of 50 trips per ticket.
[3] Average fare for AC assumes 50 trips per month, while average fare for non-AC assumes a split between first and second class tickets of 1:4. Among first class tickets, the split between single and season tickets is 5:95. Among second class tickets, the split between single and season tickets is 1:3.

Table A3.3: Fare Structure for the Average Trip Distance of 28-30 km in 2019 (INR)

	AC	Non-AC – 1st Class	Non-AC – 2nd Class
Average fare per trip	35.50	17.40	4.89

20. **Nonfare revenue.** Other sources of revenue for the Project are nonfare revenues including advertising, rental fees from spaces in the station area, parking, and others. Currently, nonfare revenues account for about five percent of fare revenues.[4] As the Project corridors are located in newly developed suburban areas, the analysis assumed nonfare revenues at three percent of fare revenues in the early years and increasing to five percent in the outer years.

21. **Additional revenue.** There will be some excess capacity from AC coaches procured under MUTP 3 which will not be fully utilized on the Project corridors. This excess capacity will be utilized to provide AC train services in other corridors of the network to optimize asset use. Such additional revenue is also included as part of the revenue stream. The revenue per AC coach is estimated at INR30 Crore (USD4.3 million) per year based on actual earnings data from an AC train introduced in December 2017.

III. Project Costs

22. **Capital Costs.** Capital costs include civil, electrical, signaling, and telecommunication works, rolling stock, environmental management and project management, taxes and contingencies. Investment costs are completion costs which have been adjusted for inflation during the five-year construction period.

23. **O&M costs.** The O&M costs were estimated based on O&M cost per train operating-km derived from IR's actual O&M expenditures. O&M costs are assumed to increase at 4.5 percent per year based on inflation forecasts.

IV. Summary of Results and Sensitivity Analysis

24. The most consequential assumption for the financial analysis is the level of AC train services to be provided on the new suburban corridors, due to the higher price point of AC tickets. While IR is considering a complete migration to AC coaches over time,[5] the migration strategy has not been fully elaborated at this point. The financial analysis was therefore conducted for three scenarios: (i) the base case with 75 percent AC train services provided along the Project corridors;[6] (ii) scenario 1 with 50 percent AC train services provided along the Project corridors and (iii) scenario 2 with 100 percent AC train services provided. The results are shown in Table A3.4.

[4] IR is exploring measures to increase the share of nonfare revenue, including transport-oriented development, to be more in line with other transit operators around the world.
[5] In addition to the AC coach introduced in December 2017 and the 47 AC coaches to be purchased under MUTP 3, 210 AC coaches are planned to be purchased under MUTP 3A.
[6] The base case assumption is in line with MRVC's broad projection of the average share of AC train services to be provided in the Mumbai Suburban Rail system in the next five to seven years.

Table A3.4: Results of Financial Analysis for Project Corridors (USD million)

	Virar-Dahanu Road			Panvel-Karjat		
	S1A	**Base**	**S2A**	**S1B**	**Base**	**S2B**
	50% AC Train Services	**75% AC Train Services**	**100% AC Train Services**	**50% AC Train Services**	**75% AC Train Services**	**100% AC Train Services**
Total net operating cash flow over 30 years	(2,373.21)	(1,112.25)	146.81	(710.49)	(138.58)	492.84
Total Operating Ratio	128%	112%	98%	125%	105%	87%

25. The results show that in the base case scenario, the total operating ratio (total operating expenses/total revenue) over 30 years will slightly exceed 100 percent for both corridors. Given CR and WR's plan for complete migration to AC services in the near future, it can be assumed that the base case will become more conservative in the outer years, leading to a positive total net operating cash flow. If AC train services only comprise 50 percent of total services, this will result in a negative net operating cash flow and an operating ratio well above 100 percent in both corridors. In this case, the Project corridors would require operating subsidies. If AC train services can be provided at 100 percent, the total operating ratio will decrease to below 100 percent with a positive total net operating cash flow in both corridors.

26. A similar analysis by varying the value of fare escalation per year was carried out. The analysis indicated that, if fare is assumed to escalate at three percent per year, rather than the presently assumed two percent, the investment could yield an operating ratio well below 100 in almost all scenarios.

27. **Financial Status of IR.** Any shortfalls from suburban rail operations are being cross-subsidized by IR, particularly through freight revenues. In 2016-2017, nationwide suburban rail revenues accounted for only 1.62 percent of IR's combined freight and passenger revenue and 13 percent of total passenger-km. IR's average revenue per passenger-km is 2.3 times the revenue per passenger-km for suburban rail which reflects the challenge of running a financially sustainable suburban rail service in light of the current low fare policy. Given the marginal share of Mumbai's suburban rail in IR's total operations, shortfalls that may arise from the extension of suburban rail services under the Project are expected to be absorbed by IR without significant impact on IR's overall financial performance.

Table A3.5: IR Operation in 2016-2017

Item	Earnings (INR Cr.)	Passenger-KM/Freight- Tonne-KM (Billion)	Avg. Revenue per Passenger-KM/Tonne-KM (INR)
Passengers (Nonsuburban)	46,280.46	1,150	0.43
Freight	102,027.82	620.175	1.64
Suburban	2,689.44	145.417	0.185
Total Freight & Passenger	150,997.72	1,915.59	n/a
Share of Suburban to Total	2%	13% (of total passenger-KM)	n/a

Source: IR Annual Report 2016-2017.

28. A review of IR's financial performance in the last four fiscal years suggests that IR has adequate financial capacity to meet any shortfalls and ensure operability of the new corridors. IR's gross revenue receipts have been growing steadily with over 60 percent coming from freight services. Gross revenue slightly declined by two percent in IFY 2016-2017. However, this is mainly caused by decline in nontraffic revenue while the gross traffic receipts still increased by one percent during the period.

29. Working expenses increased at a slightly faster rate between 2013 and 2017, mainly driven by operating expenses for traffic. The operating ratio has remained below 100 in the same period although it increased rather significantly in IFY 2016-2017 due to an increased salary bill. The financial balances have remained positive in the last four fiscal years, continuing the positive trend since IFY1990-1991. The review of IR financial performance suggested IR has adequate financial capacity to meet any shortfalls and ensure operational sustainability of the new corridors.

Table A3.6: IR Financial Performance (INR Cr.)

	IFY 2013-14	IFY 2014-15	IFY 2015-16	IFY 2016-17
Gross Revenue Receipts	143,213.87	161,017.25	168,379.60	165,382.48
Working expenses incl. depreciation, etc. and miscellaneous expenses	131,464.80	144,178.76	149,151.13	160,469.48
Net revenue receipts	11,749.07	16,838.49	19,228.48	4,913.00
Operating ratio	93.6	91.3	90.5	96.5
Dividend to General Revenues and payment to States in lieu of tax on passenger fares	8,008.67	9,173.55	8,722.51	-
Excess/Shortfalls (+-)	3,740.4	7,664.94	10,505.97	4,913.00

Source: IR's latest published annual report IFY2016-2017.

Annex 4: Sovereign Credit Fact Sheet

A. Recent Economic Development

1. India is a lower-middle-income country, with a population of 1.34 billion.[1] It is the world's seventh largest economy by nominal gross domestic product (GDP) and third largest by purchasing power parity in 2018.[2] Since 2014, India's economy has been on a gradual cyclical recovery, the average growth reached 7.9 percent during 2014-2016, helped by lower commodity prices bringing about an improvement in the current account. Following disruptions related to the November 2016 demonetization initiative[3] and the July 2017 goods and services tax (GST) rollout,[4] growth slowed to 7.2 percent in 2017.

2. Low food prices on a return to normal monsoon rainfall, agriculture sector reforms, subdued domestic demand, and currency appreciation contributed to a continued decline in inflation, from 4.5 percent in 2016 to 3.6 percent in 2017, which was a 17-year low. This provided room for a more accommodative monetary policy.

3. The current account deficit widened to 1.8 percent of GDP in 2017, on rising imports and oil prices. The further widening of the deficit in 2018 is mainly on strong demand for imports and depreciation of the rupee from 2017 to 2018. The persistent fiscal deficit mainly reflects the fact that the expenditure is budgeted to increase, primarily reflecting higher subsidy payments, despite the increase in the tax collection-induced net revenue.

B. Economic Indicators

Selected Macroeconomic Indicators—India (2015-2020)

Economic Indicators	2015	2016	2017	2018	2019*	2020*
Real GDP Growth	*8.0*	*8.2*	*7.2*	*7.1*	*7.3*	*7.5*
Inflation (change %, average)	*4.9*	*4.5*	*3.6*	*3.5*	*3.9*	*4.2*
Current account balance (% of GDP)	*-1.1*	*-0.6*	*-1.8*	*-2.5*	*-2.5*	*-2.4*
General government overall balance (% of GDP)	-7.0	-6.7	-7.0	-6.6	-6.5	--
Nominal gross public debt (% of GDP)	69.8	68.9	70.4	69.2	67.8	66.4
Public gross financing needs (% of GDP)	--	11.1	11.7	11.1	10.8	10.4
External debt (% of GDP)	23.1	20.7	20.4	20.8	20.6	20.3
Gross external financing need (% of GDP)	10.3	9.5	9.7	10.9	10.8	10.9
Gross reserves (months imports)	8.9	7.6	7.5	6.8	6.5	--
Direct investment in India (net, % of GDP)	-1.7	-1.6	-1.2	-1.4	-1.6	--
Broad money (% annual change, EOP)	10.1	10.1	9.5	11.4	11.8	--
Exchange rate (Rupee/USD, EOP)**	66.5	67.9	63.7	69.6	69.2	--

[1] The income group classification for fiscal year 2019 is based on World Bank criteria, details seen: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519; Population data use World Bank 2017 data.
[2] All data related to GDP use most updated IMF WEO database unless otherwise stated.
[3] Demonetization initiative: 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.
[4] GST is an indirect tax levied on the supply of goods and services. This law has replaced many indirect tax laws that previously existed in India. In the long run, it is supposed to help reduce cost of goods.

Note: *Denotes projected figures. Italic data from IMF WEO April 2019; **FX data from Thomson Reuters, 2019 FX rate as of April 10, 2019; EOP: end of the period. Source: IMF Country Report No. 18/254, August 2018.

C. Economic Outlook and Risks

4. Looking ahead, India's growth is projected to pick up to 7.3 percent in 2019 and 7.5 percent in 2020, supported by the continued recovery of investment, robust consumption amid a more expansionary stance of monetary policy, and some expected impetus from fiscal policy. Growth in India is expected to stabilize at 7.7 percent over the medium term, based on the continued implementation of structural reforms and easing of infrastructure bottlenecks. With demand recovering and a modest increase in food inflation from a low base, inflation is projected to rise to 3.9 percent in 2019 and 4.2 percent in 2020. The current account deficit is expected to widen to 2.5 percent of GDP in 2019, reflecting its higher oil import bills.

5. External risks include tighter global financial conditions and a retreat from cross-border integration intrigued by a global trade conflict and rising regional geopolitical tensions. Internally, India faces some risk arising from tax revenue shortfalls and higher than expected budget deficits, related to additional spending and continued issues around GST implementation. There are also some concerns that policies to address problems around the weak bank and corporate balance sheets, and policies on structural reforms, will be delayed.

6. India's public debt remains sustainable given favorable debt dynamics and the projected increasing economic growth trend. Additionally, public debt is dominated by domestic currency. Over the medium term until 2023, the public debt-to-GDP ratio is projected to decline gradually to around 63 percent of GDP from the current level of almost 70 percent. Continued fiscal consolidation is needed to bring down India's elevated public debt. Potential low growth represents the primary risk to the debt outlook. India's external debt, currently at 20.8 percent of GDP, remains sustainable.[5]

[5] International Monetary Fund (IMF), 2018. Country Report No. 18/254–2018 Article IV Consultation—Press Release; Staff Report; and Statement by the Executive Director for India, August 2018.

Annex 5: Procurement Arrangements

Core Procurement Principles and Procurement Standards—Checklist

CRITERIA	REVIEW
1. **Economy** — Procurement process demonstrates that the total price outcome of the of contracts for goods works and services, including economic life and cycle costs, does not have a negative impact on the Project	This is an established principle in MRVC's practices. The procurement approach has been well thought through; aiming to strike a balance to attract wide competition of competent contractors capable to carry out the works. **Criterion met**
2. **Efficiency** — Procurement implementation arrangements are proportional to the required outcome with regard to implementation capacity and time constraints and are effective.	The agreed implementation arrangements have been discussed at length. Contracts were packaged based on the geographical location of sites, nature and scope of works, cost estimate and market conditions to determine the procurement approach and method (IOCT and NCT). Adequate support has been included through Consultants to support MRVC in monitoring and managing the implementation. On this basis the agreed implementation arrangements are considered efficient. **Criterion met**
3. **Effectiveness** — The procurement process facilitates the achievement of the ultimate objectives of the Project taking into account the recipient's socioeconomic and other development objectives	The PDS and its implementation steps and processes to be carried out serve well the Project's aim and objective and have been crafted with the purpose of facilitating achievement of the ambitious Project's goals. Contracts implementation are planned in sequential manner (civil works first followed by OHE and PSI works), which will help to ensure effective implementation. **Criterion met**
4. **Fairness; good governance** — The procurement process is open, fair, nondiscriminatory and provides equitable opportunity and treatment for tenderers and consultants in their submission of tenders and proposals. It also provides clear rights and obligations between Recipients on the one hand and suppliers, contractors and consultants on the other. The procurement	MRVC is a Public Sector Undertaking of government of India incorporated under Companies Act. The operation of MRVC is governed by Board of Directors. The internal decision-making process are well defined and responsible officials act promptly considering applicable procedures with principles of fairness. MRVC has a successful track record having managed two projects (MUTP I and MUTP II) similar in terms of scope, complexity and magnitude. The collaboration with AIIB has so far demonstrated to in making decisions in the interest of the project implementation.

CRITERIA	REVIEW
process is aligned with principles of good governance.	**Criterion met**
5. Value for Money (VfM) — The procurement process enables the Recipient to obtain optimal benefits with the resources utilized. This may include not only the initial costs but also costs over the economic life of the procure items, the quality of the output, fitness-for-purpose, timeliness, and the achievement of other socioeconomic and environmental development objectives of the recipient, Price alone may not necessarily represent VfM.	MRVC is a government PSU created to develop world class infrastructure for an efficient, safe and sustainable Railway system in Mumbai suburban sections to provide comfortable and friendly train services to the commuters. Therefore, their policy guideline embraces in full, the principle of value for money. To achieve this a very well-structured mechanism is in place in term of technical, financial and operational requirements. **Criterion met**
6. Fit-for-Purpose (FfP) — To realize VfM, the procurement process ensures that the procurement methods and procedures applied by the Recipient for the Project, and the nature and extent of bank oversight are FfP. The procurement modalities appropriately reflect the strategic needs and circumstances of the situation. Standardized approaches maybe used for low value low-risk or low complexity procurement. Where procurement complexity, risk and impact are high, a customized approach with transaction-specific documentation and method may be the most efficient and effective approach.	MRVC has well established practice with a strong upstream technical preparation based on current market trend. During the preparation of the PDS a well-crafted procurement approach has been agreed considering geographical location of sites, nature and complexity of sub projects, market situations etc. On this basis, procurement approach (IOCT or NCT) has been decided to meet FtP requirements. **Criterion met**
7. Transparency — AIIB is committed to achieving a high level of transparency under each project. Transparency during the procurement process is a key	All procurement opportunities will receive adequate level of publicity and access to information. A General Procurement Notice (GPN) has been published on UNDB and on AIIB's website as well as on MRVC's. The use of the GoI e-procurement platform for all the specific notices

CRITERIA	REVIEW
element in establishing a good procurement outcome. To this end, sufficient and relevant information is required to be made available in an open manner to interested parties and for appropriate scrutiny.	is coupled with publication on newspaper. On this basis it is deemed that the information on project's procurement opportunities will be adequately publicized. **Criterion met**
PROCUREMENT STANDARDS	**REVIEW**
(a) Planning — Strategic Procurement Planning	MRVC is required to plan one year ahead for their budget purposes, and the due diligence has demonstrated that from the preparation of technical documentation through to tendering process and implementation a good degree of discipline in planning ahead is achieved.
(b) Transparency — Transparent and unless other approaches are adequately justified, international competitive processes	**See above**
(c) Optimized balance between price and quality to generate desired development results on a sustainable basis.	MRVC has a strong technical competence in-house and widely available standards to determine rates. The good quality of technical documentation along with clear, transparent and unambiguous pricing mechanism have nurtured a marketplace that delivers quality contracts, on time and on budget in most cases.
(d) Credible recourse and impartial and equitable dispute resolution: integrity throughout the procurement process including during contract management and closure.	The form of Contract used for the project is the Standard for WB and it does include provisions to ensure an equitable resolution of any disputes and the Bank's Policy on Prohibited Practices apply in full to the Project.
(e) Quality assurance, compliance checks, audits inspections and as appropriate third-party verification.	MRVC will apply the well-known "three tiers" quality control (applicable to most Indian public-sector projects) coupled by PMC support during implementation.
(f) Credible mechanism to address complaints of bidders and providers of goods works and consulting services.	MRVC has dedicated Vigilance Department headed by Chief Vigilance Officer to manage issues related to public grievances. In addition, the SBDs provides a clear mechanism to lodge a complaint throughout the procurement process and a mechanism to handle that.

Annex 6: AIIB Site Monitoring and Supervision Mission Plan During Project Implementation

		2020				2021				2022				2023				2024				2025
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Technical	Bank Staff	√		√		√		√		√		√		√		√		√		√		√
	Consultant	√	√	√	√	√	√	√	√	√		√		√		√		√		√		
Environmental	Bank Staff	√	√	√	√	√	√	√	√	√		√		√		√		√		√		√
	Consultant	√	√	√	√	√	√	√	√	√		√										
Social	Bank Staff	√	√	√	√	√	√	√	√	√		√		√		√		√		√		√
	Consultant	√	√	√	√	√	√	√	√	√		√										
Procurement	Bank Staff	√		√		√		√		√		√				√				√		√
Financial Management	Consultant	√		√		√		√		√				√				√				√

Notes:

1. √ indicates a participant of the mission.
2. It is expected that each site monitoring or supervision mission will be carried out over five working days.
3. It is expected that a midterm review will be carried out in Q1, 2022.
4. Mission plan including frequency and participants may be adjusted in consideration of Project implementation progress and issues during Project implementation.