

Indonesia Mass Transit Project (MASTRAN)
Bandung Basin Metropolitan Area - Bus Rapid Transit Project
Ministry of Transportation, the Republic of Indonesia



ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

REV.11

BBMA DEDC

ABBREVIATION/ACRONYM

AFD	Agency France development
AMDAL	<i>Analisis Mengenai Dampak Lingkungan Hidup</i> (Environmental Impact Assessment)
ANDAL	<i>Analisis Dampak Lingkungan Hidup</i> (Environmental Impact Statement)
ANDALALIN	<i>Analisis Dampak Lalu Lintas</i> (Traffic Impact Assessment)
Angkot	<i>Angkutan Kota</i> (urban transportation paratransit)
Bappeda	Regional Development Planning Agency
BBMA	Bandung Basin Metropolitan Area
BLUD	Regional Public Service Unit
BRT	Bus Rapid Transit
BUMD	Regional Owned Enterprise
DISHUB	Provincial/City Transport Agency
DLH	Provincial/City Environmental Agency
E&S	Environmental and Social
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standards
GBV	Gender-Based Violence
GESI-AP	Gender Equality and Social Inclusion Action Plan
GHG	Greenhouse gas
GOI	Government of Indonesia
GRM	Grievance Redress Mechanism
Jl.	Jalan (street)
MASTRAN	Indonesia Mass Transit Project
MOE	Ministry of Environment
MOF	Ministry of Finance
MOT	Ministry of Transport
PPP	Public-Private Partnership
PSO	Public Service Obligation
SEA/SH	Sexual Exploitation, Abuse, and Harassment
SEP	Stakeholder Engagement Plan
TOD	Transit-Oriented Development
UKL-UPL	Environmental Management and Monitoring Effort Document (<i>Upaya Pengelolaan Lingkungan Hidup dan Upaya Pemantauan Lingkungan Hidup</i>)
WB	World Bank

TABLE OF CONTENTS

ABBREVIATION/ACRONYM	i
TABLE OF CONTENTS	ii
LIST OF TABLES	v
LIST OF FIGURES.....	vii
EXECUTIVE SUMMARY	1
1. INTRODUCTION	7
1.1. Project Background, Objectives, and Benefits	7
1.2. ESIA and Environmental Approval	9
1.3. Scope of ESIA.....	10
2. PROJECT DESCRIPTION AND ALTERNATIVES.....	11
2.1. Key Project Design Selected and its Alternatives.....	11
2.2. Dedicated BRT Corridor.....	14
2.3. BRT Bus Stop/Platforms	17
2.4. Reconstruction of Road Intersections.....	22
2.5. Estimated Passengers.....	23
2.6. Bus Specification	25
2.7. BRT Direct Service Route (Off-corridor)	26
2.8. Infrastructure, Facilities, and Landscaping Works	27
2.9. Bus Depots, Terminals, and End Stations/Terminus	29
2.10. Clean Water Supply and Waste Management	32
2.11. Affected Lands, People, and Trees.....	34
2.12. Construction Materials, Equipment, and Vehicles.....	37
2.13. Contractor Basecamp and Workers	40
2.14. Key Activities as per Project Phases	42
3. KEY POLICY AND REGULATORY FRAMEWORKS.....	46
3.1. Key Indonesian Laws and Regulations – Environment, Health & Safety	46
3.2. Social, Gender and Customary Communities.....	48
3.3. The World’s Bank Environmental and Social Framework (ESF)	51
4. ESIA METHODOLOGY	59
4.1. Scoping Process and the Project Area of Influence.....	59
4.2. Stakeholder Identification and Analysis	62
4.3. Risk and Impact Assessment Method	62
4.4. Rapid Cumulative Impact Assessment	66
5. ENVIRONMENTAL AND SOCIAL BASELINE	67
5.1. Environment.....	67
5.1.1. Climate.....	67
5.1.2. Air Quality.....	67
5.1.3. Noise Level.....	68
5.1.4. Vibration	69
5.1.5. Hydrology and Surface Runoff	70
5.1.6. Surface and Groundwater Quality	71

5.1.7. Tree Species.....	73
5.1.8. Greenhouse Gas Emissions	74
5.1.9. Disaster Risk Profile	77
5.1.10. Existing Public Transport Services and Road Traffic.....	79
5.2. Socio-economic and Public Health Profiles.....	80
5.2.1. Population Profile.....	81
5.2.2. Education and Health	81
5.2.3. Employment and Livelihood.....	83
5.2.4. Community Perception	89
5.2.5. Accessibility and Mobility Pattern.....	91
5.2.6. Cultural Heritage	93
5.2.7. Gender Profile	95
5.2.8. Harassment and Gender-Based Violence.....	96
6. ENVIRONMENTAL AND SOCIAL RISK AND IMPACT ASSESSMENT	99
6.1. Pre-Construction Phase.....	101
6.1.1. Livelihoods and Access Restriction.....	101
6.1.2. Vulnerable People	102
6.2. Construction Phase	104
6.2.1. Ambient Air Quality	104
6.2.2. Noise and Vibration Level.....	106
6.2.3. Greenhouse Gas Emission	110
6.2.4. Stormwater Runoff.....	112
6.2.5. Soil and Groundwater	113
6.2.6. Road Traffic and Infrastructure	116
6.2.7. Affected Trees/City Landscape.....	118
6.2.8. Local Economy.....	120
6.2.9. Restriction to Buildings and Traffic Congestion	121
6.2.10. Vulnerable People	122
6.2.11. Cultural Heritage	124
6.2.12. Labor and Working Conditions.....	126
6.2.13. Community Health and Safety	128
6.3. Operational Phase.....	130
6.3.1. Ambient Air Quality	130
6.3.2. Noise Level.....	131
6.3.3. Greenhouse Gas Emissions	134
6.3.4. Stormwater Runoff.....	136
6.3.5. Soil and Groundwater	138
6.3.6. Road Traffic	139
6.3.7. Labor and Working Conditions.....	143
6.3.8. Community Health and Safety	145
6.3.9. Livelihoods.....	147
6.4. Cumulative Impact Assessment	148
7. STAKEHOLDER ENGAGEMENT AND INFORMATION DISCLOSURE	156
7.1. Consultation with Stakeholders and Project Affected Peoples (PAPs)	156

7.2. Future Engagement and Information Disclosure	157
8. GRIEVANCE REDRESS MECHANISM	160
9. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN	164
9.1. Mitigation Measures and Monitoring Plans.....	164
9.2. Institutional Roles and Responsibilities.....	180
9.3. Monitoring, Capacity Building and Budgeting.....	182
10. REFERENCES.....	185

ANNEXES:

- A. UKL-UPL Administrative Screening of BBMA BRT Project
- B. Approval and Final Report Traffic Impact Assessment (ANDAL Lalin)
- C. The Minutes of Public Consultation Already Conducted

LIST OF TABLES

Table 1. Summary of Risk and Impact Assessment Results	4
Table 2. Dedicated BRT Corridor Design	14
Table 3. Existing Road Segments to be Used by BRT Corridor	17
Table 4. Platform Type	18
Table 5. On-Corridor Bus Stops/Platforms.....	21
Table 6. Road Intersections Subject to Reconstructed/Adjusted	22
Table 7. Estimated Number of Passengers at the Bus Stops	24
Table 8. BRT Bus Specification	25
Table 9. BRT Off-corridor Service Routes.....	27
Table 10. Facilities and Area Required for the BRT Depots	29
Table 11. Area Required for BRT Stations.....	32
Table 12. Affected Land and Area	34
Table 13. Number of the Affected Kiosks/Tenants.....	36
Table 14. Affected Government-owned Assets	36
Table 15. Number of Trees Affected by Construction	37
Table 16. Indicative Construction Materials Required	38
Table 17. Construction Equipment and Vehicles	38
Table 18. Estimated Fresh Water Supply for Construction.....	39
Table 19. Indicative Workforce Skills and Requirements	41
Table 20. Key Laws and Regulations - Environment, Health & Safety	46
Table 21. Key Indonesian Laws and Regulations – Social and Gender Aspects	49
Table 22. The Bank ESS Requirements and Key Gaps Addressed in the ESIA.....	52
Table 23. The BRT Project’s Area of Influence	60
Table 24. E&S Impact Severity/Consequence	64
Table 25. Likelihood of the Impact to Occur.....	65
Table 26. Risk Level/Significance of the Impact.....	66
Table 27. Climate of Bandung City (2022)	67
Table 28. Baseline Ambient Air Quality (July 2024)	68
Table 29. Baseline Noise Level	69
Table 30. Baseline Vibration Measurement	69
Table 31. Potential Stormwater Run Off Capacity on BRT Road Corridor	70
Table 32. Surface Water Quality of <i>Cikapundung</i> and <i>Citepus</i> Rivers	72
Table 33. Groundwater Quality Results	73
Table 34. Traffic Counting Results at BRT Intersections	75
Table 35. Estimated Baseline GHG Emissions (tCO ₂ e/day) within On-corridor	76
Table 36. Natural Hazard Exposure of BRT Corridor	78
Table 37. Road Service Levels	80
Table 38. Demographic Profiles	81
Table 39. Education and Health Profiles (2022 – 2023).....	82
Table 40. Number of Schools (2022).....	82

Table 41. Number of Health Facilities (2022)	83
Table 42. Number of Sickness Recorded in Bandung City (2021)	83
Table 43. Employment Rate of Bandung City and Bandung Regency.....	84
Table 44. Average Monthly Income of Parking Attendants.....	84
Table 45. Status of Parking Attendants.....	84
Table 46. Vulnerable Groups Among Parking Attendants	85
Table 47. Number of Street Vendors within BRT Corridors.....	86
Table 48. Affected Kiosk Tenants.....	87
Table 49. Household Income of Affected Kiosk Tenants/Owners	88
Table 50. Vulnerable Individuals Among Affected Kiosk Tenants/Owners	88
Table 51. Affected Angkot Drivers and Operators and their Households	89
Table 52. Online Transport Drivers in the BRT Corridor	89
Table 53. Mobility Generators within the BBMA.....	91
Table 54. List of Cultural Heritage within the BRT Corridor.....	94
Table 55. Identified Potential Environmental and Social Impacts	100
Table 56. Noise Level of Construction Vehicle and Equipment	107
Table 57. Projection of Accumulative Noise in the Construction Phase.....	108
Table 58. Estimated GHG emissions during BRT construction phase	110
Table 59. Projected Noise Levels during the Operation of BRT Buses.....	133
Table 60. Estimated Road Traffic Volume – Without (Existing) vs With BRT Operation	141
Table 61. Existing Activities and Foreseeable Future Development within BBMA Area	149
Table 62. Environmental and Social Cumulative Impacts.....	153
Table 63. Consultation with Project’s Stakeholders and PAPs	156
Table 64. Planned Stakeholder Engagement Prior to and During Construction	158
Table 65. Complaints based on Its Risk Level	160
Table 66. Roles and Responsibilities on GRM	163
Table 67. Environmental and Social Management and Monitoring Plan	165
Table 68. Indicative Cost Items for CESMP Implementation and Capacity Building	183

LIST OF FIGURES

Figure 1. Dedicated BRT On-corridor Layout	2
Figure 2. BRT On-Corridor	12
Figure 3. Proposed BRT Corridors and Motorcycle Park and Ride (Initial Design)	13
Figure 4. BRT Corridor Design	16
Figure 5. Overview of BRT On-corridor and Bus Stop/Platform	16
Figure 6. Platform Type A	18
Figure 7. Platform Type B.....	19
Figure 8. Platform Type C.....	19
Figure 9. Platform Type D	20
Figure 10. Platform Type E.....	20
Figure 11. Platform Type F	20
Figure 12. BRT Bus Size	26
Figure 13. BRT Service Routes in Relation to Bandung Basin Metropolitan Area	26
Figure 14. Sidewalk/Pedestrian Design.....	29
Figure 15. BRT Depot Design – Cicaheum and Leuwipanjang	32
Figure 16. Wastewater Treatment and Reuse Schematic at Depot	33
Figure 17. Flowchart Water Mass Balance of Bus Washing Machine System	33
Figure 18. The Project Area of Influence	62
Figure 19. Baseline Air Quality Sampling and Noise Measurement (2024)	68
Figure 20. Vibration Measurements	70
Figure 21. Groundwater and Clean Water Sampling Activities	73
Figure 22. Some Existing Trees along BRT Corridor and Station Location	74
Figure 23 GHG Emission based on Transportation Modes	76
Figure 24. Occurrences of Natural Disasters in Bandung	77
Figure 25. Flooding and Water Puddles Sites within BRT On-corridor	78
Figure 26. Public Transportation Modes in BBMA.....	80
Figure 27. Street Vendors and Street Parking Conditions	87
Figure 28. Interview Survey Activities.....	90
Figure 29. Public Responses to the BRT-BBMA Project	90
Figure 30. Community Concerns on E&S Impacts of BRT - BBMA Project.....	91
Figure 31. Cultural Heritage Buildings Near BRT On-corridor.....	94
Figure 32. BBMA Gender Development Index 2017–2019.....	96
Figure 33. GESI Survey Results—Experience when Using Public Transportation	96
Figure 34. GESI Survey Results Based on Mobility Impaired Respondents	97
Figure 35. GBV Cases from 2008 - 2020 (Kota Bandung Diskominfo)	98
Figure 36. Traffic Load at Morning and Evening Busy Hours 2024	117
Figure 37. Noise Level of Electric Bus Compared with Conventional Bus	132
Figure 38. Forecasted Traffic Load within Peak Hours - BRT Operation.....	141
Figure 39. Grievance Redress Mechanism	162
Figure 40. Organization of BBMA – BRT Project.....	181

EXECUTIVE SUMMARY

Project Background and Key Objectives

The Government of Indonesia (GOI), through the Ministry of Transport (MoT), with support from the World Bank (WB), has launched the Indonesia Mass Transit Project (MASTRAN). This initiative is designed to strengthen the financial, technical, and institutional capacities of Sub-National Governments (SNGs) in planning, delivering, and managing public transport systems. Aligned with the 2020–2024 Medium-Term National Development Plan (RPJMN) of the Indonesian Government, MASTRAN prioritizes mass transit development across six metropolitan areas, including Bandung City.

The Ministry of Transportation, through the Directorate General of Land Transportation and specifically the Directorate of Traffic and Road Transport, is leading the implementation of this project, with support from the Transportation Agencies of Bandung and West Java. One of its central focuses is the development of Bus Rapid Transit (BRT), or “the project,” for the Bandung Basin Metropolitan Area (BBMA), where rapid urbanization is projected to intensify mobility demands by 2030. The project is designed with an inclusive approach, addressing the mobility needs of women, persons with disabilities, and other vulnerable groups who rely on public transport.

The main objectives of the project include improving urban mobility, expanding public transportation access, encouraging a shift away from private vehicles, and strengthening institutional frameworks for the operation of the BRT system. On the other hand, the project aims to deliver social, environmental, and economic benefits, ultimately contributing to more sustainable cities, a better quality of life, and equitable access to economic opportunities in the medium- to long-term.

Key Components of the Project

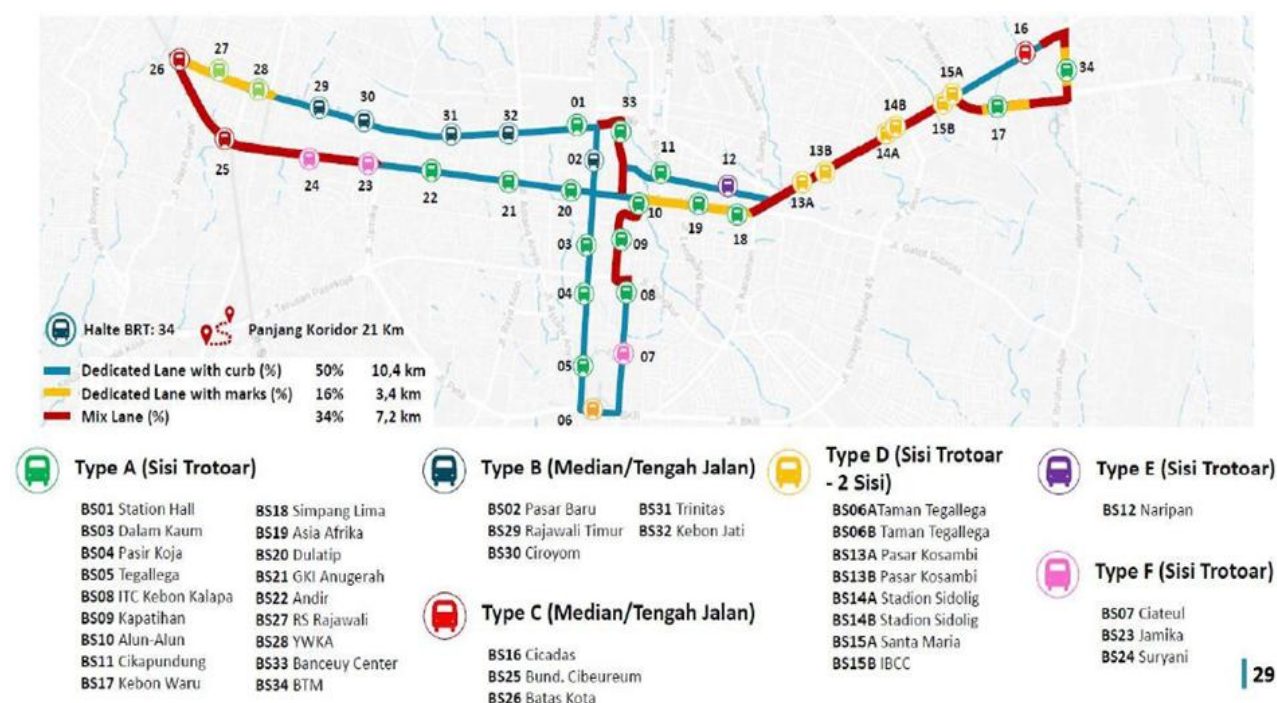
The BRT project is designed to include civil works and the installation of related transportation systems, to be undertaken by contractors appointed and supervised by MOT, with the assistance of sub-national governments. Key components of this project that will be funded through the loan include the following:

- Construction of approximately 21.7 km long, dedicated BRT lane known as “on-corridor” using existing roads that will be reinforced using a combination of asphalt and reinforced concrete pavement. Many of the dedicated corridors are designed to be a segregated lane with a barrier separate from other road users;
- Construction of 38 on-corridor bus stops/platforms along dedicated BRT lanes;
- Construction of 242 off-corridor bus stop/shelters on nine (9) transportation services routes that will be connected with nine BRT services;
- Construction of two BRT end-stations/terminals within the existing *Antapani* and *Ledeng* Terminals;
- Construction of two BRT bus depots within the existing *Cicaheum* and *Leuwipanjang* Terminals;
- Landscaping works along the BRT corridors and areas disturbed by construction-related

activities; and

- Providing sidewalk/pedestrian adjacent to the bus stops and stations, including construction of access for people with disabilities, as well as undertaking landscaping works.

The procurement of BRT buses, including engagement with future bus operators, is outside the scope of the WB and AFD loans. The on-corridor dedicated BRT bus route within Bandung City and the off-corridor routes connected to the BRT services are shown in the following figure.



Source: The figure is redrawn and updated from the Andalalin report of BBMA (2025)

Figure 1. Dedicated BRT On-corridor Layout

The Need for ESIA and Environmental Approval

The MASTRAN project including implementation of BRT project in BBMA is classified as 'Substantial Risk' project according to the World Bank Environmental and Social Framework (2018) and, therefore, an Environmental and Social Impact Assessment (ESIA) including Environmental Social Management Plan (ESMP) according to the Bank standards is prepared (this document) for clearance by the Bank and then is disclosed on the websites of the Bank and the Implementing Agency.

At the national level, the project also falls under Indonesia's environmental regulatory framework. Based on recommendations from the Ministry of Environment in the AMDALNET registration number: 6644BDAA45DDA (dated 15 May 2024), the project, including its dedicated main corridor, bus stops and end-stations, terminals and depots fell under the requirement an Environmental Management Efforts and Environmental Monitoring Efforts (UKL/UPL) document subject to evaluation by the ministry and subsequent issuance of the environmental approval.

Environmental and Social Risk and Impact Assessment

The ESIA evaluates the potential environmental and social impacts of the project throughout its pre-construction, construction, and operational phases. It identifies both direct and indirect environmental and social effects and outlines corresponding mitigation measures along with a monitoring plan known as the Environmental and Social Monitoring Plan (ESMP). As part of the ESIA scoping process, the project's Area of Influence (AoI) was defined to assess how project activities may interact with environmental and social receptors. This approach also facilitated the identification of data gaps requiring further investigation.

To inform the ESIA, several key documents and relevant data were utilized, including but not limited to:

- Final Detailed Engineering Design (DED) reports of BBMA BRT (2025);
- Traffic Management Review Report/ANDALALIN of BBMA BRT (2025);
- Draft Environmental Management and Monitoring Plan known as UKL-UPL (2025); and
- Other relevant information was sourced from websites and publicly available domains.

The risk level or significance of an Impact is determined using a standardized method as a function of the impact severity and its likelihood of occurring, which yields the following classifications:

- 'Low risk' if the impact is detectable but not considered significant and, therefore, mitigation measures are discretionary or precautionary in nature;
- 'Medium risk' if the impact is of moderate level and reversible and, therefore, can be mitigated using common mitigation measures;
- 'Substantial risk' if the impact is significant, adverse, irreversible, and, therefore, should be mitigated using specialized measures, or
- 'High risk' if the impact is significant, adverse, widespread, and irreversible that cannot be mitigated using common measures, and therefore, alternatives to the project or less-impact activities should be identified and adopted for the Project.

The risk and impact assessment of the project identified several significant environmental impacts, including elevated dust and fugitive emissions, noise levels, and road traffic congestion on top of existing poor air quality and heavy motorcycle and vehicle traffic in BBMA. From a social perspective, the project would affect approximately 1,735 street vendors, 193 parking attendants, 124 kiosk tenants at *Cicaheum*, *Antapani*, and *Ledeng* terminals, and 400 paratransit minibus (*angkot*) operators. The summary of potential environmental and social impacts of project implementation is presented in the table below.

Table 1. Summary of Risk and Impact Assessment Results

No	Potential Impacts within Project Area of Influence	Inherent Risk Level (without any mitigation measures)	Residual Risk Level (with implementation of mitigation measures)
Pre-construction Phase			
1	Livelihood and access restriction land acquisition	Substantial	Moderate
2	Marginalization of vulnerable people and gender-based violence	Moderate	Low
Construction Phase			
1	Increased airborne dust and fugitive gas emissions exceeding the baseline level	Substantial	Moderate
2	Elevated noise and vibration levels exceeding the baseline level	Moderate	Low
3	Increased greenhouse gas emissions	Moderate	Low
4	Increased stormwater runoff and siltation of drainage channels	Moderate	Low
5	Soil and groundwater contamination (particularly at future BRT depots)	Substantial	Moderate
6	Road traffic and infrastructure	Substantial	Moderate
7	Affected trees and landscape	Moderate	Low
8	Local economy	Low	Low
9	Access restriction and road traffic congestion	Substantial	Moderate
10	Marginalization of vulnerable people and gender-based violence	Moderate	Low
11	Disturbance to cultural heritage (building)	Moderate	Low
12	Poor labor and working conditions	Moderate	Low
13	Community health and safety exposure	Substantial	Moderate
Operation Phase			
1	Improved ambient air quality	Moderate	Low
2	Reduced noise level	Moderate	Low
3	Reduced GHG emissions	Moderate	Low
4	Stormwater runoff	Moderate	Low
5	Groundwater resources	Substantial	Moderate
6	Road traffic	Low	Low
7	Labor and working conditions	Moderate	Low
8	Community health and safety	Moderate	Low

Stakeholder Engagement and Information Disclosure

Several stakeholder consultations and project information disclosures were conducted in 2023 – 2024 as part of the Land Acquisition and Resettlement Action Plan (LARAP) for the project.

Grievance Redress Mechanism

A project-specific Grievance Redress Mechanism (GRM) has been established in the Stakeholder Engagement Plan (SEP) to ensure that any concerns, complaints, or disputes arising from the BBMA BRT Project are addressed fairly, promptly, and transparently.

The GRM is designed to promote accountability, improve stakeholder trust, and support inclusive project implementation. Key features of the GRM include (i) Multiple access channels to submit grievances such as in-person visits, phone calls, email, social media or an online web portal in each city/district; (ii) Complaints are categorized according to their risk level (low, moderate, or high) to prioritize urgent and sensitive cases; (iii) Defined timeline for grievance resolution; and (iv) Dedicated GRM team where a specialized unit within the Project Implementation Unit (PIU) is responsible for managing the grievance process.

Environmental and Social Management Plan (ESMP)

The ESMP is developed based on the project's risk and impact assessment and is included in this ESIA, in accordance with applicable regulatory frameworks and standards. Its effective implementation relies on the development of several overarching plans and procedures listed below. The ESMP is the primary reference for guiding the project in implementing E&S risk mitigation and monitoring. Adequate environmental mitigation measures and monitoring budget should be included in the bidding documents and civil work contracts awarded to BBMA.

Upon contract award, the contractor should prepare the following documents for submission to the PIU for review and endorsement before commencement of construction activities. These documents include, among others:

- *Construction Environmental and Social Management Plan (CESMP)*, which is an overarching project-specific E&S risk mitigation measures and monitoring requirements that should be implemented by the contractors and is also applicable to their primary suppliers as well as subcontractors.
- *Traffic Management Plan (TMP)*, which is the management plan included already in the BRT project's ANDALALIN describing mitigation measures, monitoring, and agencies' coordination required to manage the existing traffic congestion and disturbance to public transportation services and road users during construction of the BRT project.
- *Labor Management Procedures (LMP)*, which detail labor and working conditions, including health and safety requirements for project workers, should be provided by the project. The LMP would include codes of conduct for preventing sexual exploitation and abuse/sexual harassment, as well as gender-based violence.
- *Heritage Impact Assessment (HIA)* that would include assessment of the integrity and existing damages of the cultural heritage building within the dedicated BRT corridors and define mitigation measures to be implemented. The need for an HIA to be conducted by the BRT project is incorporated into ESMP and could be detailed in CESMP.
- *Standard Operating Procedures (SOP) for managing hazardous and non-hazardous wastes* as well as construction wastes, including their disposal, to ensure compliance with prevailing laws and regulations.

Institutional Responsibilities and Budget for ESMP Implementation

The project will be implemented and governed through a three-tiered management level to ensure coordinated delivery and oversight of project activities. This framework comprises three key levels: the Project Steering Committee, the Project Management Unit (PMU), and the Project Implementation Unit (PIU).

The responsibility for implementing CESMP and other plans, and for reporting, primarily lies with the contractors, who will be directly supervised by the Detailed Engineering Design and Supervision (DEDS) Consultant on behalf of the PIU.

At the national level, the PMU, represented by the Directorate General of Land Transportation, will support the project's implementation and ensure compliance with its environmental and social safeguard requirements. The PMU will consolidate monthly, quarterly, and semi-annual reports to produce a semi-annual environmental and social monitoring report (in English language) for submission to the World Bank. This monitoring report will cover the January to June and July to December periods and will be submitted to the Bank no later than 30 days after each reporting period. The report should be subject to adequate review by DEDS, PMC, and PIU prior to submission to the Bank.

In the event of design revisions or the emergence of unanticipated environmental or social impacts, the PIU is required to promptly inform the PMU and the Bank. Any necessary updates to ESIA and safeguard documents will need to be decided in alignment with the Loan Agreement and mutually agreed upon by the parties involved.

1. INTRODUCTION

1.1. Project Background, Objectives, and Benefits

Project Background. Bandung City, as the capital of West Java Province, has been experiencing heavy road traffic congestion, and this situation extends to the Greater Bandung Area, including neighboring areas in the regency (*kabupaten*) of West Bandung Barat and Bandung. In comparison to 1995, the number of trips per day has increased by 66% in 2010, and is projected to increase by 193% in 2030, following the growth of the urban population (Lubis et al. 2003 in Tarigan et al. 2016). Several mass transit proposals have been under consideration by relevant government authorities, but none have materialized to date. Considering this challenge, the Government of Indonesia (GoI), particularly the Ministry of Transport (MOT), intends to implement the Indonesia Mass Transit Project (MASTRAN) to increase the capacities of subnational governments (e.g., provincial and municipality/regency level) to plan, implement, and manage an effective public transport system. The MASTRAN aligns with the Indonesian Medium-Term National Development Plan of 2020-2024, which has targeted mass transit development in six metropolitan areas.

MASTRAN has two key components: (i) Institutional development, capacity building, and technical assistance, which will provide support to MoT and sub-national governments to operate the mass transit projects; and (ii) Demonstration of mass transit projects in Bandung Basin Metropolitan Area (BBMA) in West Java and in Medan, Binjai and Deli Serdang (Mebidang) in North Sumatera.

The Feasibility Study of the Bus Rapid Transit (BRT) scheme was finalized in 2020, and subsequently, the Urban Mobility Plan for BBMA was completed in the same year. The Ministry of Transportation (MOT) will be the implementing agency for the Project and responsible for developing BRT infrastructure and system, managing the procurement and management of all contracts, and implementing environmental and social safeguards according to the World Bank's Environmental and Social Framework (ESF). Once the construction and system installation have been completed, the BRT operation will be handed over to West Java Province.

The World Bank (WB) and *Agence Française de Développement* (AFD) agree with the Government of Indonesia to provide loans for the design and construction of BBMA – BRT Project (“the BRT project”) in addition to the funding provided by the Government of Indonesia. Therefore, this BRT project shall comply with the requirements of the WB and AFD as well as the laws and regulations stipulated by the Government of Indonesia, including the need to prepare an environmental and social impact assessment and obtain required approvals from the government agencies.

Key Objectives and Benefits. The key objectives of the BRT project are, among others, as follows:

- To improve urban mobility by reducing commuter travel time, enhancing speed and efficiency, and improving traffic flow in BBMA.
- To enhance public transport accessibility by providing safe, reliable, and comfortable

public transport services to residents and commuters, making it more affordable and accessible to all segments of the population. It will also improve connectivity between residential areas, employment centers, and important destinations.

- To promote a shift from private to public transport by encouraging private vehicle users to switch to the BRT system, and hence reducing traffic congestion, pollution, air quality, and greenhouse gas emissions in the project area.
- To strengthen the institutional capacity of local governments to plan, implement, and maintain mass transit systems, improve public transport service delivery efficiency and effectiveness, promote sustainable urban development, and improve residents' quality of life.

In addition, the BRT project is expected to offer a multitude of benefits to the BBMA population in terms of social, environmental, and economic benefits, as outlined below.

Social Benefits

- *Improved mobility* – by providing a dedicated bus lane and frequent service, the BRT can significantly reduce travel times for commuters.
- *Enhanced accessibility and social inclusion* – the BRT can connect people to jobs, education, and healthcare facilities, especially in underserved areas.
- *Increased road safety* – dedicated bus lanes and improved infrastructure can reduce accidents and improve overall road safety.
- *Improved user satisfaction* – reliable, efficient, and comfortable BRT services can enhance user satisfaction and encourage more people to use public transportation.
- *Reduced traffic congestion* – By reducing the number of cars on the road, the BRT can help alleviate traffic congestion.
- *Enhanced urban aesthetics* – well-designed BRT stations and infrastructure can contribute to the overall aesthetic appeal of the city.
- *Increased institutional capacity* – the BRT can strengthen the capacity of local authorities to plan, implement, and manage public transportation systems.
- *Enhanced human capital* – Training and capacity-building programs can improve the skills of local staff in various areas, including public transport planning, management, and operation.

Environmental Benefits

- *Reduced greenhouse gas emissions* – by reducing car usage, the BRT can help mitigate climate change.
- *Improved air quality* – fewer cars on the road due to the presence of BRT buses can lead to cleaner air and improved public health.
- *Reduced noise pollution* – the BRT is designed to minimize noise pollution, especially in residential areas.
- *Promotion of Green City concepts* – the BRT can encourage sustainable urban development practices, such as transit-oriented development.

Economic Benefits

- *Economic development* – the BRT can stimulate economic activity by attracting businesses and investments to transit-oriented development areas.
- *Job creation* – construction and operation of the BRT system can create jobs in various sectors, including construction, engineering, and transportation.
- *Reduced traffic congestion* – the BRT can improve productivity by saving travel time for commuters and businesses utilizing the services.
- *Increased land value* – the development of transit-oriented development areas can increase property values in nearby areas.
- *Public health* improvement – reduced air pollution and increased physical activity can improve public health.

1.2. ESIA and Environmental Approval

Environmental and Social Due Diligence. According to the World Bank’s Environmental and Social Framework (2018), the BRT project is classified as having ‘substantial risk’ in terms of environmental and social (E&S) risks. Furthermore, this risk classification is underscored by limited technical capacity, complex coordination across multiple agencies at various government levels, and other technical and non-technical risks in aligning the BRT project with existing transportation modes and operations in BBMA. Therefore, an environmental and social impact assessment (ESIA) including an environmental and social management plan (ESMP) shall be prepared by the MOT as the IA according to the World Bank Environmental and Social Framework (2018), particularly the provisions of the Environmental and Social Standard (ESS) 1: Assessment and Management of Environmental and Social Risks and Impacts. The ESIA shall be reviewed and cleared by the WB before disclosure on the websites of the WB, MOT, and sub-national governments.

The implementation of the BRT project is expected to result in positive, long-term outcomes through reduced road traffic congestion, improved air quality, and the promotion of local employment and business opportunities. BRT operation will also provide mobility and urban transport services to a broad range of citizens in an inclusive manner through the application of Universal Access. BRT construction will generate adverse, temporary impacts during construction activities, such as increased road traffic on top of the already congested traffic in Bandung city and neighboring areas, and elevated gaseous emissions and noise levels, as well as access restrictions to the residents living nearby.

In the event of any design changes or modifications that may cause significant E&S impacts or unanticipated E&S impacts not covered in this ESIA, the IA shall inform the Bank of this matter and determine whether an amendment to the existing ESIA and other E&S safeguard documents, including environmental approvals, will be required.

Environmental Permit Required by the Indonesian Government. The BRT project is required to prepare an environmental management and monitoring effort document (known as UKL-UPL) in accordance with Advice registration number 6644BDAA45DDA (dated 15 May 2024), issued by the AMDALNET online system of the Ministry of Environment (MOE). The advice letter No. 4.356/LH.01.06.05/PDL (dated 2 September 2021) issued by the Environmental Agency of West Java Province states that the authority to evaluate the UKL-UPL and issue the environmental permit for the BRT project resides with the Ministry of Environment (MOE) based on the design that the dedicated BRT corridor will traverse two national roads at Jl. Rajawali Timur and Jl. Jenderal Sudirman, which the National Government owns.

1.3. Scope of ESIA

The ESIA includes an E&S risk and impacts assessment of potential risks and impacts generated by the implementation of the BRT project and the ESMP, and outlines measures to mitigate them to as low as reasonably practicable, from the pre-construction through to the operation phases. Further, the ESIA includes the following chapters to align with the intent of the Bank's ESF:

- Executive Summary
- Chapter 1 Introduction
- Chapter 2 BRT Project Description
- Chapter 3 Key Policy and Regulatory Framework
- Chapter 4 ESIA Methodology
- Chapter 5 Environmental and Social Baseline
- Chapter 6 Environmental and Social Risk and Impact Assessment
- Chapter 7 Stakeholder Engagement Plan and Information Disclosure
- Chapter 8 Grievance Redress Mechanism
- Chapter 9 Environmental and Social Management Plan
- Chapter 10 Institutional Arrangements.

2. PROJECT DESCRIPTION AND ALTERNATIVES

The BRT project for BBMA is designed to include civil and landscaping works and installation of related transportation systems to ensure an effective and efficient construction and operation. Key components of the BRT project that will be funded through the loan and are anticipated to generate E&S risk and impacts are described below. The procurement of BRT buses, including engagement with the bus operators, is outside the scope of the loan.

2.1. Key Project Design Selected and its Alternatives

Final BRT Project Design Selected. The BBMA BRT project is designed to include civil works and installation of related transportation systems that will be undertaken by the contractors to be appointed and supervised by MOT, with the assistance of sub-national governments. The procurement of BRT buses, including engagement with the bus operators, is outside the scope of the WB and AFD loans. Key components of the BRT project that will be funded through the loan include:

- Construction of approximately 21.7 km long, dedicated BRT corridor using existing roads that will be primarily reinforced using asphalt pavement and, to a lesser extent, using reinforced concrete pavement. The majority of the dedicated corridors are designed to be a segregated lane with a barrier separate from other road users;
- Construction of 38 on-corridor bus stops/platforms along dedicated BRT lanes;
- Construction of 242 off-corridor bus stop/shelters on nine (9) transportation services routes that will be connected with nine BRT services;
- Construction/upgrade of two BRT-end stations, also serving as terminals in *Antapani* and *Ledeng*;
- Construction of two BRT bus depots within the existing *Cicaheum* terminal and *Leuwipanjang* Terminals.
- Landscaping works along the BRT corridors and areas disturbed by construction-related activities; and
- Providing sidewalk/pedestrian adjacent to the bus stops and stations, including access for people with disabilities.

To finalize the Detailed Engineering Design (DED) for the BBMA BRT project, a traffic impact assessment was conducted to identify the most effective configuration in terms of technical feasibility, financial efficiency, and socio-economic outcomes. Three alternatives were considered: (i) the baseline route using existing infrastructure, (ii) an integrated route connecting BRT with '*angkot*,' commuter rail, and dense residential/educational areas, and (iii) an expanded corridor to peripheral zones to promote equitable mobility and long-term urban development.

Of the three alternatives above, the final DED combines elements of Alternatives 2 and 3, emphasizing high-demand corridors, intermodal connectivity, and targeted expansions to maximize coverage and reduce congestion. This integrated approach was determined to be both technically and financially viable, while also minimizing environmental and social impacts during construction. As detailed in the earlier sub-section, the resulting, final DED

comprises a 21-km dedicated BRT on-corridor with 38 bus stop platforms (see figure below); 2 bus depots within the existing *Cicaheum* and *Leuwipanjang* Terminals; Layover at two existing *angkot* (paratransit minibus) terminals at *Antapani* and *Ledeng*, which also serve as the end stations; and 9 BRT off-corridor services.

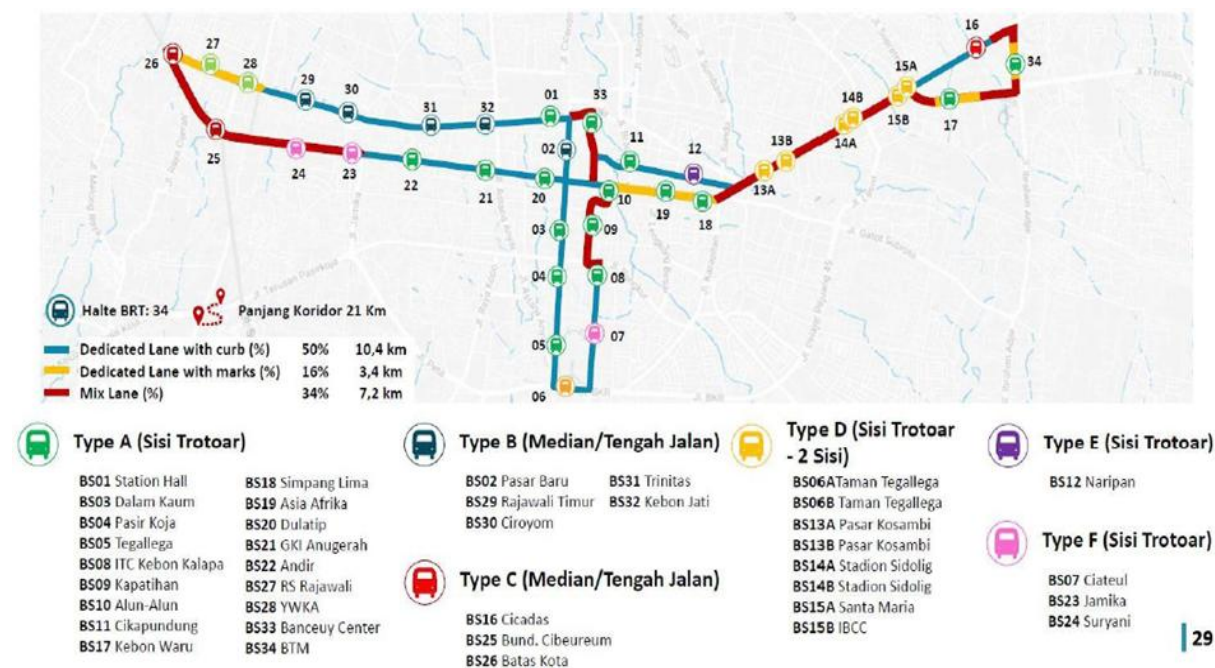


Figure 2. BRT On-Corridor

“Do Nothing” scenario. In the absence of the BRT project, BBMA will encounter worsening mobility and heavily congested road traffic. Traffic congestion will be severe due to the increasing use of motorcycles and private vehicles. The implication of such situations will lead to longer daily commuting, higher transportation costs, and the loss of productivity for businesses and formal workers. Without a reliable mass transit system, opportunities to integrate urban mobility with other planned modes, such as commuter rail and bus services, would be missed, keeping the transport network in the BBMA area fragmented and inefficient.

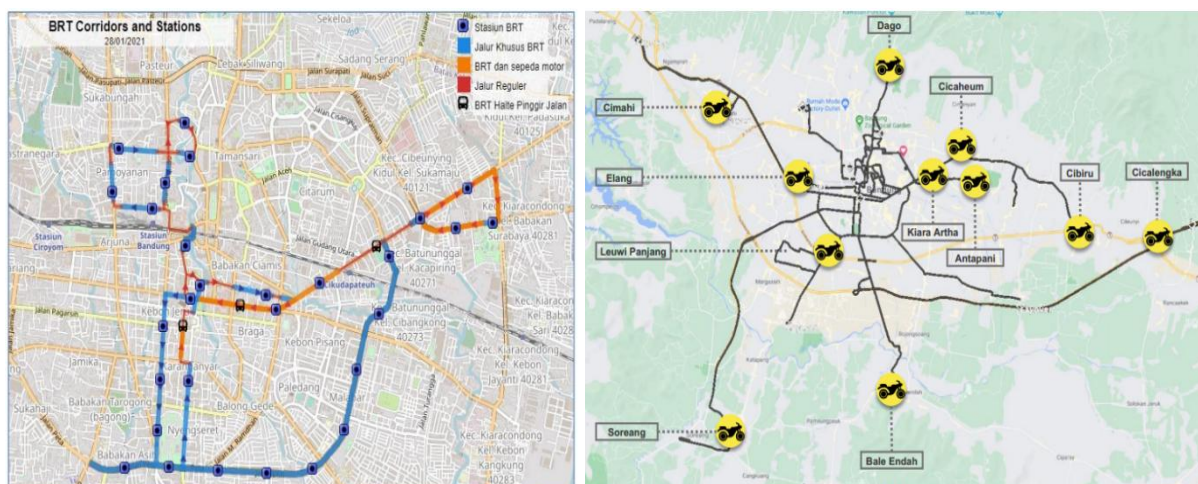
On the other hand, the environmental and social consequences would also be significant. Greenhouse gas emissions and air pollution would continue to rise due to the increasing use of private vehicles. Vulnerable road users, including pedestrians and cyclists, would remain exposed to safety risks in a network system dominated by mixed and unpredictable traffic. Communities, particularly low-income families, would continue to bear the burden of rising transportation costs, deepening inequities, and limited access to economic opportunities and inclusive growth across the metropolitan area. Therefore, the ‘Do Nothing’ option is considered not feasible and therefore not adopted.

“Do Something” Scenario Leading to Final DED. Prior to finalizing the Detailed Engineering Design (DED), the BRT system planning in the BBMA underwent a comprehensive review of the design and alternative routes. The initial concept was developed under the Bandung Low Carbon Mobility Plan by SYSTRA (France) in 2017 and later refined through the Sutrinama–

Indobus Project by German International Cooperation Agency (GIZ) in 2021. These initiatives led by the MOT produced feasibility studies for BRT systems in BBMA, forming the basis for subsequent design refinements by Dohwa Engineering (Korea) and PT Lenggogeni (Indonesia) consortium as the DED and supervision firm.

As shown in the figure below, the original BRT design proposed a 23 km long corridor connecting major activity hubs along BKR street, Bandung city centre, and primary transport terminals. To address Bandung's high motorcycle traffic volume and spatial constraints, a mixed-lane configuration was adopted, comprising 13.2 km of segregated BRT lanes, 4.8 km of mixed BRT–motorcycle lanes, and 5.0 km of mixed-traffic lanes. A total of 33 bus stops were planned based on local conditions with median stations on wide boulevards, kerb-side stations on adequate sidewalks, and directional stations on one-way streets.

A Motor Park and Ride (MPR) scheme was initially proposed at some terminals to provide parking areas for the public who will use BRT. However, this scheme is not adopted due to technical and financial considerations. The proposed depots at *Rancanumpang* and *Gedebage* were also deemed unsuitable due to geotechnical and flood risk assessment results.



Source: Feasibility Study by German Agency for International Cooperation (GIZ), 2021

Figure 3. Proposed BRT Corridors and Motorcycle Park and Ride (Initial Design)

To finalize the Detailed Engineering Design (DED) for the BBMA BRT project, a traffic impact assessment was conducted to identify the most effective configuration in terms of technical feasibility, financial efficiency, and socio-economic outcomes. Three alternatives were considered: (1) a baseline route using existing infrastructure, (2) an integrated route connecting BRT with *angkot*, commuter rail, and dense residential/educational areas, and (3) an expansion corridor to peripheral zones to promote equitable mobility and long-term urban development.

Of the three alternatives above, the final DED combines elements of Alternatives 2 and 3, emphasizing high-demand corridors, intermodal connectivity, and targeted expansions to maximize coverage and reduce congestion. This integrated approach was determined to be both technically and financially viable, while also minimizing environmental and social

impacts during construction. As detailed in the earlier sub-section, the resulting DED comprises a 21-km dedicated BRT corridor with 38 bus stops/platforms; 2 bus depots within the existing *Cicaheum* and *Leuwipanjang* Terminals; Layover at two existing *angkots* (paratransit minibus) terminals at *Antapani* and *Ledeng*, which also serve as the end stations; and 9 BRT off-corridor services.

2.2. Dedicated BRT Corridor

BRT On-corridor. A dedicated BRT corridor is designed for approximately 21.7 km long using existing roads that will be reinforced using asphalt pavement and, to a lesser extent, using concrete pavement at the BRT bus stops (platforms). The majority of the dedicated corridors are designed to be a segregated lane with a physical barrier separate from other road users. The geometric design of the dedicated BRT corridor is generally unaltered from the existing road and only requires some widening at certain road segments. The horizontal and vertical alignments along the BRT corridor comply with the standards of ASHTO A Geometric Design Policy for Highways and Roads; Road Geometric Design Guidelines No. 13/P/BM/2021; and the Ministry of Public Works and Housing Regulation No. 5 of 2023 on Technical Requirements for Roads and Technical Planning of Roads, as summarized in the following table.

Table 2. Dedicated BRT Corridor Design

Criteria	Value
Minimum design speed	40 km/h
Minimum stopping sight distance	50 m
Minimum stopping sight distance at station areas (passenger comfort)	85 m
Minimum passing sight distance (station areas only)	410 m
Minimum horizontal sight distance	AASHTO Exhibit 3-58
Maximum superelevation	6 %
Maximum superelevation at stations	2%
Minimum horizontal curve radius, mainline	55 m
Minimum horizontal curve radius, station areas	120 m
Spirals, all curves less than 870 m radius	25 m
Minimum tangent at station ends	20 m
Maximum intersection skew angle	20°
Minimum turning radius at intersections	12 m
Minimum grade	30%
Maximum grade	5% up to 8% for short runs (120-150 m)
Grade range, stations	0.5% - 2.0%
Minimum crest and sag curves	35 m
Minimum crest and sag curves at stations (passenger comfort)	K= 14

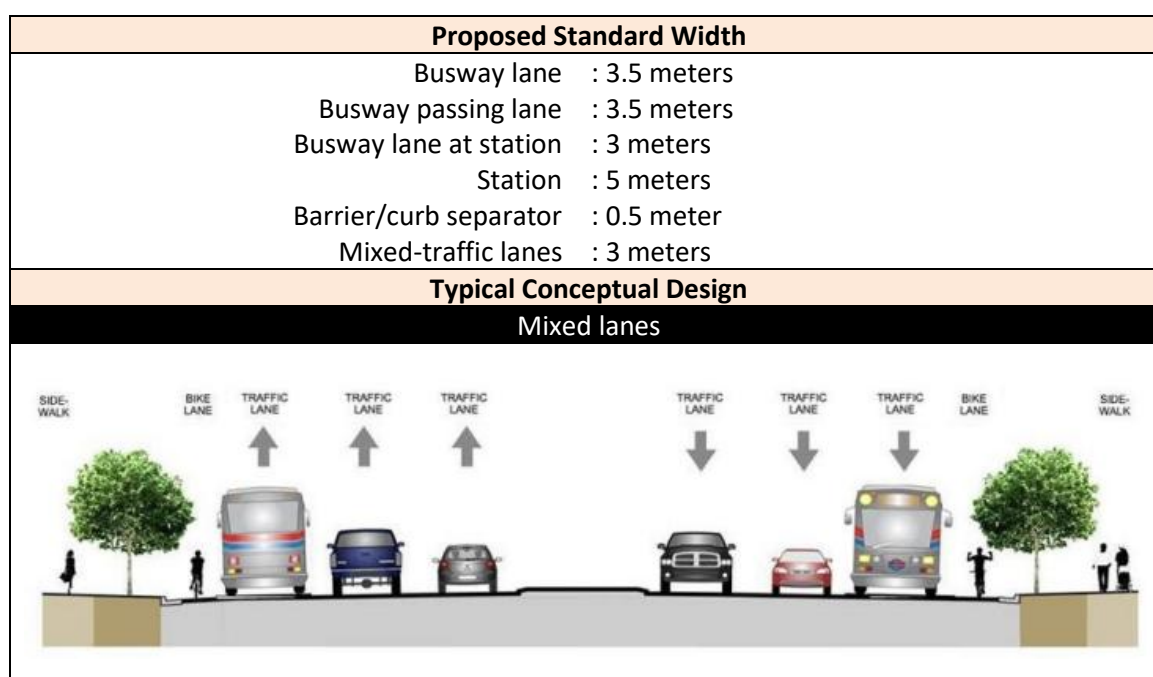
Source: DED 2024, Interim Report 3 page III-65 to page III-71; and 10072024_Project_BBMA BRT_ver1.4

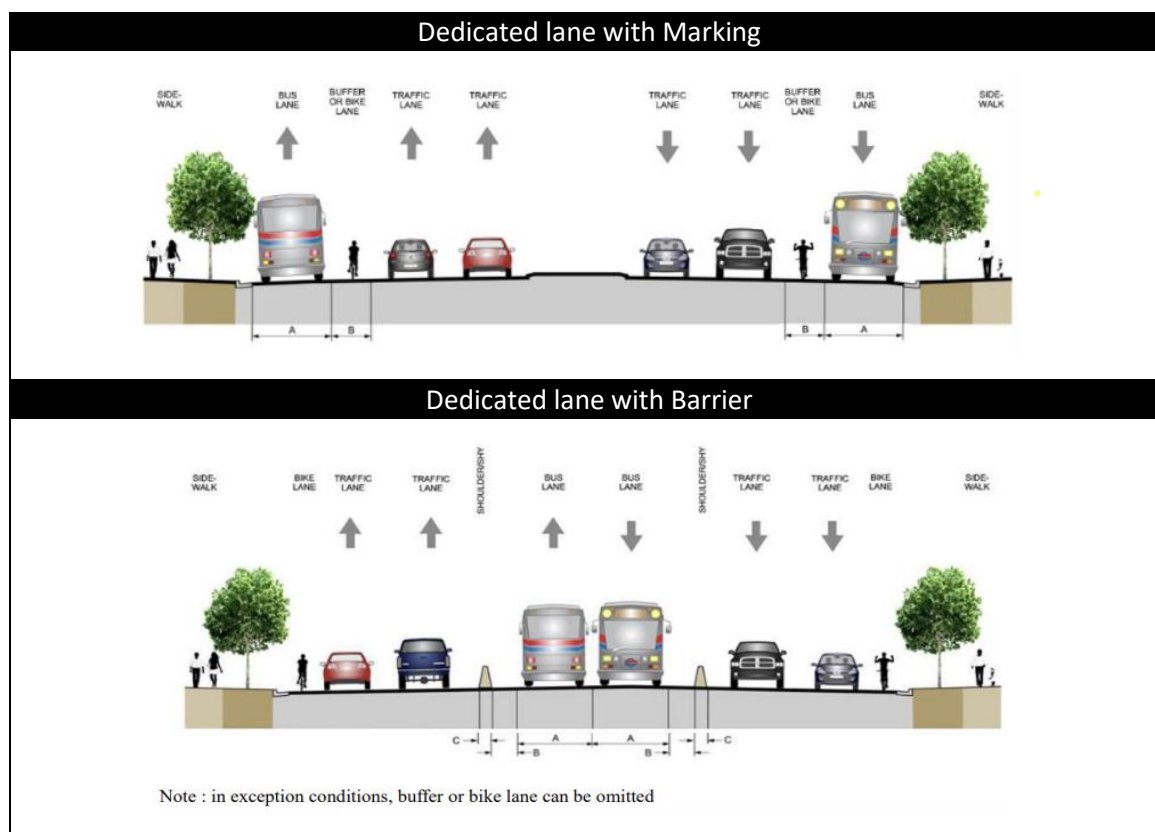
Traffic Design Consideration. The BRT corridor is approximately 22 km long, with a dedicated 1-lane for BRT buses. The BRT corridor will use existing road networks, primarily asphalt-paved, and at bus stop stations, the roads will likely be paved with reinforced concrete. The BRT corridor will have a combination of: (i) Segregated Lane using markings for approximately 4.20 km long and that using a physical barrier for approximately 9.45 km long; and (ii) Mixed Lane (without segregation) with a total length of 7.35 km.

Key advantages of the above corridor design are, among others:

- The speed of the bus can be higher than that of other vehicles outside the dedicated corridor due to small interference from ordinary bus stops, roadside motor vehicle parking, roadside non-motor vehicles, and pedestrians;
- Simple traffic management at the road intersection, which is provided with divided lanes, and the BRT traffic flow is controlled by a signal phase to follow the traffic flow in the same direction;
- High flexibility of station layout with the on-corridor bus stations is designed according to the stopping function, including right stopping, left stopping, and left and right stopping of the bus;
- Relatively little impact on the entrance/exit of units along the route as the BRT lane is arranged in the median mode and operated independently, which has no impact on the access of motor vehicles along the route; and
- Relatively little impact on the long-term reconstruction of the road due to the adoption of the dedicated lane in the road median.

The figure presenting the BRT corridor with segregated and mixed lanes is shown earlier. Typical cross-section design of the BRT corridor for segregated and mixed lanes is illustrated in the following.



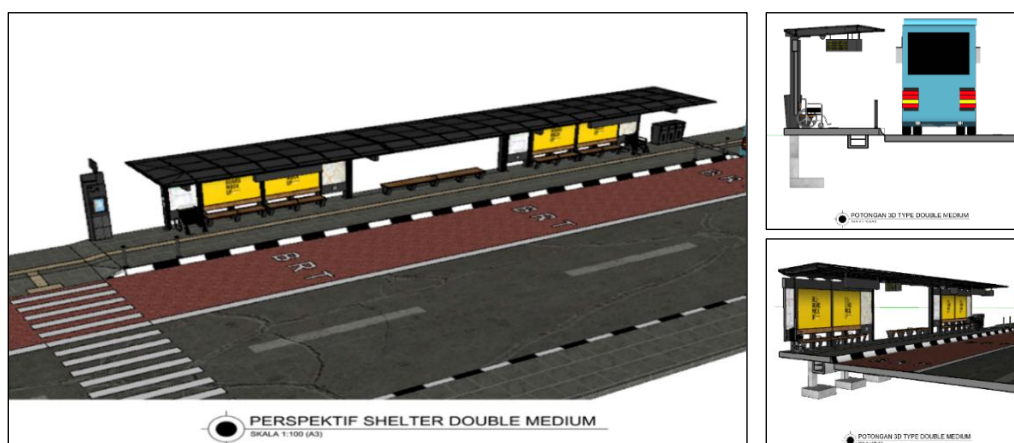


Source: Interim Report: Preliminary Engineering Design BRT-BBMA (DOHWA – Lenggogeni, 2024)

Figure 4. BRT Corridor Design

The existing road network will require widening, particularly to accommodate the dedicated BRT lane and the construction of 30 on-corridor bus stops based on the following design considerations:

- The width of the dedicated lane is in a range of 3.00 – 3.25m for the speed of the BRT bus of less than 40km/h and in a range of 3.25 – 3.50 m for the speed of the BRT bus of 40 - 50km/h. Crash barrier shall be arranged for hard isolation, and further road marking and colored asphalt shall be used to indicate the exclusive right-of-way of BRT in sections with limited road width.



Source: Presentation Preliminary Design Report (DOHWA – Lenggogeni, 2024)

Figure 5. Overview of BRT On-corridor and Bus Stop/Platform

- The width of the bus platform stopping lane is in a range of 2.75 – 3.25m. The platform stopping lane should be marked with road markings and colored asphalt to indicate the exclusive right-of-way for BRT. Typical BRT bus stops are illustrated in the following figures.

Road Segments to be Used by BRT Corridor. The following table describes the existing roads (called ‘jalan’, abbreviated as “Jl.”), including estimated length and road status, that will be used as the BRT corridor in Bandung City.

Table 3. Existing Road Segments to be Used by BRT Corridor

Name of the road	Length (m)	Road Status
Jl. Asia Afrika	1,474.90	City road
Jl. Jenderal Sudirman (from Jl. Otto Iskandardinata intersection to Jl. Nurtanio)	2,990.17	City road
Jl. Jenderal Sudirman (from Jl. Nurtanio intersection to Jl. Rajawali Barat)	1,250.0	National road
Jl. Rajawali Barat	956.80	Nasional road
Jl. Rajawali Timur	1,461.90	City road
Jl. Kebon Jati	1,541.70	City road
Jl. Suniaraja	205.92	City road
Jl. Banceuy	632.67	City road
Jl. ABC	354.34	City road
Jl. Naripan	835.15	City road
Jl. Ahmad Yani (SW -NE direction)	2,409.00	City road
Jl. Ahmad Yani A (SW-NE direction from Jl. Laswi to Jl. Supratman)	535.00	Provincial road
Jl. Ahmad Yani B (NE-SW)	1,049.00	City road
Jl. Ahmad Yani B (NE-SW direction from Jl. Laswi to Jl. Supratman)	535.00	Provincial road
Jl. Ibrahim Adjie	515.00	City road
Jl. Jakarta	1,049.00	City road
Jl. Otto Iskandar Dinata	2,333 .00	City road
Jl. BKR	279.00	Provincial road
Jl. Mochamad Toha	1,056 .00	City road
Jl. Pungkur	87.00	City road
Jl. Dewi Sartika	533.00	City road
Jl. Dalem Kaum	101.00	City road
Jl. Alun Alun Timur	133.00	City road
Jl. Sunda	57.74	City road
Jl. Veteran	169.01	City road

Source: Interim Report 3 - Preliminary Engineering Design BRT-BBMA (DOHWA – Lenggogeni, 2024)

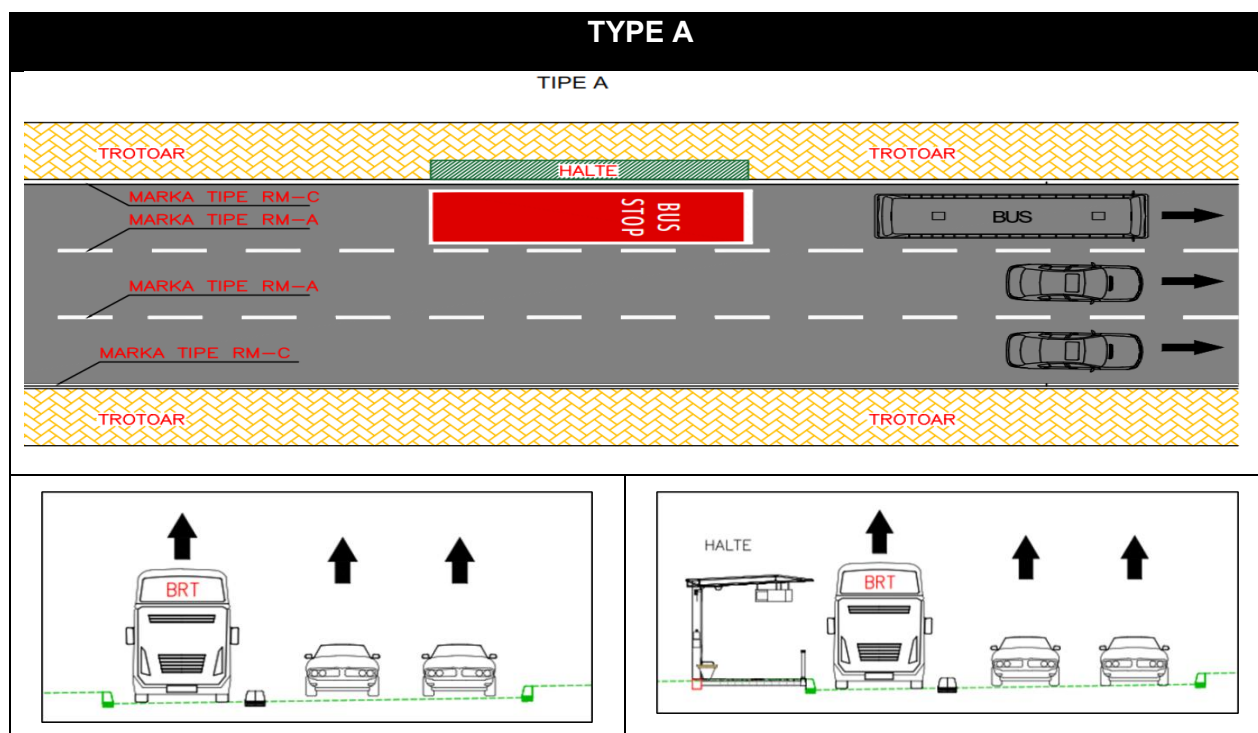
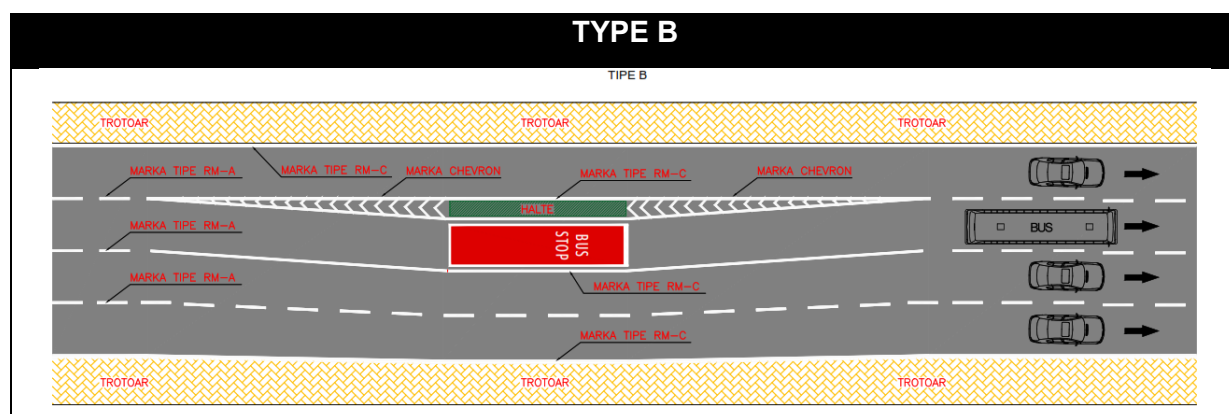
2.3. BRT Bus Stop/Platforms

The BRT project design includes 6 (six) types of platforms for 38 bus stops, designated Type A to Type F, as presented and illustrated below. The use of these platforms depends on the typical cross-section of BRT lanes.

Table 4. Platform Type

Platform	Number Of Lanes	Number of Roadways	Bus Stop	
			Position	Roadways Number
Type A	1	3	Curb	1
Type B	1	4	Median	2
Type C	2	4	Median	3
Type D	2	2	Curb	1
Type E	2	2 - 1	Curb	1
Type F	2	3 - 2	Curb	1

Source: DOHWA-Lenggogeni, 2024

**Figure 6. Platform Type A**

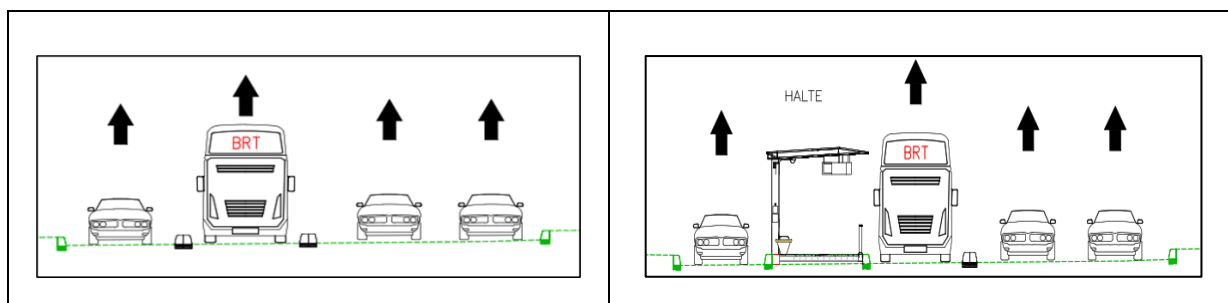


Figure 7. Platform Type B

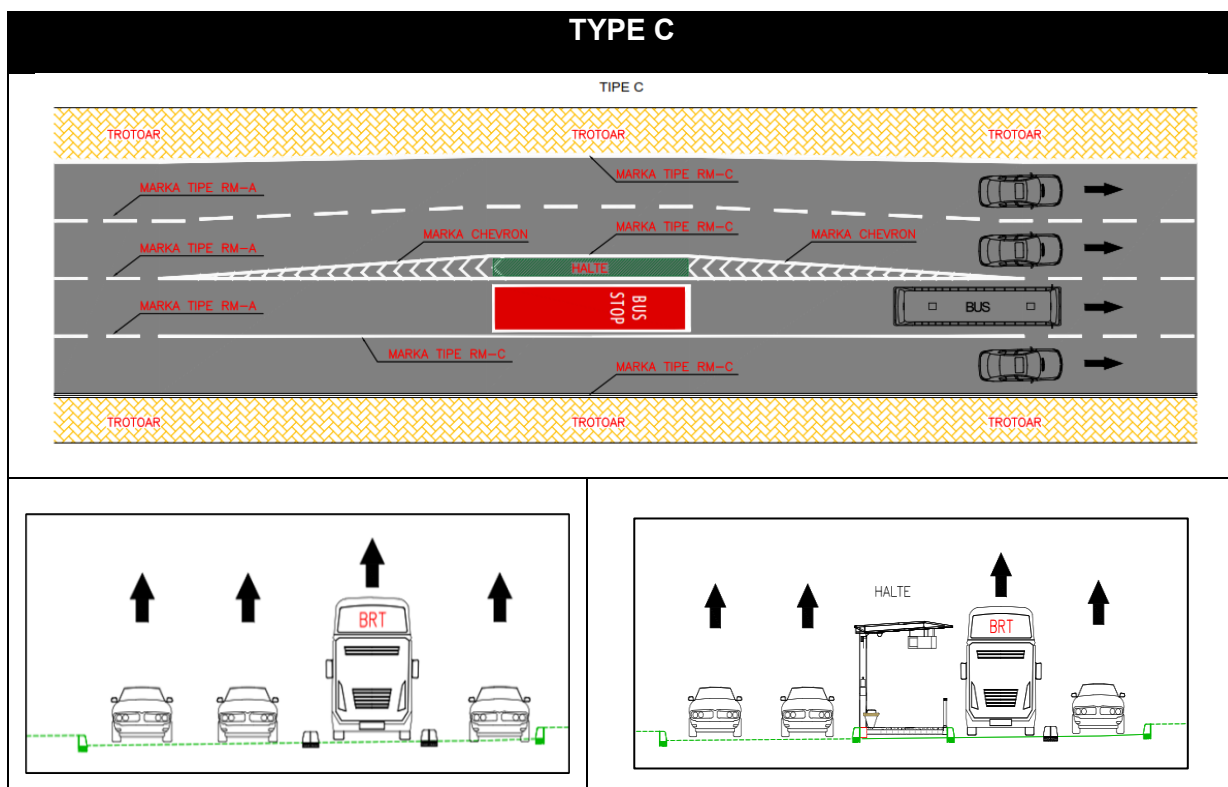
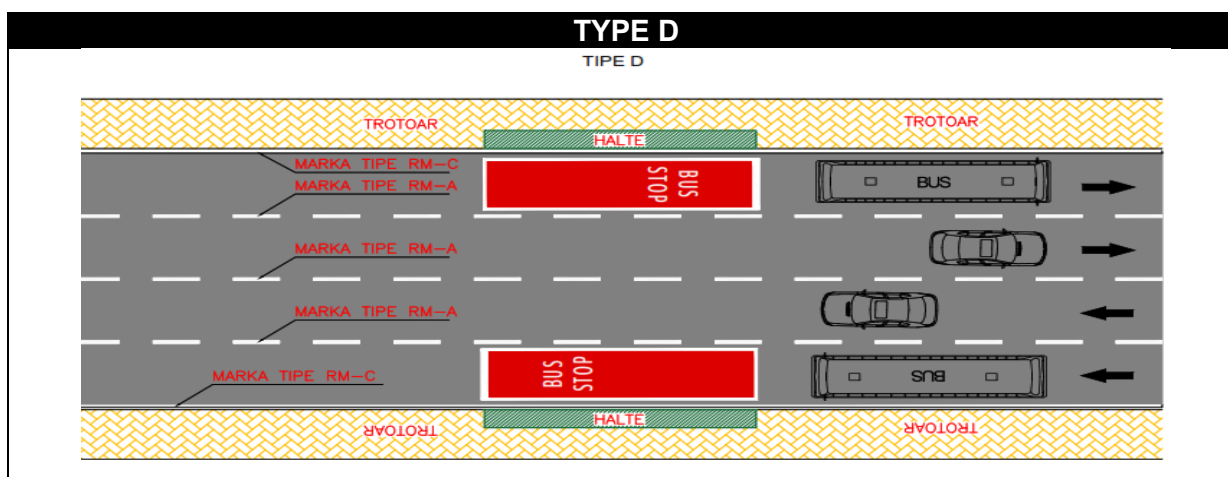


Figure 8. Platform Type C



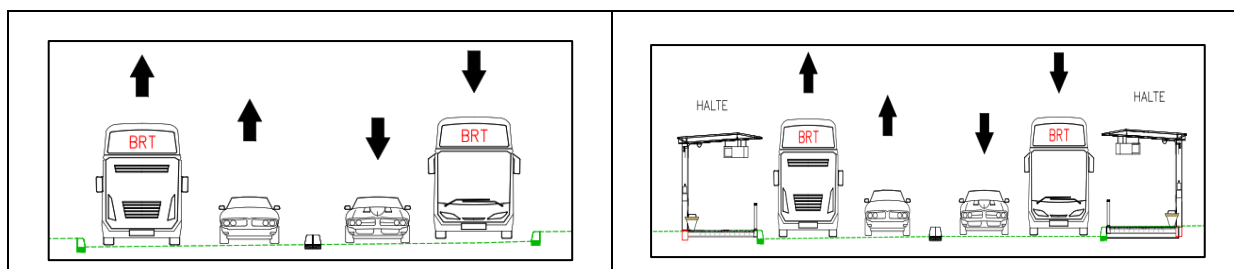


Figure 9. Platform Type D

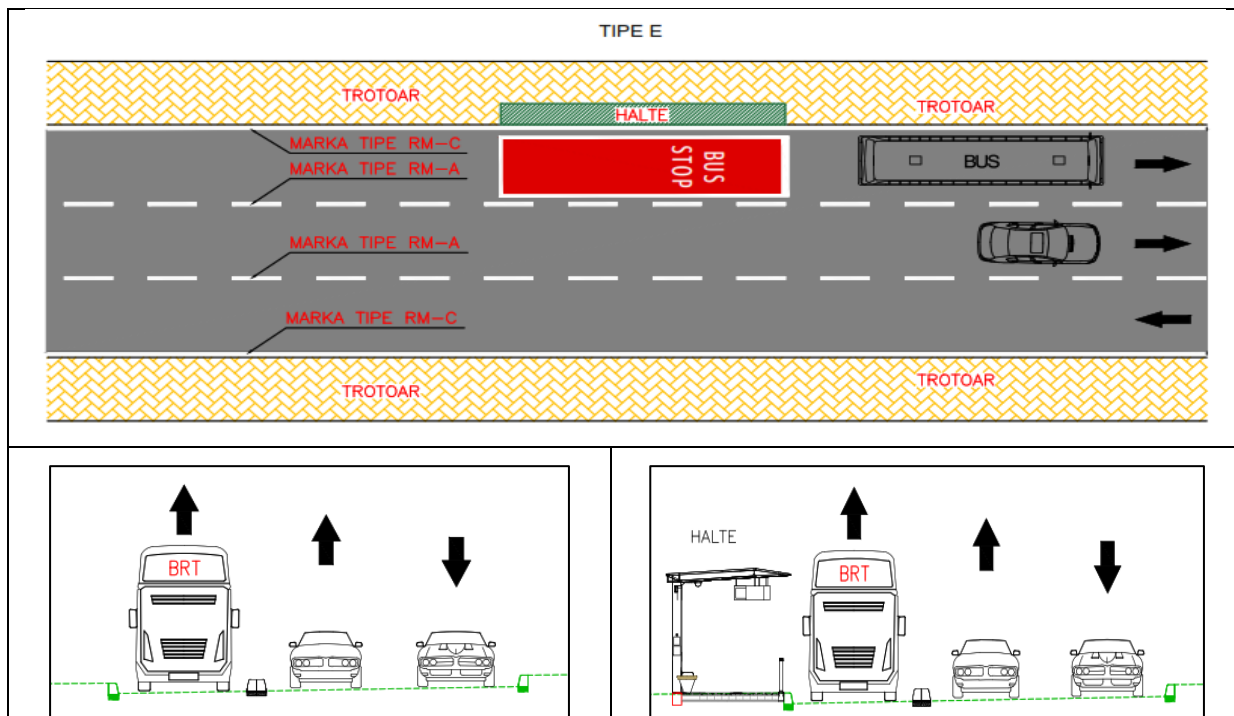


Figure 10. Platform Type E

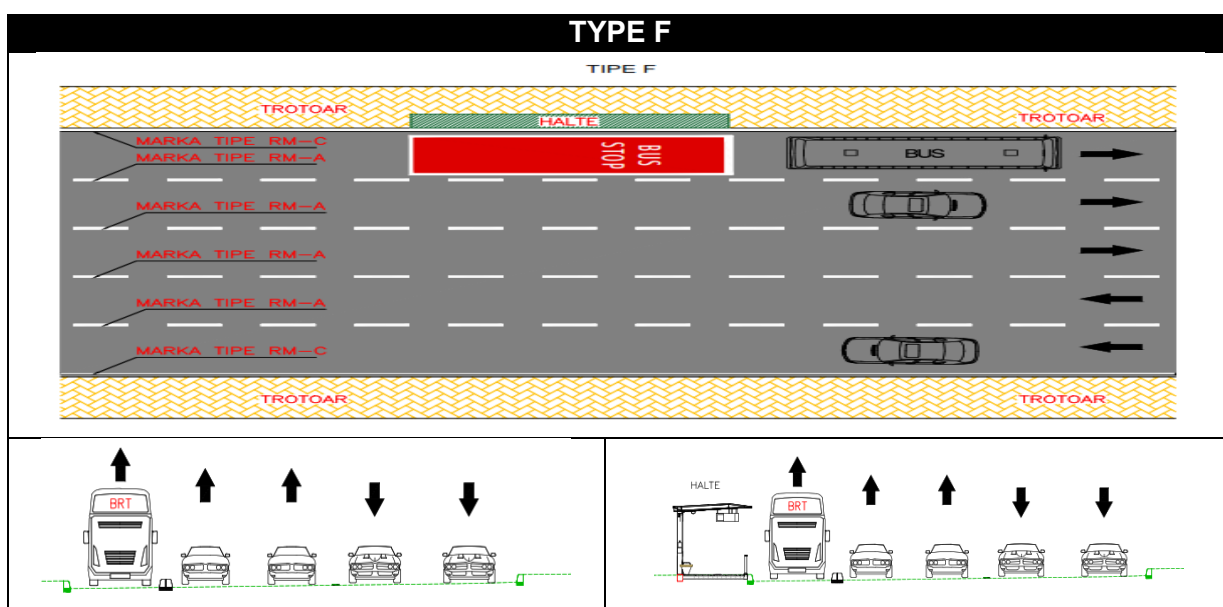


Figure 11. Platform Type F

The proposed type of platforms at each of the on-corridor BRT stations are located at the bus station area. BRT stations are designed to enable passengers to board and alight from buses, purchase and validate tickets, and wait for service. The construction of BRT stations will include new bus stops equipped with improved access and arrival areas, platforms, and an information system related to BRT services. To serve passengers efficiently, buses must approach and align designated areas within the station. The following table lists the names of BRT stations and the proposed type of platforms used.

Table 5. On-Corridor Bus Stops/Platforms

Code	Name	Platform Type	Platform Dimension		
			Length (m)	Width (m)	Area Required (m ²)
BS 1	Stasiun Hall (Terminal)	Type A	27	3	81
BS 2	Pasar Baru	Type B	72	3	216
BS 3	Dalam Kaum	Type A	72	3.2	230.4
BS 4	Pasir Koja	Type A	15	3	45
BS 5	Tegallega (Jalan BKR)	Type A	33	3	99
BS 6A	Taman Tegallega - Sisi Utara	Type D	72	3.1	223.2
BS 6B	Taman Tegallega - Sisi Selatan	Type D	15	3	45
BS 7	Ciateul	Type F	28	3.2	89.6
BS 8	ITC Kebon Kelapa	Type A	24	3	72
BS 9	Kapatihan	Type A	72	3.5	252
BS 10	Alun-Alun	Type A	72	6.75	486
BS 11	Cikapundung	Type A	15	3	45
BS 12	Naripan	Type E	15	3	45
BS 13A	Pasar Kosambi	Type D	33	3.6	118.8
BS 13B	Pasar Kosambi	Type D	24	2.5	60
BS 14A	Stadion Sidolig	Type D	15	3	45
BS 14B	Stadion Sidolig	Type D	33	3.5	115.5
BS 15A	IBCC (Istana Building Commodities Centre)	Type D	24	3	72
BS 15B	Santa Maria	Type D	24	3.5	84
BS 16	Cicadas	Type A	28	3.5	98
BS 17	Kebon Waru	Type A	24	3.5	84
BS 18	Simpang Lima	Type A	24	3.5	76.8
BS 19	Asia Afrika	Type A	18	3.5	63
BS 20	Dulatip	Type A	24	3.5	84
BS 21	GKI Anugrah	Type A	15	3.3	49.5
BS 22	Andir	Type A	24	3.2	76.8
BS 23	Jamika	Type F	12	3.0	36
BS 24	Suryani	Type F	24	3.0	72
BS 25	Bundaran Cibereum	Type C	46	3.0	138
BS 26	Batas Kota	Type C	46	3.0	138
BS 27	RS Rajawali	Type A	24	3.4	81.6
BS 28	YWKA (Yayasan Wanita Kereta Api)	Type A	18	3.5	63
BS 29	Rajawali Timur	Type A	12	3.0	36
BS 30	Ciroyom	Type A	24	3.0	72

Code	Name	Platform Type	Platform Dimension		
			Length (m)	Width (m)	Area Required (m ²)
BS 31	Trinitas	Type A	13	3.0	39
BS 32	Kebon Jati	Type A	22	3.5	77
			16	3.5	56
BS 33	Banceuy Center	Type A	24	3.5	84
BS 34	BTM (Bandung Trade Mall)	Type A	33	3.5	115.5

Source: DED Report (2024); and Transport Management Review Report of BRT-BBMA (March 2025)

2.4. Reconstruction of Road Intersections

The BRT project will require a reconstruction or adjustment of 38 road intersections along the BRT corridor, including a four-way intersection, which is a crossroad where two roads meet, and a T-intersection, which is a three-legged intersection where two roads meet. This can take the form of traffic light management, providing road markings and signs, as well as creating curb islands to regulate traffic movements. The road intersections subject to reconstruction and adjustment, including installation of road traffic signals, are presented in the following table.

Table 6. Road Intersections Subject to Reconstructed/Adjusted

Code	BRT Corridor Site	Intersection Type	Intersecting Roads			
SP01	Ahmad Yani – St Yusuf	T-Intersection	Santo Yusuf	Kiaracondong	Ahmad Yani	
SP02	Kiaracondong	4-Intersection	Santo Yusuf	Kiaracondong	Antapani	Sudirman
SP03	Jakarta – A Yani	4-Intersection	Supratman	Kiaracondong	Cicadas	Cihapit Laswi
SP04	Laswi	4-Intersection	Cihapit	Cikaso	Laswi	Kosambi
SP05	Simpang Lima	5-Intersection	Naripan	Malabar	Karapitan	Kosambi, Asia Afrika
SP06	Lengkong Besar	4-Intersection	Tamblong	Lengkong Besar	Naripan	Braga
SP07	Karanganyar	4-Intersection	Gardujati	Braga	Cibadak	Kebon Jati
SP08	Gardujati	4-Intersection	Gardujati	Karanganyar	Cibadak	Kebon Jati
SP09	Jamika	T-Intersection	Jamika	Andir	Garuda	
SP10	Garuda	T-Intersection	Sudirman	Cibeureum	Rajawali	
SP11	Bunderan Cibereum	4-Intersection	Jamika	Rajawali	Soekarno-Hatta	Cimahi
SP12	Cibeureum	3 Ramp merge	Sudirman	Rajawali	Cimahi	
SP13	Nurtanio	4-Intersection	Nurtanio	Andir	Rajawali	Garuda
SP14	Pasirkaliki	4-Intersection	Pasirkaliki	Suniaraja	Gardujati	Kebon Jati
SP15	Simpang Pasar Baru	4-Intersection	Braga	Suniaraja	Pasar Baru	Kebon Jati
SP16	Suniaraja	T-Intersection	Braga	Suniaraja	Banceuy	
SP17	ABC	4-Intersection	Naripan	Suniaraja	Alun-alun BDG	ABC/Pasar Baru
SP18	Naripan – Braga	4-Intersection	Braga	Naripan	Asia Afrika	Banceuy

Code	BRT Corridor Site	Intersection Type	Intersecting Roads			
SP19	Naripan – Sunda	4-Intersection	Braga	Naripan	Veteran	Asia Afrika
SP20	Veteran – A Yani	4-Intersection	Veteran	Kosambi	Burangrang	Asia Afrika
SP21	Banceuy	T-Intersection	Banceuy	Braga	Karanganyar	
SP22	Alun – alun bandung	T-Intersection	Banceuy	Braga	Kepatihan	
SP23	Dalem kaum	4-Intersection	Alun-alun BDG	Dalem kaum	Kepatihan	Bojong gede
SP24	Pungkur	4-Intersection	Alun-alun BDG	Pungkur	Moh. Toha	Pasir Koja
SP25	Balonggede	4-Intersection	Alun-alun BDG	Lengkong Besar	Tegalega	Pasir Koja
SP26	Inggit G – Moh. Toha	4-Intersection	Pungkur	Lengkong Besar	Moh. Toha	Ciateul
SP27	BKR – M Toha	4-Intersection	Pungkur	Lengkong Besar	Moh. Toha	Tegalega
SP28	BKR – Tegalega	4-Intersection	Pungkur	Astana anyar	Moh. Toha	Kopo
SP29	Inggit – Otista	4-Intersection	Panjunan	Ciateul	Pasir Koja	Tegalega
SP30	Jl. Pasirkoja	4-Intersection	Pungkur	Karanganyar	Pasir Koja	Tegalega
SP31	Tamblong	4-Intersection	Tamblong	Naripan	Asia Afrika	Braga
SP32	Gudang Utara – A Yani	4-Intersection	Merdeka	Laswi	Cikudapateuh	Kosambi
SP33	Ciroyom	3 Ramp merge	Rajawali	Kebon Jati	Andir	
SP34	Andir	T-Intersection	Andir Market	Jamika	Cibadak	
SP35	Rajawali	T-Intersection	Cimahi	Garuda	Soekarno-Hatta	
SP36	Braga – Asia Afrika	T-Intersection	Braga	Lengkong Besar	Alun-alun BDG	Cikawao
SP37	Veteran – Sunda	4-Intersection	Siliwangi	Lembong	Kosambi	Asia Afrika
SP38	Malabar	T-Intersection	Asia Afrika	Laswi	Papandayan	

Source: Interim Report 1: Preliminary Engineering Design BRT-BBMA (DOHWA – Lenggogeni, 2024)

2.5. Estimated Passengers

On-corridor Bus Stops. In the table below, the DED report of BRT-BBMA (DOHWA – Lenggogeni JV, March 2025) estimates the total number of passengers boarding and alighting at each on-corridor bus station in a range of 5 passengers/hour at Rajawali Timur station to 1,560 passengers/hour at Taman Tegalega station. The highest numbers of passengers are estimated at 948 passengers/hour at Kebon Jati and 1,038 passengers/hour at Alun-Alun. The scenarios used in this estimate are as follows:

- 77 BRT buses with a combination of electric and internal combustion engines will be operated for 16 hours per day from 06.00 to 22.00; In addition, nine (9) buses will be on stand-by at the depots.
- At peak hours in the morning and evening, the BRT will provide a higher service frequency to meet the demand of a large number of passengers with a bus operating frequency of every 3 – 5 minutes;

- At non-peak hours, the BRT service frequency will be reduced as the number of passengers decreases, and the number of buses operating frequency of every 5 – 10 minutes, ensuring that the passengers have a reasonable waiting time; and
- During weekends and public holidays, the BRT service frequency will be adjusted depending on the passenger demand and other operational factors.
- Dedicated on-corridor services are designed to connect with the existing transport service providers in BBMA.

Table 7. Estimated Number of Passengers at the Bus Stops

BRT Bus Stop Code	Bus Stop Name	Number of Passengers/hours			Bus frequency/day	No of bus trip/hours
		Boarding	Alighting	Total		
BS 01	Station Hall	22	166	188	55	3
BS 02	Pasar Baru	250	289	539	61	4
BS 03	Kalipah Apo	127	328	455	72	5
BS 04	Otista	176	96	272	45	3
BS 05	Terminal Tegallega	126	68	194	36	2
BS 06	Taman Tegallega	769	791	1,560	52	3
BS 07	Ciateul	8	194	202	36	2
BS 08	ITC-Kebon Kalapa	60	29	89	36	2
BS 09	Kepatihan	393	465	858	63	4
BS 10	Alun Alun	520	518	1,038	104	7
BS 11	Cikapundung	380	179	559	18	1
BS 12	Naripan	51	119	170	28	2
BS 13	Pasar Kosambi	273	384	657	25	2
BS 14	Stadion Sidalig	275	280	555	34	2
BS 15	Ahmad Yani	231	331	562	25	2
BS 16	Cicadas	242	79	321	25	2
BS 17	BTM (Baru)	254	249	503	25	2
BS 18	Kebon Waru	254	249	503	25	2
BS 19	Simpang Lima	143	118	261	42	3
BS 20	Asia Afrika	5	75	80	42	3
BS 21	Sudirman Dulatip	255	246	501	31	2
BS 22	Sudirman GKI Anugerah	218	137	355	31	2
BS 23	Sudirman Pasar Andir	54	302	356	31	2
BS 24	Sudirman Jamika	75	94	169	31	2
BS 25	Sudirman – Suryani	64	51	115	31	2
BS 26	Bundaran Cibeureum	252	51	303	31	2
BS 27	Sudirman Batas Kota	10	19	29	22	1
BS 28	RS Rajawali	245	216	461	22	1
BS 29	Rajawali YWKA	7	303	310	31	2
BS 30	Rajawali Timur	5	0	5	31	2
BS 31	Pasar Ciroyom	50	50	100	31	2
BS 32	Sekolah Trinitas	59	84	143	31	2
BS 33	RS Kebon Jati	309	639	948	31	2
BS 34	Banceuy/Suniaraja	5	3	8	55	3
TOTAL					-	-

Source: Propose DED Report (2024); and Transport Management Review Report of BRT-BBMA (March 2025)

2.6. Bus Specification

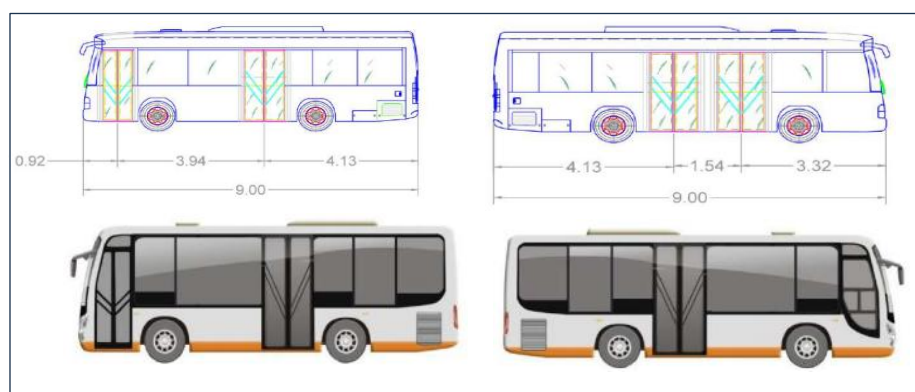
The BRT project will use 12-meter-long buses to serve passengers within the on-corridor and 9-meter-long buses to serve passengers off-corridor, taking into account the width of the road. The bus will have a low deck to provide accessibility for passengers and allow those boarding from the curb and those with special needs to hop on directly without stairs/steps. Special platforms will be provided at several bus stops to allow passengers to board the BRT on the on-corridor high deck. The following table provides the bus specifications of the BRT project.

Table 8. BRT Bus Specification

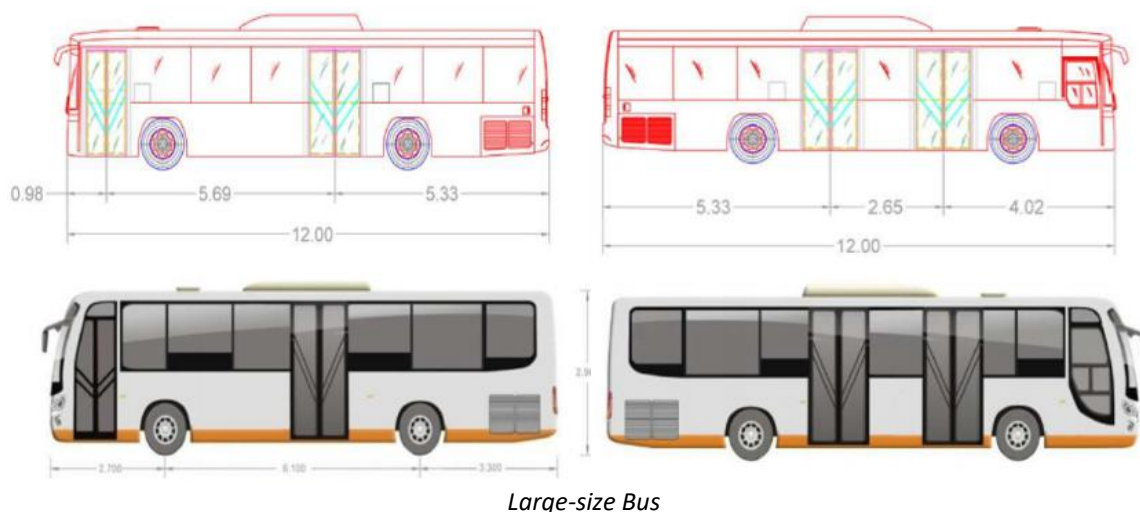
Parameter	12-m long bus (large size)	9-m long bus (medium size)
Length	12 m	9 m
Width	Max 2.50 m	Max 2.45 m
Height	Max 3.1 m	Max 3.1 m
Entrance height	300 mm	300 mm
Door width	1.200 mm (mid door) 1.000 mm (front door)	1.200 mm (mid door) 1.000 mm (front door)
Number of seats	29 seats	20 seats
Wheelchair space	1 space	1 space
Number of people standing	Max 55 passengers	Max 25 passengers

Source: DED by Dohwa-Lenggogeni, 2024

The following illustrates two types of buses to be operated by the BRT project.



Medium-size Bus

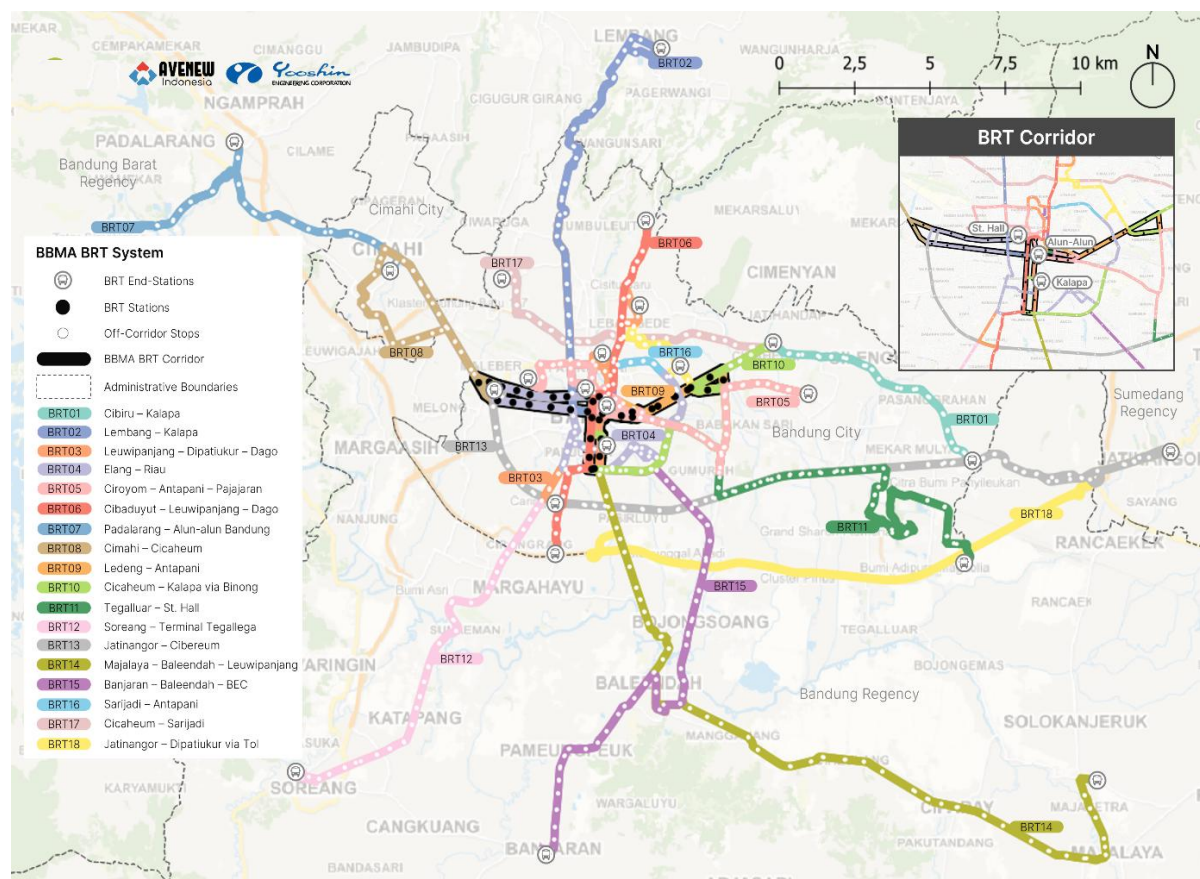


Large-size Bus

Figure 12. BRT Bus Size

2.7. BRT Direct Service Route (Off-corridor)

The BRT project plans to connect directly with on-corridor BRT services, initially supported by nine (9) transport service routes in the off-corridor area. The off-corridor routes providing direct service to and from the BRT corridor are shown in the following figures. A total of 242 off-corridor bus stops/shelters will be constructed along these off-corridor service areas.



Source: Redrawn from draft Andalalin BRT-BBMA (DOHWA – Lenggoneni, 2024)

Figure 13. BRT Service Routes in Relation to Bandung Basin Metropolitan Area

As presented in the following table, nine (9) transport service routes (BRT off-corridor) are planned to be connected with the BRT on-corridor services.

Table 9. BRT Off-corridor Service Routes

Service Number	From	To (and vice versa)	Total travel distance of both directions (km)
BRT01	Bundaran Cibiru	Halte BRT Kebon Kalapa	31.25
BRT02	Terminal Ledeng	Halte BRT Kebon Kalapa	19.80
BRT03A	Terminal Leuwipanjang	Dago Tea House	27.27
BRT03B	Terminal Leuwipanjang	Dago Tea House (via Dipati Ukur)	28.62
BRT04	Pangkalan Elang	Riau	26.38
BRT06	TVRI Jawa Barat, Cibaduyut	Halte BRT Alun-Alun Bandung	11.55
BRT07	Padalarang	Alun-Alun	45.50
BRT08	Stasiun Cimahi	Terminal Cicaheum	36.67
BRT09	Terminal Ledeng	Terminal Antapani	30.22

Source: Off-Corridor Bidding Document of BBMA (August 2025)

2.8. Infrastructure, Facilities, and Landscaping Works

BRT Pavement and Markings. According to BRT DED, rigid/concrete pavement is only used at the bus stops/platforms of the dedicated BRT on-corridor, while the asphalt-typed pavement would be used for the remaining road segments of the on-corridor. To ensure driving comfort at high speeds and connection with the existing pavement, the pavement structure uses flexible pavement, such as asphalt- and/or concrete pavement. Compared with other types of pavement structures, asphalt pavement has advantages such as road surface smoothness, driving comfort for vehicles, low driving noise, good road friction performance, and easy maintenance.

Based on the pavement inspection conducted as part of the DED, reinforcement shall be provided for the subgrade defects identified along the BRT corridor. The stopping lane at the platform is reinforced. Colored epoxy resin would be applied within a 50-meter-long range of the entrance lane and exit lane at the road intersection, as well as at the entire range of dedicated lanes on both sides of the platform. Non-BRT lanes shall be repaired and reconstructed, including the repair of the sidewalk surface of the existing sidewalk.

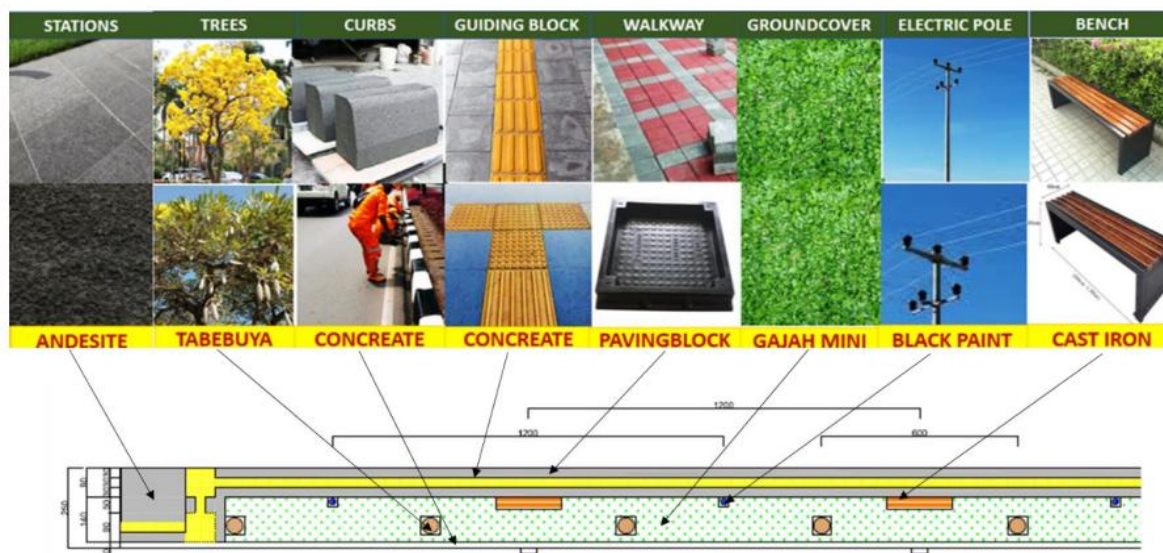
Crash Barrier. Crash barriers will be installed at some segments of the dedicated BRT on-corridor to segregate the lane for BRT buses and those for other road users. The raised barriers are generally 50 cm high and used to separate the dedicated BRT lane from non-BRT bus traffic, preventing traffic flow from entering the BRT lane in violation of regulations, and guiding the vehicles to drive according to the specified route, so as to avoid collisions between vehicles. At the same time, the crash barrier can effectively absorb energy when the vehicles hit the guardrail, reduce the damage to vehicles, and protect the safety of the related drivers.

Road Drainage. The road drainage system within the dedicated BRT corridor shall be designed and constructed according to the provisions of the Ministry of Public Works and Housing (MPWH) Regulation No. 12/PRT/M/2014 (dated 2 October 2014) on City Drainage System and the MPWH Guidelines No. 06/P/BM/2023 (dated 14 April 2023) on the Road Drainage Inventory as well as international standards for drainage aspects not covered in these Indonesian regulations and guidelines. The drainage system design uses estimated daily rainfall data from 1992 to 2021 and a 10-year return-period design flood discharge. The existing drainage channel, likely affected by bus stop platform construction and some road reconstructions, consists of side ditches that will be adjusted to 0.6–1.2 m in width and 0.1–1.0 m in depth.

Road Curb. The code requirements according to Letter of Director General of Highways No./BM0402-Db/145 2022 regarding “*Peninjauan Ulang Pekerjaan Kereb Beton untuk Jalan, Pengecatan Marka Jalan, dan Pengecatan Bagian-bagian Jalan dan Jembatan Lainnya*” would be adopted for the works related to the road curb. Road curbs are used to establish the boundary between the carriageway (vehicle lanes) and the sidewalk. They are also important facilities for road drainage and protect the edges of the road surface structure. The curbs are made of prefabricated concrete. Damaged road curbs would be newly constructed along the dedicated BRT corridor.

Landscaping Works. As shown in the figure below, the existing sidewalks/pedestrian along the dedicated BRT corridor will be upgraded. In this circumstance, the presence of trees and vegetation and landscaping works will be undertaken to improve the urban landscape within the dedicated BRT corridor while restoring the surrounding aesthetic within the project area that may have been disturbed during the construction of the BRT project. The landscaping works would include construction of permanent, concrete-made seats, pavement of the pedestrian with durable and anti-slip materials, street lighting, and other ancillary facilities such as trash can. The following images are examples of the urban landscaping works that will be undertaken as part of the BRT project.

Facilities for Disabled Persons. The marching blind road as a guiding block (as referred to in Figure 14) of 0.30 m wide will be installed on the pedestrian to guide the person with visual disability while walking. The barrier-free paving location is generally 0.10 to 0.60 m away from the greening belt or roadside. A prompt blind road is set at the turning point of the marching blind road. Protruding objects on the pedestrian path that may cause danger to the visually impaired person will be enclosed, enabling them to bypass them. At the same time, no sudden height differences or cross ridges are established on the sidewalks of the road section to facilitate the use of wheelchairs for physically disabled individuals. In case of a height difference or cross ridge, a slope is used as a transition and ramp



Source: Interim Report: Preliminary Engineering Design BRT-BBMA (DOHWA – Lenggogeni, 2024)

Figure 14. Sidewalk/Pedestrian Design

Electrical Equipment. Since PLN is reducing its electricity supply, solar panels are expected to be used as an alternative energy source for the bus stops. Bus stop electrical equipment will include CCTV, Sound system, Wi-Fi, LED TV, shelter lighting, waiting-time panel, stop contact/socket, and charger for cellular phones.

2.9. Bus Depots, Terminals, and End Stations/Terminus

Bus Depots. Two BRT bus depots, which also serve as terminals, will be constructed within the existing *Cicaheum* and *Leuwipanjang* Terminals. Essential depot facilities to be constructed include parking space, high-quality pavement, bus maneuvering space, fueling stations, bus cleaning and washing areas, maintenance and repair workshops, and operator administration offices. These depots will also serve as the BRT end stations. The facilities and area required for the design of the bus depots are presented in the following table.

Table 10. Facilities and Area Required for the BRT Depots

Facilities	Cicaheum (m ²)	Leuwipanjang (m ²)
Depo entrance/exit gate (security post)	18	18
Parking areas:		
- Internal parking (bus)	3710.5	2805.5
- External parking (Officials & Visitors)	190	175.75
Bus fuelling and charging area	90.2	83
Cleaning washing facility with a washing bay	60	60
Maintenance facility		
- Main workshop	345	309,75
- Body shop zone (painting)	119.41	119.41
Administrative facility		
- General office	95	95

Facilities	Cicaheum (m ²)	Leuwipanjang (m ²)
- Operation office	55	55
- Employee facilities (including toilet, kitchen, bathroom, and canteen)	297	240,5
Total Area	4,980.11	3,961.91
BRT bus parking capacity (unit)	57	29
Land/facility ownership	City Government of Bandung	Partly owned by Bandung City & MOT

Source: Final DED Report (2024); and Transport Management Review Report of BRT-BBMA (March 2025)



Existing Cicaheum Terminal (Ref:

https://www.google.com/search?q=terminal+bus+cicaheum&rlz=1C1GCEA_enID1148ID1148&oq=terminal+bus+cicaheum&gs_lcrp=EgZiaHJvbWUyBggAEEUYOdIBCDg0NTFqMGo5qAIAAsAIB&sourceid=chrome&ie=UTF-8#vhid=/g/11h_vwn7jh&vssid=lcl&pg=cid:CgIgAQ%3D%3D,ik:CAoSf0NJSE0wb2dLRUIDQWdJRE1tdl9XOXdf



Future BRT Depot – Cicaheum



Ref: <https://www.antarafoto.com/id/view/1556457/revitalisasi-terminal-leuwipanjang>

Existing Leuwipanjang Terminal



Future BRT Depot – Leuwipanjang

Figure 15. BRT Depot Design – Cicaheum and Leuwipanjang

Bus Terminals/End Stations. Based on existing public transport routes and demand analysis, the *Ledeng* and *Antapani* Terminals are selected as the BRT bus terminals and serve as the end stations/terminus. The area required for the BRT station is shown in the table below.

Table 11. Area Required for BRT Stations

Existing Terminal	Current Use	Future Use	Existing area (m ²)	Area needed for BRT (m ²)
Ledeng	<i>Angkot</i> terminal	Current use and future BRT terminal	2,600	699.8
Antapani	<i>Angkot</i> terminal	Current use and future BRT terminal	3,200	689.8

Source: DED Report (2024); and Transport Management Review Report of BRT-BBMA (March 2025)

In addition, 14 BRT end stations/terminus will be designated as part of the BRT system as presented in the following table.

2.10. Clean Water Supply and Waste Management

Water Supply and Wastewater Treatment. The DED estimates that the clean water supply required to support the operation of BRT depots and terminals/end stations is approximately 493 m³/day, particularly for domestic usage by passengers and operators, housekeeping, and BRT bus washing at the depots. Clean water supply will be primarily sourced from the local government water supply company (PDAM), supplemented by groundwater extraction as a backup, given that PDAM's existing capacity may not be sufficient to meet the project's full water demand. Therefore, the groundwater utilization permit (as SIPA) will be processed and obtained in the subsequent phase of the project. Furthermore, the wastewater generated by clean water use is estimated at 379 m³/day (i.e., less than 80% of the clean water supply).

A wastewater treatment system, known as STP-FRP Biotech (using aerobic and anaerobic processes), to treat domestic wastewater from depot and terminal operations, with a treatment capacity of 5-25 m³/d, will be installed. The effluent from the WWTP will enter an

interim storage tank before discharge to a soil infiltration area. The sludges accumulated in the WWTP will be periodically removed using vacuum trucks. In addition, a pre-treatment grease trap with a capacity of 2.5 m³/d will be provided at depots and terminals at the wastewater discharge point from the cafeteria and kitchen.

The following diagram illustrates the clean water supply and wastewater treatment flows for the depot, indicating that wastewater from BRT bus washing will undergo some treatment for reuse in the washing system. Approximately 60% of the water generated by the bus-washing WWTP system will be recirculated and reused to wash incoming BRT buses.

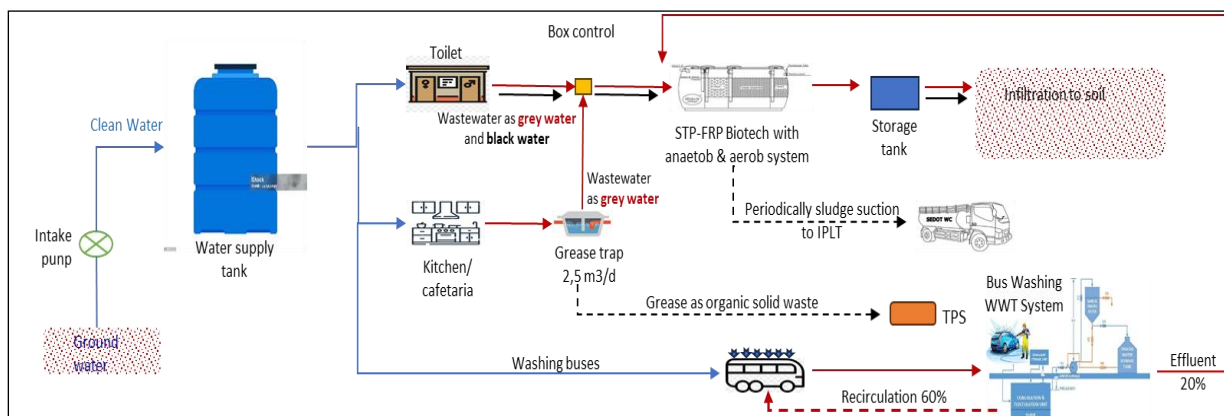


Figure 16. Wastewater Treatment and Reuse Schematic at Depot

Water supply required for bus washing machines is about 4.8 m³/day. Then, the effluent from its wastewater treatment will be reused for about 60%, whilst the remaining 20% will go to the WWTP of STP-FRP biotech, as shown in the following diagram.

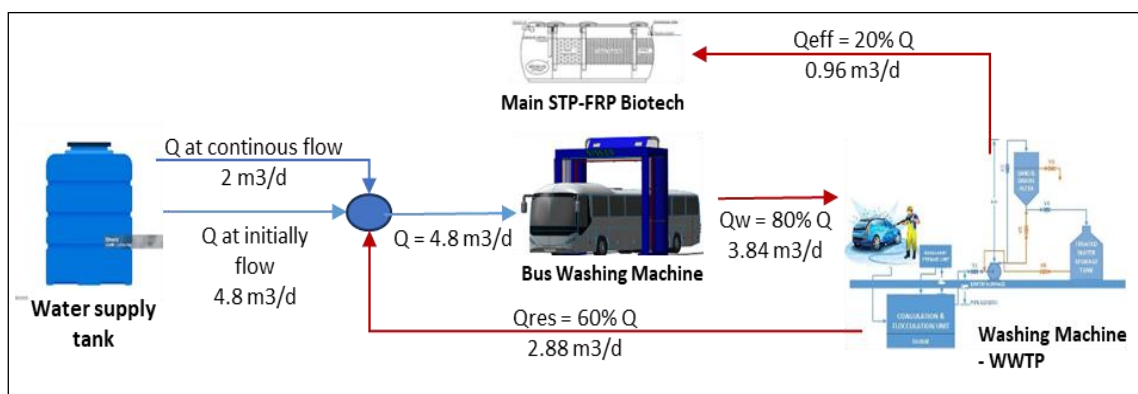


Figure 17. Flowchart Water Mass Balance of Bus Washing Machine System

Solid Wastes. The BRT operation is anticipated to generate approximately 10 m³/day of solid waste, comprising approximately 53% organic/putrescible waste and 42% recyclable waste. Provide a dust bin with volumetric capacities of 40L, 100L, and 240L, for a total of 446 units, to be allocated at depots, terminals, and bus stops. These wastes will be collected by the Bandung City Environmental and Cleanliness Department and disposed of at a licensed waste disposal facility operated by the local government.

Hazardous Wastes. Hazardous waste from bus maintenance and office activities, such as used batteries from e-buses and buses with combustion engines, used lubricant oil, paint waste, and cartridges from office printers. Hazardous waste storage will be located at each depot and terminal, with complete facilities, as per the Minister of Environmental and Forestry Regulation No. 6 of 2021. Hazardous waste will be removed periodically by cooperating with a licensed transporter for official hazardous waste disposal. Therefore, the management of hazardous waste activities, which comprises collecting, packaging, recording, and spillage protection, will be established by providing SOP (Standard Operating Procedure).

2.11. Affected Lands, People, and Trees

Affected Land and Area. No acquisition of privately owned land will be required for the BRT project, according to the project's LARAP (dated March 2025). The land and/or areas required for the BRT Project include, among others, 21.7 km long existing roads for BRT on-corridor; 38 BRT stops/platforms covering 3,965-m² area; 14 terminals/end stations covering 4,008-m² area; and *Cicaheum* and *Leuwipanjang* Depots. The breakdown of affected lands and areas is presented in the following table.

Table 12. Affected Land and Area

Facility	Length/Area	Current Use	Land Ownership and Area Affected
Dedicated BRT corridor	21.7-km	Existing road's right-of way	- Ministry of Public Works: 2.206.8-meter-long - West Java Province: 814 meter long - Bandung City: 18,560 meter-long
38 BRT bus stops	3,964.70 m ²	Sidewalk within ROW	- Ministry of Public Works: 357.6 m² - West Java Province: 424 m² - Bandung City: 3,182.90 m²
Terminals/End Stations	4,008 m ² (total)	Sidewalk within ROW	
<i>End stations within on-corridor</i>		Existing bus stop; and road within RoW	
1. Alun-Alun			
2. ITC Kebon Kalapa			
<i>12 End stations within off-corridor</i>			
1. Terminal Antapani		Type C Terminal (Angkot terminal)	- Bandung City: 1.583 m² - Ministry of PWH: 90 m² - PT. KAI: 90 m²
2. Cibaduyut		Sidewalk/existing bus stop	PT. KCIC: 45 m²
3. Bundaran Cibiru		Sidewalk and parking area	West Java Province; 2.200 m²
4. Cicaheum		Intercity bus and <i>angkot</i> terminals	
5. Cimahi		Sidewalk	
6. Dago		Park	
7. Elang (Cibeureum)		Existing Bus Stop	

Facility	Length/Area	Current Use	Land Ownership and Area Affected
8. Terminal Ledeng		Angkot terminal	
9. North Leuwipanjang		Dishub Office	
10. South Leuwipanjang		Sidewalk	
11. Padalarang Station		Parking area	
12. Riau		Sidewalk	
Cicaheum Depot	10,058 m ²	Active terminal with offices and kiosks	Bandung City
Leuwipanjang Depot – south of the existing terminal	6,298 m ²	Active terminal with offices	Bandung City

Source : LARAP Document (DOHWA – Lenggogeni, Feb 2025)

Project Affected Peoples (PAPs). Based on the LARAP prepared for BBMA, it is identified that the PAPs whose livelihoods may be impacted by the BRT project are as follows:

- Affected street vendors (*pedagang kaki lima* or PKL) along the BRT corridor, depots, terminals, and end stations. Overall, the number of affected street vendors is around 1,735, which were grouped by zone based on the provisions of Bandung City Regulation No. 4/2011 as 331 street vendors in the green zone, 353 street vendors in the yellow zone, and 1,051 street vendors in the red zone. The green zone and the yellow zone refer to allocated spaces where street vendors could sell their goods. Meanwhile, the red zone refers to unallocated space for street vendors (from the local government regulation's viewpoint, it is 'illegal' for street vendors to sell there).
- Parking attendants of on-street parking along the on-corridor and other parking locations at the terminal, end station, and depot locations. The total number of parking attendants potentially affected by the BRT project is around 193 people, including 188 people who are the household heads. These 193 people consist of permanent parking attendants (as electronic and manual parking offers) registered with the Transportation Agency of Bandung City (*Dinas Perhubungan Kota Bandung*) and unregistered parking attendants.
- Land/kiosk tenants are found in several terminals that are planned to become BRT Depot and End Station locations, as follows: (1) Existing *Cicaheum* Terminal which is planned to be a Depot, (2) Existing *Antapani* Terminal, planned to be an end station/Terminus, and (3) Existing *Ledeng* Terminal planned to be an end station/terminus. No kiosk is identified at the existing *Leuwipanjang* Terminal. The distribution of the number of land/kiosks likely to be affected by the BRT project is shown below.

Table 13. Number of the Affected Kiosks/Tenants

Location	Number of Kiosk Tenants
Terminal Cicaheum	59
Terminal Antapani	22
Terminal Ledeng	43
Total	124

Source: LARAP Document of BBMA BRT Project (DOHWA – Lenggogeni, Feb 2025)

- Paratransit *angkot* (mini-bus service), which operates within the BRT on- and off-corridor routes, based on Systra's (2022) Feasibility Study report, the proposed BRT routes will overlap to some degree with 48 existing *angkot* routes, including eight of them that are highly overlapped. Approximately 1,554 *angkot* vehicles operate on overlapping routes, affecting *angkot* cooperatives and 5,069 *angkot* operators (drivers, ticketing, timers, and maintenance staff). *Angkot* impact assessment and mitigation actions plan are to be discussed and presented in the Public Transport Reform document.
- Government/public assets at the proposed bus stations and corridors that are potentially affected, as presented in the following table.

Table 14. Affected Government-owned Assets

Items	Type of Assets	Number	Unit
Affected asset at bus stop location	Iron poles (electricity, telephone, traffic sign, etc.)	66	unit
	Concrete poles (electricity, telephone, traffic sign, etc.)	5	unit
	Concrete balls	10	unit
	Iron fence	56.5	meter
	Pots and plants	19	unit
	Park bench	1	unit
	Bicycle parking set	1	unit
Affected asset in the BRT corridor	Concrete balls	95	unit
	Pots and plants	44	unit
	Park bench	35	unit
	Police post	1	unit
	Billboard	1	unit

Affected Trees. As shown in the table below, about 270 trees within the BRT on-corridor area will need to be relocated or removed. Relocating or replanting the tree elsewhere is preferred due to its maturity, aesthetic appeal, and shade function. If tree cutting is necessary to enable construction work, it must be informed to and agreed with the relevant government agency. For each tree to be cut, 5 (five) replacement trees will be required and planted in a designated area and maintained until they are considered growing.

Table 15. Number of Trees Affected by Construction

Location	Tree Names													Total
	Ketapang	Pule	Bintaro	Jackfruit	Palm	Oil Palm	Mahogany	Pterocarpus	Cinnamon	Flamboyant	Ashoka	Crape Myrtle	Banyan	
BS 3 Dalem Kaum	1		1											2
BS 6B Taman Tegallega Selatan							3			1				4
BS 7 Ciateul							2							2
BS 12 Naripan						1								1
BS 14A Stadion Sidolig								1						1
BS 14B Stadion Sidolig							2							2
BS 17 Kebon Waru							4							4
BS 18 Simpang Lima												2		2
BS 19 Asia Afrika											3	2		5
BS 20 Dulatip	1													1
BS 21 GKI Anugrah		2												2
BS 22 Andir					2									2
BS 23 Jamika							1							1
BS 24 Suryani							6							6
BS 25 Bundaran Cibereum	8								4					12
BS 26 Batas Kota	1				5					5			2	13
BS 27 RS Rajawali							5							7
BS 28 YWKA				2			2							4
BS 34 BTM			2				0							2
Sudirman street	29	42					55			10				166
A Yani street						10	20							30
Total														269

Source : LARAP Document (DOHWA – Lenggogeni, Feb 2025)

Urban landscaping and amenity work will be undertaken to improve the urban landscape within the dedicated BRT corridor and depot construction, while restoring the areas disturbed by the construction of bus stops/shelters within the off-corridor. The landscaping works would include the construction of permanent concrete seats, pedestrian-grade pavement with durable, anti-slip materials, street lighting, and other ancillary facilities such as trash cans.

2.12. Construction Materials, Equipment, and Vehicles

The implementation of the BRT project will require construction materials, among others, boulders, sand, concrete, and asphalt. These materials will be sourced from suppliers with valid operating licenses and environmental permits. In addition, facilities such as base camp, trucks, and equipment will be required to support construction activities as described below.

Construction Materials. Wood, stone, iron, asphalt, cement, and sandstone that meet material or technical criteria will be required for construction activities. The building materials are generally sourced from local suppliers. However, especially for asphalt and concrete materials to be procured from the asphalt and concrete plants contracted by the contractors.

The indicative construction materials required for the BRT project are listed in the table below, indicating that a significant volume of materials will be required, including boulders/rocks up to 480.000 m³, sand up to 230.225 tons, and cement up to 390.000 bags. These volumes are subject to change based on the final DED design and the bidding outcome.

Table 16. Indicative Construction Materials Required

Items	Unit	Amount
Wood	m ³	1,200
Boulder, rocks	m ³	480,000
Sand	m ³	230,225
Iron/steel bars	ton	18,000
Asphalt	ton	15,000
Portland Cement	bag	390,000

Source: Estimates by Dohwa-Lenggogeni, 2024

Construction Equipment and Vehicles. A range of equipment and vehicles in various capacities that would be operated during the construction of the BRT project is presented in the table below.

Table 17. Construction Equipment and Vehicles

Items and Specifications	Number of Units Required		
	Depot Construction	On-Corridor Construction	Off-corridor Construction
Mobile crane (up to 15-ton capacity)	1	9	6
Excavator (various capacities)	4	30	4
Dump truck (up to 10-ton capacity)	3	39	8
Flatbed truck 3 to 4-ton capacity	2	15	6
Water tanker 3,000 – 4,500 litres	2	12	6
Concrete mixer 0.3 – 0.6 m³	2	15	6
Generator set 5000 watts	2	21	6
Concrete vibrator	2	15	6
Water pump 70 – 100mm	2	15	6
Tamper 5 HP	2	12	6
Welding set	2	12	9
Bar bender	2	15	6
Bar cutter	2	15	6
Survey equipment	2	12	4
Bore pile testing equipment	2	-	-
Jack hammer	-	12	4
Asphalt finisher	-	6	-
Powered broom	-	6	-

Items and Specifications	Number of Units Required		
	Depot Construction	On-Corridor Construction	Off-corridor Construction
Motor grader	-	3	-
Wheel loader	-	3	-
Tyre, vibratory & pedestrian rollers	-	15	-
Cold mill machine	-	6	-
Concrete mixer truck	-	18	-
Air compressor	-	3	-

Source: Bidding documents of BBMA Depot, On-corridor and Off-corridor Works (August 2025)

Freshwater Supply. To support construction activities of the project, freshwater supply will be required for concrete making, dust suppression, general washing purposes, and workers' sanitation at approximately 20.3 m³/day based on the estimation presented in the following table. This water need will be supplied through existing boreholes and water tankers, and, for drinking, through the supply of bottled water or similar alternatives. The final volume is subject to change depending on the number of workers, the final DED, and the working method applied.

Table 18. Estimated Fresh Water Supply for Construction

Items	No of workers		Consumption	Amount (litres/day)
Contractor offices	45	persons	50 litres/person/day	2,250
Field workers	240	persons	50 litres/person/day	12,000
Construction activities incl. general washing purposes	-		-	6,050
Total				20,300

Source: Estimation by Dohwa-Lenggogeni, 2024

Fuel and Lubricants. The operation and maintenance of construction trucks, vehicles, and heavy equipment would consume a moderate volume of fuel and lubricant. The volume of diesel fuel and lubricant required during project construction is estimated at 39,000 liters/month and 5,000 liters/month, depending upon the number and efficiency of the construction fleets.

Hazardous Waste Management. The appointed contractors for the BRT project would generate a relatively small amount of hazardous waste, such as used lubricants, off-specification fuels, oily-contaminated rags, used spill kits, and other waste, such as leftover or containerized paints, coatings, solvents, and resin residues. These wastes are commonly generated by the operation and maintenance of the project fleet at construction sites or at the contractor basecamps. Infectious waste that may be generated from such a clinic would be limited to used medicine packaging and bandages.

According to the Government Regulation No. 22/2021 on Environmental Protection and Management, these wastes are categorized as hazardous waste and, therefore, should be handled and disposed of separately from non-hazardous wastes. These hazardous wastes will be stored in 200-L capacity of steel drums or similar materials.

All those hazardous wastes will be stored in some dedicated shelter which is equipped by roof, isolated bund wall, signage and safety tools such as fire extinguisher within the construction sites or the contractor basecamps prior to removal by the appointed third parties and disposal to licensed facilities. The volume of hazardous waste that would be generated by the project is not yet estimated at the time of the ESIA preparation.

Wastewater/Sewage Treatment. Sewage/wastewater in the order of 12 m³/day (see **Error! Reference source not found.**) would be generated from the number of workers employed by the project. This waste stream would be channeled to mobile toilets (latrine) and the sludge is removed regularly using a third-party service provider and eventually disposed to a licensed facility operated by the private sector or a government entity.

Management of Construction and Other Non-hazardous Wastes. The main waste streams from the construction activities would be, among others, spoils, concrete and steel rods that do not meet specifications, used planks, and packaging. It is estimated that the construction waste, including demolition waste,, will be generated at approximately 411 tons.

In addition, household-typed waste such as leftover food, plastic bottles, and paper boxes packaging would be generated and estimated from the worker activities at around 53 kg/day. These wastes are not considered hazardous but require safe, temporary storage at construction sites prior to use as backfill materials or disposal to the final waste disposal sites (*tempat pembuangan akhir/TPA*) operated and have licenses issued by the local governments. Disposal of the construction waste to these TPAs or other designated sites should be agreed among the appointed contractor, the project proponent, and the relevant government agencies.

2.13. Contractor Basecamp and Workers

The sites that may be required for the contractor basecamps, including temporary accommodation for the project workers and storage of construction materials and equipment, have not been identified at the time of ESIA preparation, as this will depend on the outcome of the bidding process of the civil and other associated works. Limited temporary accommodation may be provided for project workers from outside the Bandung area, and this may be provided at the contractor's basecamp, rented houses, or hotels nearby. The contractor base camp may include small workshops for simple maintenance of the contractor's equipment and vehicles.

The appointed contractors will be responsible for selecting the contractor basecamp that are located away from environmentally sensitive areas such as residential, public facilities, sensitive rivers, and protected areas. Further, the access road to the contractor basecamp is expected to be on a wide and paved road.

The construction of the BRT Project will be divided into several civil work packages for: Dedicated BRT corridor, or called “On-corridor”, off-corridor serving direct BRT service routes; Terminal layover; and Construction of *Leuwipanjang* and *Cicaheum* Depots that will be implemented by qualified contractors to be appointed through a competitive bidding process.

Worker Recruitment. The workforce requirement for the construction phase of BRT – BBMA is estimated at approximately 285 people, with 25% of them, subject to meeting the qualification and opportunities available, would be prioritized from local communities residing near the project location, selected based on their qualifications and the specific needs of the project. The number of workers required could change depending on the construction workload, schedule, and the worker qualifications required at a particular time. The following table presents the expected qualifications of skilled workers to be provided by the contractors.

Table 19. Indicative Workforce Skills and Requirements

Job Type	Education Background	Area of Expertise	Minimum Working Experience (years)
Key Personnel			
Project Manager	Bachelor – Civil Engineering	Project management specialist (SKK level 8)	8
Site Manager	Bachelor – Civil Engineering	Project management specialist (SKK level 8)	5
Civil Engineer	Bachelor – Civil Engineering	Technical building expert – SKK level 7	3
Architect	Bachelor – Architect	Architect (SKK level 7)	3
Electrical Engineer	Bachelor – Civil Engineering	Electrical expert (SKK level 7)	3
HSE Specialist	Bachelor – Civil Engineering	Construction expert (SKK level 7)	3
Environmental, Health and Safety Specialist	Bachelor – Environmental Engineering	Environmental expert (SKK level 7)	3
Social Specialist	Bachelor – Social Science	-	3
Utility and Liaison Officer	Bachelor – Civil Engineering		5
Supporting Personnel			
Finance Manager	Bachelor – Economic/ Accountant	-	3
General Affair Officer	Bachelor – Social/Communication	-	3
Surveyor	Diploma (3 years)- Technical	-	3
Administration - Technical aspect	Diploma (3 years)- Technical	-	3
Administration - Financial aspect	Diploma (3 years)- Finance	-	3
Logistic personnel	Diploma (3 years)- General	-	3

Source: Bidding Documents of BBMA BRT Project, 2025.

Note: SKK – *Sertifikat Kompetensi Kerja* (Work Competency Certificate)

Selected, Final DED of the BRT project. Following the decision to finalize the DED for the BBMA BRT project, a traffic impact assessment was conducted to identify the most effective configuration with respect to technical feasibility, financial efficiency, and socio-economic outcomes. The options considered were as follows:

- *Alternative 1 – Baseline Route.* Focused on a core corridor utilizing existing infrastructure. While cost-effective and faster to implement, this option provided limited coverage, weak intermodal integration, and minimal benefits for traffic congestion.
- *Alternative 2 – Integrated Route.* Prioritized integration with Bandung Raya Bus Transit, minibus/*angkot* networks, and commuter rail, while extending service to dense residential and educational areas. This option offers high potential for modal shift but requires greater capital investment and more complex coordination across operators.
- *Alternative 3 – Expansion Corridor.* Targeting peripheral growth areas to promote equitable mobility and long-term urban development. However, this alternative requires substantial capital, extensive land acquisition, and longer construction timelines.

Of the three alternatives above, the selected, final DED combines elements of Alternatives 2 and 3. It emphasizes high-demand corridors, intermodal connectivity, and targeted expansions to maximize coverage and reduce congestion. This integrated approach was determined to be both technically and financially viable, while also minimizing environmental and social impacts during construction. As detailed in earlier sub-section, the final design of the BRT project includes: 21 km-long dedicated BRT corridor and associated 38 bus stops/platforms; 2 bus depots within the existing *Cicaheum* and *Leuwipanjang* Terminals; Layover at two existing *angkot* (paratransit minibus) terminals at *Antapani* and *Ledeng*, which also serve as the end stations; and 9 BRT off-corridor services.

2.14. Key Activities as per Project Phases

The BRT project will be undertaken in the following phases, from pre-construction through to operation, as described below to inform the E&S risk and impact assessment (see Section 6 of this ESIA). The BRT project activities will comprise some stages at pre-construction, construction, and post-construction (operational), which can be described as follows:

A. Pre-construction Phase

Land Acquisition, including Disclosure of Project-Related Information. Socialization for the BRT-BBMA Project will be conducted in accordance with the recommendations of the environmental documents (ESIA & UKL/UPL) for the surrounding community around the project area. Socialization will cover all affected areas, which comprise 17 districts at Bandung City, two districts at West Bandung Regency, 1 district at Bandung Regency, and 1 district at *Cimahi* City. At this stage, the community is expected to be informed about project activities, including the implementation of the DED and the mitigation measures to address potential adverse impacts. An asset inventory survey will also be conducted by relevant government authorities to identify and record affected utilities and trees in an accurate manner prior to their removal or demolition.

B. Construction Phase

Construction Permits. It is a necessary process that must be completed before construction activities begin. In this regard, the project proponent and implementing agency are required to open coordination with relevant authorized government agencies. Key permits include:

- Permission for road use for material mobilization and construction within the road right-of-way (for bus station construction and conduit pipe crossing) was issued by the Regional Public Works Department.
- Tree-cutting permits are issued by the Regional Environmental and Parks Department in Bandung City.
- Type C Mineral Permit and UKL/UPL (Environmental Management and Monitoring Documents) for quarry operations.
- Operating License and UKL-UPL for batching plant and/or asphalt mixing plant.
- Permissions from landowners and surrounding communities regarding the use of land for soil borrowing and disposal locations.

The Operation of Contractor Basecamps. Several base camps would be constructed or contracted by the contractor winning the tender process. The number and locations of basecamps are not yet known at the time of ESIA preparation, as it depends on the outcomes of the tender process and the number of civil work packages awarded. The activities that will be carried out at the basecamp and site office include the daily activities of workers and office staff; apart from that, it is also used for vehicle or heavy equipment repair activities and material storage. To support activities at the base camp, it is necessary to provide clean water, interim waste storage, and a potable water supply.

Recruitment of Project Workers. The BRT project would require approximately 285 workers; of this total, about 25% would be prioritized from local communities residing near the project location, selected based on their qualifications and the specific needs of the project.

Mobilization of Construction Equipment and Project Vehicles. The appointed contractors would mobilize their construction equipment and project vehicles to their basecamps and/or directly to parts of the project areas, including BRT depots, off-corridor as well as off-corridor sites where the civil work packages are awarded.

Transportation/Interim Storage of Construction Materials, Fuels, and Wastes. To facilitate the transportation of materials using trucks, the contractor will coordinate in advance with the relevant government agencies, such as the Bandung City Transportation Department, and engage with the local community through regional officials. This coordination aims to minimize traffic disruptions and reduce environmental impacts.

Heavy equipment will be transported to the site in two phases: first, it will arrive and remain on-site for the duration of construction; second, it will be removed upon completion of the work. Therefore, heavy equipment transportation will occur at least twice during the construction period. In contrast, material transport will continue throughout the construction phase.

Civil and Landscaping Works. These works are the primary components of the BRT project implementation that include the civil and landscaping works below, which would be divided into several packages:

- *Relocation/dismantling of infrastructure and utilities* - some existing utilities, such as electrical cables, including conduit pipeline and power poles, and water supply pipelines, that may have potentially been crossed by project construction, will need to be relocated or demolished. This relocation process will take place after prior coordination and completion of necessary permitting procedures with the relevant government authorities. Before the relocation begins, public socialization will be conducted, and protective measures will be implemented to delineate the utilities targeted to establish a safety zone for the public and project workers.
- *Land clearing and demolition of structures* - the existing conditions along the BRT-BBMA corridor area include existing roads as well as bus stop buildings and terminals, which will be renovated to accommodate additional functions. The land is government-owned and falls under the authority of the Transportation Department. Accordingly, site-clearing activities will involve dismantling existing building structures and removing sections of asphalt pavement for overlay.
- *Asbestos survey and safe disposal* - before demolition activities, an investigation to identify the presence of Asbestos Containing Material (ACM) must be carried out. This includes an inventory of potential ACM. If any indications of ACM are found, a certified third-party asbestos specialist must be engaged to conduct sampling, develop an asbestos management plan, and oversee the safe handling, transportation, and disposal of the material. Demolition of existing structures will take place specifically at the depot areas at the *Cicaheum* and *Leuwipanjang* terminals.
- *Construction of dedicated BRT corridor and road pavement* - overlay work on the existing road section of 21,7 km with asphalt material transported from AMP. The re-paving work activities will be initially conducted by determining the part of the road body and/or the area of the road body that needs to be re-paved with asphalt up to 3 cm thick using a Cold Milling Machine. The dredging process is assisted by a dump truck, which is positioned at the front of the machine.

The cleaning process at work areas in the field that had previously been dismantled will begin with drying using a gas torch. Then, subsequently, cleaned up the remains of demolition parts that were not previously removed using an air jet compressor, and finally sprayed with tack coat in the work area that had dried and been cleaned. Asphalt is spread by the asphalt finisher in the area that has been previously cleaned. As for spreading, it is carried out using a hopper which is pulled by a dump truck, where hot-mixture asphalt is poured from the asphalt finisher with a layer thickness of 7 cm as loose thickness.

The vibration machine is turned on throughout the spread in order that the asphalt combination is distributed thoroughly. Then the workers in the field will evenly distribute the asphalt mixture using shovels and lackers to ensure that the mixture is evenly distributed. The overlay compaction will be undertaken by adhering to the Bina Marga General Specification in the 2018 method.

- *Construction of BRT Depots, Terminals, and End Stations* - Construction work includes BRT foundation and column work as well as construction of facilities and infrastructure. Foundation work planning uses drilled piles, with K-350 reinforced concrete material, and the columns used are transverse beam columns with reinforced concrete material. The transverse beams use I-girder beams with precast concrete material, and the floor slabs use reinforced concrete. Construction of facilities and infrastructure includes building a platform equipped with counters, waiting rooms, and information rooms. Especially for the terminal, toilets are also provided. The BRT depo construction at two areas at *Cicaheum* and *Leuwipanjang* Terminals will be undertaken as additional facilities to the existing bus and *angkot* terminals at these locations.
- *Landscaping works* – The landscaping works would include construction of permanent, concrete-made seats, pavement of the pedestrian with durable and anti-slip materials, street lighting, and other ancillary facilities such as trash cans. The following images are examples of the urban landscaping works that will be undertaken as part of the BRT project.

C. Operation and Maintenance (O&M) Phase

Operational stage worker recruitment of the BRT project is estimated to be up to 232 people with different qualifications, and this number excludes the workers employed by bus operators, infrastructure, and systems. Further, indirect employment is anticipated to occur as a result of the need for goods, services, and human resources to operate, maintain, and repair the associated BRT bus, infrastructure, and system.

3. KEY POLICY AND REGULATORY FRAMEWORKS

This chapter summarizes key policy and regulatory frameworks related to environmental, health, safety, social, and labor aspects of the BRT Project, as stipulated by the Indonesian Government and the 2018 World Bank Environmental and Social Framework (ESF). This section is not intended to list all policies, laws, regulations, and standards, but rather to provide an understanding of applicable key requirements that should be adhered to by the BRT project.

3.1. Key Indonesian Laws and Regulations – Environment, Health & Safety

In planning and implementing the BBMA Project, national and subnational (local) governments must prevent environmental pollution and health and safety accidents, and ensure compliance with the provisions of the laws and regulations listed in the following table.

Table 20. Key Laws and Regulations - Environment, Health & Safety

Key Laws and Regulations	Provisions
Law 32/2009 on Environmental Protection and Management was superseded by Law 11/ 2020 on Job Creation (also known as the Omnibus Law)	Law 32/2009 stipulates that all business and/or project activities must prepare an environmental assessment and subsequently obtain the Environmental Permit, in addition to complying with environmental standards. This Law has been superseded by Law 11/2020, with the main provisions remaining the same as the former Law, but some changes are introduced and detailed in the implementing regulations, i.e., Government Regulation or GR (<i>Peraturan Pemerintah</i>) and Technical Ministerial Regulation (<i>Peraturan Menteri</i>) listed below.
Law 22/2009 on Road Traffic and Transportation	This Law stipulates the provisions of road traffic and transportation concerning transportation network, vehicle and driver requirements, safety and security of traffic and transportation, traffic impacts, and facilities for disabled persons, pregnant women, and those with sickness.
Law 2/2017 on Construction Services and Government Regulation No. 14/2021 as the Implementing Regulation of Law 2/2017	This Law stipulates that in every construction undertaking, the user and provider of construction services are required to meet security, safety, health, and sustainable standards. Therefore, a project is required to establish and implement a management system on construction safety (Sistem Manajemen Keselamatan Konstruksi or SMKK). The SMKK is provided in a project-specific document, containing: – Conceptual SMKK; – Construction Safety Plan (<i>Rencana Keselamatan Konstruksi</i> or RKK); – Construction Quality Plan (<i>Rencana Mutu Pekerjaan Konstruksi</i> or RMPK); – Quality Assurance/Quality Control Plan (<i>Program Mutu</i>); – Environmental Management and Monitoring Plan (<i>Rencana Kerja Pengelolaan dan Pemantauan Lingkungan Hidup</i> or RKPPL); and

Key Laws and Regulations	Provisions
	– Project Traffic Management (<i>Rencana Manajemen Lalu Lintas Pekerjaan</i> or RMLLP). This regulation stipulates that material resources such as stone, sand, steel, concrete blocks, and timber, etc., have to be obtained from the local sources and their surrounding areas that have obtained relevant and valid licenses. Further, construction, heavy equipment, and machinery used in construction activities should pass the tests and obtain relevant certificates or licenses from the authorized agencies.
Law 1/1970 on Occupational Safety Provisions	This Law stipulates provisions for occupational safety. Further, the Ministry of Manpower Regulation No. 5/2018 on Occupational Health and Safety Standard for the Working Areas includes the provisions on the threshold values of physical, chemical, and biological parameters for the working areas. It also includes the standard on ergonomics and physiological factors, indoor air quality, and hygiene.
Government Regulation (GR) No. 22/2021 on the Implementation of Environmental Protection and Management stipulates the provisions on: - Environmental assessment - Ambient air quality standards - Surface water quality standards - Hazardous and toxic (infectious) waste management.	This GR stipulates, among others, the requirements for the Project to obtain an environmental approval prior to construction, including other technical recommendations related to water and air pollution control, hazardous and toxic wastes management within the authority of the MoEF. It stipulates that a project shall be screened to determine the type of environmental assessment required, i.e., Amdal (similar to ESIA for a project likely to generate significant E&S impacts), UKL-UPL (similar to EMP for a project with non-significant E&S impacts) or SPPL, which is a commitment letter to conduct environmental management and monitoring related to micro- and small-scale activities. The environmental screening is undertaken based on the MoEF regulation No. 4/2021 that includes a prescribed list of businesses and/or activities requiring Amdal, UKL-UPL, or SPPL. Further, GR No. 22/2021 stipulates the regulations and standards on the matters below into one regulation, whereas in the past these were stipulated individually. - Guidelines to prepare Amdal, UKL-UPL, and SPPL - Ambient air quality standards - Freshwater quality standards - Hazardous and toxic (infectious) waste management. - Non-hazardous and non-toxic waste management.
MoEF Regulation No. 4/2021 on Business and/or Activity Requiring AMDAL, UKL-UPL, or SPPL	This MoEF regulation stipulates the types and scale of business and/or activities that need to be completed by Amdal, UKL-UPL or SPPL. Further, this ministerial regulation provides the list of types and/or businesses that shall undertake Amdal Types A, B or C. In principle, this ministerial regulation serves as a self-screening tool to determine the type of environmental assessment required for a particular business sector and/or activity.

Key Laws and Regulations	Provisions
Government Regulation No. 81/2012 on Management of Household Wastes and Similar Wastes	The GR also stipulates provisions for those negatively affected by the operation of waste disposal sites to be compensated in the form of resettlement, environmental remediation, provision of medical treatments, sanitation facilities, etc.
Minister of Environment and Forestry No. 6 of 2021 on Procedures and Requirements for Hazardous and Toxic Waste Management	This regulation stipulates the guidance of hazardous waste collection and transportation management, final treatment, and also requests and issues permits of technical approval for hazardous waste management.
Minister of Manpower Regulation No. 5/2018 on Occupational Safety and Health in the Work Environment	This regulation stipulates guidelines on threshold values of physical, chemical, and biological factors, ergonomic factors, hygiene, and sanitation at workplaces.
Minister of Manpower Regulation No. 50/2012 on Implementation of Occupational Health and Safety Management System	This ministerial regulation stipulates that the occupational health and safety management system (<i>sistem manajemen keselamatan dan kesehatan kerja</i> , or SMK3) is an integral part of a company's overall risk management, and therefore it is an obligation for the company to implement that management system. This SMK3 is mandatory for companies employing 100 workers or more or operating in potentially high-risk activities.
Minister of Manpower No. PER-03-/MEN/1985 concerning Occupational Safety and Health in the Use of Asbestos	This regulation stipulates the obligation for the management executor (especially workers) to work with asbestos material.
Ministry of Environment Decree No. 48/1996 on Noise Level Standard	This decree stipulates noise level standards for the environment and sensitive receptors that should be adhered to during project implementation.
Ministry of Environment Decree No. 49/1996 on Vibration Standard	This decree stipulates vibration standards applicable to buildings and other physical structures that should be adhered to during project implementation.
Relevant sub-National regulations	- Mayor of Bandung City Regulation No.18/2025 regarding Water Quality Management and Pollution Control - Governor of West Java Regulation No. 78/2013 regarding the implementation of the Regional Regulation of West Java Province concerning Air Pollution Control - Regional Regulation of Bandung City No. 9/2018 regarding Solid Waste Management

3.2. Social, Gender and Customary Communities

Besides EHS considerations, social, gender and customary community aspects are seen as important considerations for the BRT-BBMA Project. Key laws and regulations on this matter applicable for the Project are presented in the following table.

Table 21. Key Indonesian Laws and Regulations – Social and Gender Aspects

Laws and Regulations	Summary and Relevance with the Project
The Indonesian Constitution (Article 18, Point B, No. 2)	The Indonesian Constitution (known as Undang-Undang Dasar) recognizes and respects traditional communities and their customary rights where these exist, and if these are in accordance with the societal development and principles of the state. The agrarian reform and management of natural resources is stipulated by the Decree No. IX/MPR/2001 of the People’s Consultative Assembly of the Republic of Indonesia. Further, the Agrarian Law 5/1960 and the Human Rights Law 39/1999 provide implicit, though conditional, recognition of some rights of customary communities known as “masyarakat hukum adat” (or MHA). This terminology has been adopted in various policies, such as forest management under the customary forest scheme of the social forestry stipulated by the MoEF, the customary village under the Village Law, and the communal certificate belongs to the MHA group under the regulations stipulated by the Ministry of Agrarian and Spatial Plan/National Land Agency regulations.
Law Number 6 of 2023 concerning Job Creation	This Law stipulates changes in land acquisition for public interest, including in terms of providing compensation and land acquisition. This law also regulates the acceleration of the licensing process and land acquisition for public interest.
Law 2/2012 on Land Acquisition for Development in the Interest of the Public	Chapter 40 of this Law recognizes that “masyarakat hukum adat” is entitled to compensation. Any project location will be determined and decided by the provincial/district/city government only if it has been agreed with the entitled parties and the affected communities.
Law 14/2008 on Disclosure of Information for the Public	This Law requires that public information is made available and transparent for use by the public at large.
Law 12/2022 on Criminal Acts of Sexually Related Crime	This Law stipulates protection for the public from sexually related crime and promotes cultures that prevent violation and harassment in these regards.
Government Regulation 19/2021 on Land Acquisition for Development in the Interest of the Public	The provisions of this GR replace Presidential Regulation No. 71/2012, including its four amendments. This GR includes the following provisions: - Six additional types of activities/businesses that are included in the development of the public interest where this GR is applied; - Release permits for lands with unique characteristics affected by the project (sustainable agri-food land, forest-lab, village treasury, waqf-land, state-owned land) are finalized before issuing the Location Determination Permit (Penlok); - Involvement of Land Office/Spatial Plan (Kantor Agraria dan Tata Ruang/Badan Pertanahan Nasional) during the planning stage; and - Land acquisition for the public interest is carried out by providing appropriate and fair compensation, and it is emphasized that the results of the assessment are final and binding. Independent

Laws and Regulations	Summary and Relevance with the Project
	appraisals involve negotiations with affected people to obtain a compensation agreement.
Government of Regulation No. 39/2023 on the Amendment of GR No. 19/2021 Government Regulation No 19/2021 on Land Acquisition for Development in the Interest of the Public	The GR No. 39/2023 amends several articles of GR No. 19/2021, including: - The acquisition of land indicated as destroyed land (<i>tanah musnah</i>) is to be implemented following the provisions of the land acquisition law/regulation; - The government appraiser can do valuation of compensation in addition to the independent appraiser. A government appraiser is a civil servant who is given duties, authority, rights, and obligations to conduct valuation assessment; and - Articles 17 and 18 of GR No. 39/2023 recognize “Masyarakat hukum adat” as the party eligible for compensation in the land acquisition process. - Article 41 of the above GR states the need to ascertain the consent of affected IPs for the acquisition of customary community land (“tanah ulayat”).
Presidential Regulation No. 62/2018 on the Handling of Social Impacts in the Community during the Land Acquisition Process for National Development	It regulates the provision of compensation in the form of money or relocation to non-titled land users. This regulation requires that compensation should consider the cost of mobilization, cost for moving, house rent during the transition period, and loss of income. It also requires the proponent to produce documents on the Social Impact Management Plan if affected government-land has been physically used/controlled by the community consecutively for a minimum of 10 years. The Social Impact Management Plan shall be proposed to the Governor, which subsequently forms an Integrated Team to undertake data inventory, compensation appraisal, and facilitate grievance management.
Presidential Regulation No. 78/2023 on the Amendment of Presidential Regulation No. 62/2018 on the Handling of Social Impacts in the Community during the Land Acquisition Process for National Development	This regulation amends several provisions in Presidential Regulation No. 62/2018, including the addition of two new articles, namely Articles 14A and 14B, and the Minister of Agrarian and Spatial Planning/National Land Agency Regulation No. 6/2020 regulates the Provisions for the Implementation of Presidential Regulation No. 62/2018 on Handling Community Social Impacts in the Framework of Land Provision for National Development. This regulation was established to improve and accelerate the implementation of national development by ensuring that societal impacts are considered in the process of providing land for development.
Presidential Regulation No. 78/2007 on Ratification of the Convention for Safeguarding of the Intangible Cultural Heritage	Indonesia through, which is regulated further in the Minister of Education and Culture Regulation No. 106/2013. This ministerial regulation requires the national and local governments to guarantee the preservation of Indonesia's intangible cultural heritage.

Laws and Regulations	Summary and Relevance with the Project
Presidential Instruction No. 9/2000 on Gender Mainstreaming	This Presidential Instruction stipulates gender mainstreaming in development planning, also in its implementation and evaluation; it is done by gender analysis that includes participation in the development process and the benefits they enjoy.
Minister of Transportation Regulation No. 98/2017 on Provision of Access for Those with Special Needs on Public Transportation	This regulation sets out universal access provisions that can be used by all groups, including vulnerable groups (people with disabilities, the elderly, pregnant women, and children), in public transportation and its associated facilities.

3.3. The World's Bank Environmental and Social Framework (ESF)

The BRT-BBMA Project is an investment project financing (IPF) to be funded through loan from the World Bank and AFD, and therefore, is subject to due diligence process of the WB ESF to ensure this Project is implemented in a sustainable manner from both E&S perspectives. The scoping process undertaken for the BBMA BRT Project identifies some gaps between the requirements of the Indonesian E&S laws and regulations and those of the WB ESS, and therefore, gap filling measures are undertaken to bridge these gaps and comply with the mentioned ESS (see the following table).

Table 22. The Bank ESS Requirements and Key Gaps Addressed in the ESIA

Applicable ESS	Key Requirements to be Fulfilled by the BRT Project According to the ESS	Indonesian Laws and Regulations	Gap-filling Measures
ESS1 Assessment and Management of Environmental and Social Risks and Impacts	This ESS is directly relevant for the BRT Project in identifying and assessing E&S risks and impacts, and defining associated mitigation measures and monitoring (ESMP). - Description of key legal and institutional setting and responsibilities, - Scope of ESIA including potential indirect and cumulative E&S risks and impacts - Environmental and social risk and impact assessment, including labor and working conditions, health and safety, cultural heritage, and resettlement - Mitigation measures and monitoring (ESMP) and reporting arrangements - Capacity building, budget items, and institutional responsibility to implement the ESMP - Stakeholder Engagement Plan (SEP) and Feedback and Grievance Redress Mechanism (FGRM) of the Project.	Law 32/2009 on Environmental Protection and Management, then superseded by Law 11/ 2020 on Job Creation, requires all projects to conduct environmental assessments and obtain environmental approval, and to streamline environmental approval as part of the risk-based, online business licensing process. Government Regulation (GR) No. 22/2021 on the Implementation of Environmental Protection and Management – This regulation implements Law 11/2020, detailing AMDAL, UKL-UPL, and SPPL procedures; monitoring and reporting; and environmental approval. Ministry of Environment and Forestry (MoEF) Regulation No. 4/2021 on Business and/or Activity Requiring AMDAL, UKL-UPL, or SPPL – This regulation lists types and scales of businesses and/or activities for determining the level of environmental assessment needed.	The current Indonesian regulatory framework has, in several aspects, demonstrated alignment in principle with the requirements of ESS 1. However, notable gaps remain as the existing regulations do not consistently or comprehensively address social impacts with the same level of rigor as environmental impacts, particularly on the issues related to livelihoods, vulnerable groups, labor and working conditions, community health and safety influx, cultural heritage, and risks of gender-based violence. Further, the impact assessment of the Indonesian EIA does not evaluate the risk of such impact, i.e., it does not use a risk-based approach. The above limitations are addressed in this ESIA in alignment with good international industry practice.
ESS2 Labor and Working Conditions	This ESS is directly relevant for the BRT project, involving construction activities that would require a significant number of workers within a relatively short construction period. from areas near BBMA. The ESIA needs to include an assessment of potential risks and impacts related to labor and working	Law 1/1970 on Occupational Safety – This law establishes employer duties to ensure workplace safety and worker protection, with authority for inspections and accident prevention measures. GR No. 50 of 2012 on the Occupational Health and Safety Management System – This	The mentioned Indonesia regulatory frameworks provide key foundation, ensuring legal obligations for worker protection, safe work environments, contractor accountability, and labor rights, which broadly align with ESS2's objectives.

Applicable ESS	Key Requirements to be Fulfilled by the BRT Project According to the ESS	Indonesian Laws and Regulations	Gap-filling Measures
	conditions including gender-based violence risk. The assessments will also explore options to increase capacity to manage occupational health and safety issues for workers.	regulation mandates companies to implement the Occupational Health and Safety Management System (known as SMK3). Ministry of Manpower Regulation No. 5 of 2018 and No. 11 of 2023 on Occupational Safety and Health Regulations – These specify standards for workplace safety, hazard management, emergency preparedness, and the appointment of competent OHS officers. Law No. 35 of 2014 on Child Protection – This law has provisions on child protection from abuse and hazardous labor, ensuring government responsibility for enforcement. Law 2/2017 on Construction Services and Government Regulation No. 14/2021 as the Implementing Regulation of Law 2/2017 – These regulations regulate the construction sector, including contractor qualifications, safety standards, supervision, and dispute resolution.	However, key gaps remain in translating these legal provisions into project-level ESIA to be consistent with ESS2 requirements. The national framework has limited coverage of gender-based violence (GBV) risk or community workers. Therefore, this ESIA document is prepared to bridge the above gaps in the risk and impact assessment section, emphasizing the requirement to develop project-specific Labor Management Procedures (LMP) and a worker grievance mechanism. Bidding documents and civil work contracts will need to include requirements for labor and working conditions reflecting the relevant elements specified in the LMP.
ESS3 Resource Efficiency and Pollution Prevention and Management	This ESS is directly relevant for the BRT-BBMA Project, where technical specifications for the Project will incorporate climate resilience, as well as good engineering and energy efficiency standards (e.g., such as the combination of electric and combustion engine buses, and sourcing construction materials from facilities and quarries that have valid operating permits. Hazardous and non-hazardous waste	MoEF Regulation No. 6 of 2021 on Hazardous and Toxic Waste Management Procedures – This regulation governs hazardous waste management procedures, from generation to disposal including licensing, recordkeeping, technical standards, and emergency response Law No. 22 of 2009 on Road Traffic and Transportation – This law regulates transport	Indonesia's environmental laws and regulations provide a solid foundation for pollution control and waste management that generally aligns with the ESS3. They ensure legal obligations for preventing and managing impacts due to hazardous and non-hazardous wastes, air quality, water quality, noise and vibration, as well as road traffic.

Applicable ESS	Key Requirements to be Fulfilled by the BRT Project According to the ESS	Indonesian Laws and Regulations	Gap-filling Measures
	management will need to be assessed for its risk and impacts in the ESIA.	safety, emission control, and vehicle operation standards. MoE Decrees No. 48/1996 on Noise Level Standards and No. 49/1996 on Vibration Standards – These decrees set noise and vibration standards for residential, commercial, and industrial areas. Minister of Manpower Decree PER-03/MEN/1985 on Occupational Safety in Asbestos Use - This decree regulates asbestos handling, requiring PPE, worker training, air monitoring, and safe disposal procedures GR No. 81 of 2012 on the Management of Household and Similar Wastes - This regulation promotes waste reduction, reuse, and recycling through integrated solid waste management by local governments.	However, these regulations lack explicit provisions on resource efficiency, GHG emissions assessment, climate, and disaster risks, which are central to the ESS 3. Therefore, the scope of this ESIA is expanded to cover components such as GHG emissions, climate and disaster risks, and emphasizes the project to implement waste minimization and recycling strategies.
ESS4 Community Health and Safety	Community health and safety risks and impacts will arise from the Project's construction and operation activities and will be assessed in the ESIA pursuant to meeting the requirement of ESS1 and ESS4. The PMU and PIUs will need to develop an Emergency Preparedness and Response Plan (EPRP) for managing an emergency situation such as fire, earthquake, labor strike, etc. and communicating this matter and undertake exercise to the community within the Project area.	Law No. 36 of 2009 on Health – This law ensures the right to a healthy environment and sanitation, and preventive health measures in development projects. Law No. 24 of 2007 on Disaster Management - This law establishes disaster risk reduction, preparedness, response, and recovery frameworks, emphasizing coordination and community participation. Law No. 12 of 2022 on Criminal Acts of Sexual Violence - This law made provisions on prohibition and sanction on sexual violence,	The mentioned Indonesia laws and regulations include requirements that are generally aligned with the ESS 4. However, they lack of detailed requirements for project proponents to prepare site-specific emergency response plans, labor influx and GBV risk management, and impacted community-level health monitoring and awareness, which are key to WB ESS 4 components. Therefore, the above gaps will be addressed in this ESIA to address the missing ESS4 requirements.

Applicable ESS	Key Requirements to be Fulfilled by the BRT Project According to the ESS	Indonesian Laws and Regulations	Gap-filling Measures
	The Project will need to include requirements and procedures for GBV “prevention” to be applied for project workers and subcontractors, provision of GBV grievance redress mechanisms and confidential reporting with safe and ethical documentation of GBV cases, and coordination with licensed service provider for GBV cases handling.	mandates victim protection and confidentiality. Law No. 22 of 2009 on Road Traffic and Transportation - This law governs road traffic safety, transportation management, and vehicle operation standards and traffic planning. Minister of Transportation Regulation No. 98 of 2017 on Provision of Access for Persons with Special Needs in Public Transportation – This regulation mandates that all public transportation systems, including buses and terminals, to provide accessibility for persons with disabilities and other vulnerable users, with design and training standards. Minister of Manpower Regulation No. 5 of 2018 and No. 11 of 2023 on Occupational Safety and Health Regulations. Although designed for workplaces, these regulations may apply to community health and safety by establishing provisions on spills or emissions that could extend beyond the project site.	
ESS5 Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement	The BRT-BBMA Project will not involve land acquisition as the lands required by the Project are owned by the government. However, resettlement, including compensation, will be required for kiosk owners/tenants and street vendors affected by the construction of on-corridor, terminals, and depots. The impacts on these affected people, including those with	Law No. 2 of 2012 on Land Acquisition for Development in the Interest of the Public – This law includes provisions on land acquisition planning and implementation including dispute resolution for landowners. Government Regulation No. 19 of 2021 on Implementation of Land Acquisition for Public	Indonesia’s current regulatory frameworks on land acquisition provide a clear legal pathway for compulsory acquisition, valuation, compensation, and institutional coordination for public-interest projects. These laws generally align with WB ESS5, but don’t recognize resettlement and compensation for

Applicable ESS	Key Requirements to be Fulfilled by the BRT Project According to the ESS	Indonesian Laws and Regulations	Gap-filling Measures
	legal title of landownership as well as those without legal title but have structures or access on the land, will need to be assessed, and mitigation measures are described in the ESIA.	Interest – This is the implementing regulation of Law 2/2012, detailing procedures for planning, valuation, determining compensation, and dispute resolution in land acquisition processes. Presidential Regulation No. 62 of 2018 on the Handling of Social Impacts in the Land Acquisition Process – This regulation requires social assessment and impact mitigation during land acquisition, ensuring community welfare and coordination among agencies. Presidential Regulation No. 78/2023 on the Amendment of Presidential Regulation No. 62/2018 on the Handling of Social Impacts in the Community during Land Acquisition Process for National Development – This regulation updates Presidential Regulation No. 62/2018 to clarify roles and accelerate procedures for social impact handling in national development projects.	those affected but do not have legal title to their lands. However, important gaps remain at the project level, such as statutory valuation methods and accelerated procedures, which may undercompensate non-titled/ informal users and vulnerable individuals, fail to capture full replacement costs or livelihood losses, and compress the time needed for culturally appropriate consultation. Therefore, to align with the WB ESS 5 requirements, the BRT BBMA Project is complemented with ESIA and LARAP studies to ensure that all affected persons, including those without legal land title, are documented and fairly compensated.
ESS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources	The requirements of ESS6 applies to the BRT project as it include construction on the existing road involving dedicated on-corridor corridor and bus stop platforms within the heavily developed urban setting of Bandung City. Nevertheless, some mature trees that will need to be removed and relocated elsewhere	Law No. 5 of 1990 on Conservation of Biological Natural Resources and Their Ecosystems – This law establishes biodiversity conservation principles, protected areas, species protection, and penalties for violations. MoEF Regulation No. 106 of 2018 on Technical Guidelines for Biodiversity Inventory, Monitoring, and Reporting – This regulation	The Project's ESIA provides a screening of protected and critical flora and fauna species potentially affected by the proposed BRT BBMA project development. This screening was conducted not only in accordance with national regulations but also by referencing international indicators such as the IUCN Red List. Based on the findings, the ESIA proposes appropriate mitigation and monitoring measures to minimize impacts, support

Applicable ESS	Key Requirements to be Fulfilled by the BRT Project According to the ESS	Indonesian Laws and Regulations	Gap-filling Measures
	for conservationm to enable the establishment of on-corridor and bus stop platforms.	provides technical guidance for biodiversity inventory, monitoring, and reporting to the national biodiversity information system.	biodiversity offsets, and achieve a no-net-loss outcome for biodiversity.
ESS8 Cultural Heritage	Several buildings in Bandung City have been identified as cultural heritage objects from the colonial era and preserved within the proximity of BRT-BBMA corridor. Therefore, the ESIA requires assessment of potential risk and impact of these cultural heritages due to construction of the project. The ESIA will also include a Chance Finds Procedure, for the situation where affected cultural heritage may be found during the construction of BRT bus stops, end station, terminal and depot.	Law No. 11 of 2010 on Cultural Heritage – This law defines protection of tangible and intangible cultural heritage. It establishes procedures for identifying, designating, and preserving cultural heritage assets. It also requires developers to protect registered heritage sites and prohibits destruction, alteration, or relocation without official approval. In addition, it mandates public participation, local government responsibility for heritage management, and penalties for damage to cultural heritage.	The existing Indonesia’s law on cultural heritage ensures that recognized heritage assets are protected through official listing, permitting, and community involvement. However, the prevailing laws and regulations do not explicitly require any development to assess the risk and impact on both tangible and intangible cultural heritage due to construction of the project. Therefore, the Project’s ESIA addresses these gaps by recommending that a Heritage Impact Assessment (HIA) be conducted prior to the commencement of the construction phase. This assessment will help identify and evaluate potential impacts on cultural heritage and ensure that appropriate mitigation measures are in place. In addition, the ESIA emphasizes the need to develop and implement a Chance Find Procedure to manage any unexpected discoveries of cultural heritage sites or objects during construction activities.
ESS10 Stakeholder Engagement and Information Disclosure	The BRT project will involve stakeholder engagement at various levels, including government authorities, project management entities, BRT authorities, and project-affected parties such as local communities,	Law No.14 of 2008 on Public Information Disclosure – This law guarantees public access to government information and mandates institutions to disclose and manage public data proactively.	The prevailing Indonesian laws and regulations, however, do not provide structured mechanisms for engaging and documenting stakeholder input, monitoring engagement outcomes, or establishing

Applicable ESS	Key Requirements to be Fulfilled by the BRT Project According to the ESS	Indonesian Laws and Regulations	Gap-filling Measures
	landowners/occupiers, and vulnerable groups. However, the need for a strategic and regular stakeholder engagement and information disclosure is not regulated in Indonesia, other than, a one-time disclosure of project information and public consultation to be undertaken as integral part of the Indonesian impact assessment.	Presidential Instruction No. 9 of 2000 on Gender Mainstreaming – This Presidential Instruction directs all government bodies to integrate gender perspectives in development planning, implementation, and evaluation.	grievance redress systems (GRMs) to meet WB ESS10 standard for accessibility, confidentiality, and responsiveness. Therefore, the Project's ESIA includes the development of a Stakeholder Engagement Plan (SEP), Grievance Redress Mechanism (GRM) designed to be gender-sensitive and responsive to the needs of vulnerable groups, with clearly defined timelines for resolution and confidential handling of sensitive cases.

4. ESIA METHODOLOGY

This section describes the methodologies adopted to undertake the ESIA of the Project, including desk-top study and literature review, collecting E&S baseline data and information through conducting E&S risk and impact assessments, and developing an environmental and social management plan (ESMP) to mitigate these risks and impact.

4.1. Scoping Process and the Project Area of Influence

The scoping process was conducted to define the project's area of influence (Project's Aoi) and identify interactions between the project's key activities/components and the E&S resources and receptors. It also assists in identifying key gaps on the existing E&S data and those required for the ESIA.

A desk-top study and literature review, including project-related documents, such as the DED reports, and relevant data and information already available, was conducted. The following data and information collated and presented in this ESIA are primarily sourced from:

- Data and information related to the DED (proposal) of the BBMA-BRT project;
- Draft UKL-UPL document of BBMA-BRT;
- Draft Traffic Analysis Report (ANDAL Lalin) of BBMA-BRT²
- Draft Land Acquisition and Resettlement Action Plan (LARP) of the BBMA-BRT project (2025);
- Very limited, one-time primary environmental data such as ambient air quality and noise levels;
- Relevant environmental and social data and information sourced from websites and public domains; and
- Key E&S policy, legal, and administrative frameworks (e.g., national laws and regulations, required permits, the World Bank's Environmental and Social Framework (2018), and good industry international practices.

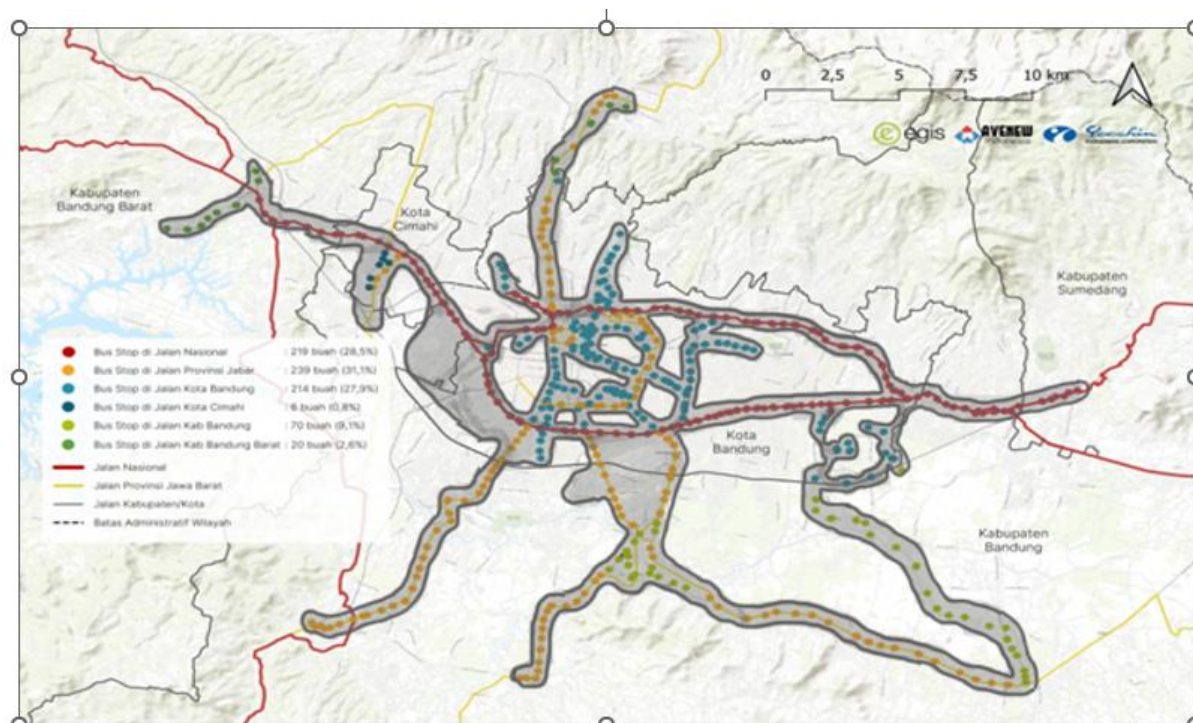
The area of influence, as defined by the World Bank's ESS 1: Environmental and Social Assessment and Management, refers to the geographic and socio-economic zone where a project's environmental and social impacts may occur. This area is not only limited to the project footprint but also includes its associated facilities and all other locations or factors directly and indirectly affected by the Project, such as traffic and transport shifts, adjacent areas impacted by the project's direct impacts, and socio-economic changes resulting from changes in accessibility or economic activities. Additionally, the area of influence also accounts for cumulative impacts, where incremental impacts from the project combine with those of other existing or planned developments that may occur to sensitive receptors and the environment.

Table 23. The BRT Project's Area of Influence

E&S Components	Area of Influence (Construction Phase)	Area of Influence (Operational Phase)	Consideration
Air Quality Noise Vibration	Up to 500m from the project boundary at depot and terminal and at end station and bus stop on BRT corridors	Up to 250m from the project boundary at depot and terminal/end stations and bus stop on BRT corridors	Based on professional judgement that the distribution of air quality, noise and vibration impact could be felt at considerable distance beyond the project boundary depending on atmospheric, physical structures. However, in operational the potential of air quality issue may not significant since BRT buses will use a combination of electric bus and conventional bus.
Surface Water Quality; Soil and Groundwater Quality	Any watercourse such as river, streams, wells within the project boundary. <u>Note:</u> The nearest project area to the river is Bus stop at Kebon Jati (BS32) and Cikapundung (BS11)	Any watercourse such as river, streams, wells within the proximity of project area, especially at terminal and depot	The BRT project will be undertaken within the urban landscape of Bandung basin which dominantly at Bandung City where the number of rivers likely affected by the project is limited (Cikapundung river and Citepus river) and water quality is likely to have been significantly degraded by sewage and wastewater discharges from residential and commercial areas.
Stormwater and run off	Within the BRT project boundary	Within the BRT project boundary including the BRT corridor and on-corridor and off-corridor bus stops.	DED of the BRT project

E&S Components	Area of Influence (Construction Phase)	Area of Influence (Operational Phase)	Consideration
Terrestrial flora and fauna as biodiversity and landscape	Within the project boundary and the areas (yet to be determined) designated for replanting the trees that will be removed to enable the construction of BRT corridor, stations, terminal and bus depots.	Within the BRT project boundary including the BRT corridor and on-corridor and off-corridor bus stops.	DED of the BRT project
Road traffic and infrastructure	The roads used by the project vehicles/trucks to transport construction materials and wastes; the roads leading to/from the quarries and concrete plants supporting the project.	Within the BRT project boundary including the BRT on-corridor and off-corridor bus stops.	Based on the BBMA-BRT ANDAL Lalin report. Based on the requirements of the Bank's ESS 1.
Local economy development	Within the project boundary, particularly future BRT corridors, bus depots, terminals and end stations.	Within the BRT project boundary at depot and terminal including the dedicated BRT on-corridor and off-corridor bus stops.	The UKL/UPL documents of BBMA-BRT and LARAP document of the BBMA-BRT project
Economic displacement, livelihood, and access restriction	Within the project boundary, particularly the BRT corridor, bus depots at Leuwipajang and Cicaheum, and the locations of workshop and basecamp of construction activity.	Within the BRT project boundary including the BRT corridor and on-corridor and off-corridor bus stops	Based on the LARAP document of the BBMA-BRT project.
Cultural heritage	Within the project boundary, particularly at nearby BRT corridor.	Not applicable as the cultural heritage impact would be primarily during construction.	Based on the requirements of the Bank's ESS 1.
Health & Safety (workers and communities)	Within the project boundary and the roads used by the project vehicles and equipment	Within the project boundary, particularly the BRT corridor and bus terminal at Antapani and Ledeng and bus depots at Cicaheum and Leuwipanjang	Based on the requirements of the Bank's ESS1 and ESS4.

Based on the above considerations, the project's Aol of the BBMA-BRT project is shown as shaded areas in the in the following figure.



Source: Reproduced from existing maps of Egis et al.

Figure 18. The Project Area of Influence

4.2. Stakeholder Identification and Analysis

The identification of stakeholders related to the Project has been undertaken and documented in the project-specific Stakeholder Engagement Plan (SEP). Both formal and informal consultations have been conducted as part of the ESIA, and the land acquisition and resettlement plan (LARAP) document.

4.3. Risk and Impact Assessment Method

In this case, the impact is defined as a noticeable effect on a person, including his/her activities and the changes in physical and biological environment due to the Project's activities. The risk is defined as the exposure to harm and other adverse outcomes due to the impact. While the risk assessment is a process of determining the probability of an impact occurring and the severity of its impact. The risk assessment of the Project is conducted to determine the inherent risk of an impact, i.e., without any mitigation measures and the residual risk of an impact which remains after the related mitigation measures are implemented.

E&S risk and impact assessment in this ESIA are conducted using the following approach:

- (i) *Impact identification* - all potentially significant impacts are identified based on the main activities described in the project description and local environmental and social context described in relevant baseline sections of this ESIA. These impacts include:

- Direct impacts potentially resulting from a direct interaction between the Project's activities and the receiving environment and/or receptors (e.g., land clearing resulting in soil erosion and changes in water run-off pattern).
 - Indirect impacts potentially resulting from subsequent interactions of the Project's direct impacts and other related receiving environment and/or receptors (e.g., soil erosion will increase turbidity of the receiving water bodies or changes in water run-off pattern could result in water inundation or flooding at low lying areas downstream of the Project).
 - Induced impacts potentially resulting from other activities, which are not part of the Project, but happening because of the Project (e.g., Increased pressure to the existing road and public facilities due to mobilization of large numbers of workforce working for the Project).
- (ii) *Impact prediction and evaluation* - the significance of an impact will be predicted and also evaluated for its severity and likelihood to occur. The inherent risk level (i.e., without any mitigation measures) of an impact is evaluated using the severity, likelihood, and risk level matrices below to ensure a standardized and consistent process.
- (iii) *Defining mitigation measures* – relevant mitigation measures will be proposed to address significant impacts commensurate with its risk level using the principles of impact avoidance, reduction, minimization, mitigating or offsetting the impacts.
- (iv) *Determining residual risk of an impact* – The residual risk is defined as the impact remaining after all proposed mitigation measures are implemented. If residual impacts are still significant, additional measures will be required to minimize the risk.
- (v) *Defining monitoring requirement* - monitoring and audit will be proposed to gauge the actual impacts onto receptors during project implementation. Based on the monitoring results, adaptation or addition of mitigation measures may be required

The severity or consequence of each environmental, social or health and safety impact is determined using the matrix and criteria presented in the following table.

Table 24. E&S Impact Severity/Consequence

Severity level Aspects	1	2	3	4	5
	Incidental	Minor	Medium	Major	Severe
Environmental including biodiversity	Localized, brief concerns and issues.	Minor scale, short-term, and reversible impacts.	Medium-scale, medium-term, adverse but reversible impacts.	Large-scale, medium-term, adverse, beyond the subproject area, but reversible impacts. These impacts may result in penalties and/or legal prosecution.	Large-scale, long-term, adverse, beyond the subproject area, but reversible impacts. These impacts result in penalties, legal prosecution, and/or the project is suspended.
Socio-economic; Physical cultural resources	Localized, brief concerns raised by some individuals of affected community.	Minor scale, short-term concerns raised by minority of affected community.	Medium-scale, medium-term, adverse, but reversible impacts on moderate number of affected populations.	Widespread, ongoing impact affecting majority of the affected population and other stakeholders. These impacts may result in penalties and/or legal prosecution.	Widespread, ongoing impact affecting majority of the affected population and other stakeholders. These impacts result in penalties, legal prosecution, and/or the project is suspended.
Health & Safety - Occupational & Community aspects	Near-miss or incidents requiring first aid treatment. Minor, brief-term health impacts, no medical intervention required.	Minor incidents require one-time medical treatment. Short-term health impacts require one-time medical treatment.	Moderate incidents causing functional impairment require multiple medical treatments. Moderate illness requires multiple medical treatments and hospitalization.	Major incidents cause permanent impairment requiring a high level of medical treatment. Serious illness with reversible effect requires a high level of medical treatments or management.	Serious incidents resulting in fatality. Serious and irreversible illness requires a high level and ongoing medical treatments or management.

Source: This matrix is a consensus of the ESIA authors by considering the risk assessment methods commonly used for ESIA.

The likelihood of each environmental, social of health and safety impact to occur is determined based on the criteria presented in the following table.

Table 25. Likelihood of the Impact to Occur

Likelihood	Descriptions	Level
Certain	The impact will occur even though the project proceeds as planned e.g., soil erosion when conducting land clearing	5
Likely	The impact will occur under normal operating conditions e.g., minor spills during handling and storage of lubricants	4
Possible	The impact would occur in certain circumstances although it is not intended to be the case e.g., reduced fauna due to increased access to forest areas	3
Unlikely	The impact may occur only in exceptional circumstances e.g., oil spills due to absence of secondary containment in the storage area	2
Rare	The impact is not expected to occur under normal circumstances but still represents a risk in the event of an incident or unforeseen condition happening e.g., fire incident due to the operation of heavy equipment.	1

Source: This matrix is a consensus of the ESIA authors by considering the risk assessment methods commonly used for ESIA.

The risk level of an impact is determined as a function of the impact consequence and its likelihood of occurring is determined as follows using the criteria presented in the table below:

- ‘Low risk’ if the impact is detectable but not considered significant and, therefore, mitigation measures are discretionary.
- ‘Moderate risk’ if the impact is evaluated as moderate, irreversible, or reversible and, therefore, can be mitigated using readily, common available measures to reduce the risk to an acceptable level.
- ‘Substantial risk’ if the impact is evaluated as significant, adverse, irreversible, or reversible and, therefore, should be mitigated using specialized measures to reduce the risk to as low as reasonably practicable.
- ‘High risk’ if the impact is evaluated as significant, adverse, widespread, and irreversible that cannot be mitigated and, therefore, alternatives to the project’s activities that are of less impact should be identified and adopted for the project.

Table 26. Risk Level/Significance of the Impact

Likelihood Level	Consequence/Severity Level				
	5 Severe	4 Major	3 Medium	2 Minor	1 Incidental
5 Certain	25 High	20 High	15 High	10 Substantial	5 Moderate
4 Likely	20 High	16 High	12 Substantial	8 Moderate	4 Moderate
3 Possible	15 High	12 Substantial	9 Moderate	6 Moderate	3 Low
2 Unlikely	10 Substantial	8 Moderate	6 Moderate	4 Moderate	2 Low
1 Rare	5 Moderate	4 Moderate	3 Low	2 Low	1 Low

Source: This matrix is a consensus of the ESIA authors by considering the risk assessment methods commonly used and found in the following references: <https://www.riskpal.com/risk-assessment-matrices/>
<https://www.safeworkpro.com.au/an-example-of-risk-assessment-matrix/>

4.4. Rapid Cumulative Impact Assessment

A cumulative impact assessment (CIA) of the Project will be conducted using the Rapid Cumulative Impact Assessment (RCIA) approach recommended in the Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for the Private Sector in Emerging Markets (IFC, August 2013). The CIA was undertaken to obtain an appreciation as to how the Project may contribute to the existing E&S impacts (cumulative impacts) on valued environmental and social components due to existing or future developments within the project's area of influence. Subsequently, based on this assessment, measures to enhance the cumulative positive impacts and those to mitigate adverse impacts to an acceptable level are defined. The step-by-step process to conduct the CIA and the corresponding results are described in relevant sections of the ESIA.

5. ENVIRONMENTAL AND SOCIAL BASELINE

Prehistorically a lake, Bandung City is the third most populated metropolitan city in Indonesia after DKI Jakarta and Surabaya (Dam 1994 in Tarigan et al. 2016; Indonesian Population Census 2010 in Katherina 2018). This city is the capital of West Java Province that has historical value for Indonesia, is marked by various heritage buildings, such as Kantor Pos Besar (main post office) and Asia Afrika Conference Museum, and is known as the education city housing the Bandung Institute of Technology and Padjajaran University and many private universities. Key environmental and social baseline conditions within BBMA are presented in this section as the basis to conduct risk and impact assessment of the BRT project.

5.1. Environment

5.1.1. Climate

The climate of Bandung City is affected by the humid and cool mountainous climate, that refers to Koppen Climate classification is categorized to Rain Tropical Climate (A). Based on the 2022 data, the average temperature of the city was around 25.35 °C, with the highest temperature reached 32.2 °C in September, and the minimum temperature reached 16.8 °C in July. The highest rainfall occurred in October, which amounted to 366.7 mm with 30 days of rain. While the lowest rainfall is in August when the rainfall only reached 29.9 mm with 26 days of rain. According to BMKG criteria that that monthly rainfall may indicate that the daily rainfall can approximately reach the maximum value on the scale of High Rainfall (300 – 500 mm) which likely occurred in October.

Table 27. Climate of Bandung City (2022)

Month	Temperature (°C)	Humidity (%)	Wind Velocity (mm/sec)	Rainfall (mm)	No of Rainy Day
January	26.4	66.6	3.5	59.5	20
February	25.0	72.5	2.7	117.1	21
March	26.0	70.2	2.7	238.9	25
April	25.3	75.3	1.6	336.2	28
May	25.7	73.8	2.3	146.9	25
June	24.5	75.8	1.8	150.6	20
July	25.1	70.5	2.2	98.5	23
August	25.6	68.8	2.3	29.9	26
September	25.6	70.3	2.2	182.2	26
October	25.0	74.9	1.9	366.7	30
November	25.0	75.8	2.2	307.2	28
December	24.9	75.1	2.3	277.7	29

Source: Bandung City in Numbers, 2023

5.1.2. Air Quality

Air quality sampling has been conducted on 22 – 30 July 202 as part of the preparation of the environmental management and monitoring effort document (known as UKL-UPL) required by law for the BBMA BRT Project. The air quality sampling was undertaken at eight (8) locations representing some of the future BRT bus stops/platforms, bus depots, and terminals/end stations. The air quality sampling code/location is as follows: U1: *Antapani*

Terminal; U2: Ledeng Terminal; U3: Shadow terminal at Jl. Elang; U4: Shadow terminal at Kebon Kelapa; U5: Bus station at Alun-alun; U6: Leuwipanjang Terminal; U7: Cicaheum Terminal; and U8: Bus station at Kebon Jati Hospital.



Ambient air quality measurement using a High-Volume Sampler (HVS) and noise level measurement using a Sound Level Meter by KAN-accredited independent laboratory personnel

Figure 19. Baseline Air Quality Sampling and Noise Measurement (2024)

The weather conditions at the time of sampling were reportedly stable, with low wind speeds and bright skies. All ambient air quality parameters during this monitoring period complied with the national air quality standard stipulated in Government Regulation No. 22/2021, Appendix VII. However, several parameters exceeded the international standard set by the 2021 WHO Air Quality Guidelines, including nitrogen dioxide at all monitoring locations and PM₁₀ at U2 (*Ledeng* Terminal). Particulate matter of 2.5 µm (PM_{2.5}) was not analyzed from the samples collected and, therefore, identified as the baseline gap in this regard.

Table 28. Baseline Ambient Air Quality (July 2024)

Parameter	Standard		Sampling Sites/ Results							
	GoI	WHO	U1	U2	U3	U4	U5	U6	U7	U8
Sulphur dioxide	150	40	<27,6	<39,3	<37,7	<29,1	<30,5	<30,6	<29,5	<27,3
Carbon monoxide	10,000	-	3,369	3,560	3,418	3,097	3,117	3,349	3,261	3,070
Nitrogen dioxide	200	25	27.6	48.8	51.3	47.6	48.1	56.2	49.6	46.7
Ozone	150	100	46	39	31	22	25	30	27	22
Hydrocarbon	160	-	17	21	26	20	32	36	28	24
Total suspended particulates	230	-	112	135	124	108	121	132	127	119
Particulate Matter (PM ₁₀)	77	45	38	48	37	25	29	33	30	26
Lead (Pb)	2	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Source: Kementrian Perhubungan, 2025

Remark: Standard of Government of Indonesia based on Government Regulation No. 22 of 2021 - Appendix VII on Ambient Air Quality Standard; Quality standard of WHO as stipulated in the Air Quality Guidelines Global Update (WHO, 2021)

5.1.3. Noise Level

Noise level measurement was carried out at the same locations as air quality monitoring. The monitoring results, as presented in the following table shows that noise level at all locations remained below the noise level standards for their designated land use, in accordance with Ministry of Environment Decree No. 48/1996. Specifically, at location K3 near the shadow

terminal on Jl. Elang and K8 near Kebon Jati bus stop (adjacent to Kebon Jati hospital), daytime noise levels were slightly higher than the noise standard for residential areas and special zones such as hospitals, which are set at 55 dB(A). Furthermore, when compared to the international standard as set by the World Bank EHS General Guidelines, nighttime noise level at all monitoring locations exceeded the recommended limit of 45 dB(A).

Table 29. Baseline Noise Level

Parameter and designated land use of noise level	Monitoring Location							
	K1	K2	K3	K4	K5	K6	K7	K8
	22/7/24	23/7/24	24/7/24	25/7/24	26/7/24	27/7/24	29/7/24	30/7/24
Daytime noise (Ls)	56.1	56.6	55.9	56.9	57.2	54.4	55.1	55.5
Night-time noise (Lm)	49.3	49.4	47.1	47	47.9	44.8	45.4	46.6
Total noise (Lsm)	55.6	56.0	55.0	55.8	56.1	53.3	54	54.6

Source: Ministry of Transportation (2025)

5.1.4. Vibration

Baseline vibration level was measured at Cicaheum Terminal and Leuwipanjang Terminal, where these terminals will be renovated and designated as BRT depo. In these terminals, there is frequent movement of buses and paratransit (angkot). Vibration parameter measured in these locations was mechanical vibration which indicated the potential structural damage of the buildings as stipulated in the MoE Decree No.49/1996 – Annex II.

The monitoring result as presented in Table 30 shows that baseline vibration levels at Terminal Cicaheum and Terminal Leuwipanjang were classified as Category A as per Kep.Men-LH No.49/1996 – Annex II, which indicates that the existing activities at these terminals do not appear to pose a potential risk of structural damage to nearby buildings.

Table 30. Baseline Vibration Measurement

Frequency (Hz)	Vibration Standard based on Velocity of Set Frequency (mm/second)	Measurement Result (mm/second)	
		Terminal Cicaheum	Terminal Leuwipanjang
		29/7/2024	30/7/2024
4	<2	0.376	0.298
5	<7.5	0.285	0.276
6.3	<7	0.26	0.262
8	<6	0.228	0.253
10	<5.2	0.217	0.241
12.5	<4.8	0.8	0.23
16	<4	0.2	0.34
20	<3.8	0.18	0.35
25	<3.2	0.198	0.21
31.5	<3	0.19	0.23
40	<2	0.17	0.22
50	<1	0.15	0.2

Source: UKL/UPL BRT-BBMA, 2024

Remarks: Category A: No damage caused



Vibration measurement at Terminal Cicaheum and Terminal Leuwipanjang

Figure 20. Vibration Measurements**5.1.5. Hydrology and Surface Runoff**

River Hydrology. Two main rivers, i.e., Cikapundung and Citepus Rivers will be traversed by the dedicated BRT corridor. The Cikapundung River divides the city of Bandung, in West Java, Indonesia. The length of this river is 28 km with flowrate of 12 – 250 m³/sec. This river is categorized as lightly polluted. Domestic waste, including human waste and detergents, is the main source of pollution as more people are living along the riverbanks.

Citepus River that passes through Kebon Jati Road and Jend. Sudirman Road is the closest, future BRT bus stops are Bus Stop RS Kebon Jati (around 82m) and Bus Stop GKI Anugerah (around 208m). Length of the river is 6,5 Km with a flow rate of 0.1 - 38 m³/s. The river status is categorized as slightly polluted.

Stormwater Runoff. Rainy conditions on urban areas can potentially lead to flooding and inundation, particularly when existing drainage channels are no longer sufficient to accommodate stormwater runoff. The recent survey results on stormwater runoff capacity on each road segment within BRT corridor are presented below.

Table 31. Potential Stormwater Run Off Capacity on BRT Road Corridor

BRT Corridor	Estimated Stormwater Runoff (m ³ /s)	Remarks
Jl. Rajawali Barat	0.039 – 0.374	Average runoff capacity 1.88 m ³ / with maximum run off area at outlet cross box culvert under Jl. Rajawali Barat/Superindo
Jl. Rajawali Timur	0.055 – 0.385	Averagely run off capacity 0.247 m ³ /s with maximum run off area at outlet cross box culvert under Jl. Rajawali Timur/Jl.Ajuna
Jl. Kebon Jati	0.192 – 0.324	Averagely run off capacity 0.242 m ³ /s with maximum run off area IC Jl. Pasir Kaliki/Jl.Gardujati to IC Jl. Dulatip
Jl. Suniaraja	0.41	IC Jl. Dulatip - Jl. Suniaraja to outlet location in Kali Cikapundung
Jl. Banceuy	0.296	IC Jl. Suniaraja - IC Jl. ABC
Jl. ABC	0.181	IC Jl. Otpp Iskandar Dinata to outlet location in Kali Cikapundung
Jl. Naripan	0.117 – 0.774	Maximum run off capacity at IC Jl. Braga to outlet location in cross drain canal Jl. A. Yani/Kosambi

BRT Corridor	Estimated Stormwater Runoff (m ³ /s)	Remarks
Jl. Asia Afrika	0.274 – 0.455	Maximum run off capacity at IC Jl. Lengkok Besar/Jl. Tamblong to Simpang Lima/Jl. Sunda
Jl. Sudirman	0.177 – 0.553	Averagely run off capacity 0.345 m ³ /s with maximum area at IC Jl. Sudirman/Jl. Raya Cibeureum to outlet location in cross drain canal Jl. Sudirman/Lucky Petshop
Jl. Ahmad Yani	0.014 – 0.209	Averagely run off capacity 0.113 m ³ /s with maximum are at FO Jl. Supratman to outlet location in cross drain canal Jl. A.Yani/Jl. Cikaso
Jl. Ibrahim Adjie	0.277 – 0.360	Maximum run off area at IC Jl. A. Yani to outlet location in cross drain canal Jl. Terusan Jakarta
Jl. Jakarta	0.091 – 0.201	Averagely run off capacity 0.144 m ³ /s with maximum area at FO Supratman to outlet location in cross drain canal Jl. Jakarta/Jl. Labuan
Jl. Otto Iskandar Dinata	0.203 – 0.332	Averagely run off capacity 0.242 m ³ /s with maximum area at IC Jl. Inggit Garnasih to IC Jl. Astana Anyar/Taman Tegalega
Jl. BKR	0.193	IC Jl. Otto Iskandar Dinata to outlet location in cross box culvert under Jl. Moh. Toha
Jl. Alun-alun Timur	0.109	IC Jl. Asia Affrika to Jl. Dalem Kaum
Jl. Dalem Kaum	0.186	IC Jl. Dewi Sartika to outlet location in Kali Cikapundung
Jl. Dewi Sartika	0.1 – 0.195	IC Jl. Kautamaan Istri to Jl. Dalem Kaum
Jl. Pungkur	0.198	IC Jl. Dewi Sartika to Jl. Moh. Toha
Jl. Moh. Toha	0.028 – 0.323	Averagely run off capacity 0.196 m ³ /s with maximum area at IC Jl. Inggit Garnasih to outlet location in cross box culvert under Jl. Moh Toha/Jl. BKR

Source: Dohwa – Lenggogeni, 2023

Note: Stormwater runoff estimation based on rainfall data for 30 years (1992 – 2021) from 3 BMKG station as Sta Ujung Berung, Sta Bandung and Sta Cibeureum. Average daily rainfall from Sta Bandung data was 79.35 mm with maximum 191 mm when occurred in 2020

Based on the potential stormwater runoff capacity shown in **Table 31**, Jl. Naripan has the highest estimated runoff, reaching 0.774 m³/s. However, the likelihood of flooding or inundation is also influenced by drainage conditions, including the dimensions of the drainage system and the presence of trash.

5.1.6. Surface and Groundwater Quality

Bandung City primarily has two soil types underlying the hydrology and water quality within the BRT project area. Latosol, a type of soil formed from the weathering of sedimentary and metamorphic rocks it is widely found across Indonesia. This soil has a thick solum layer, ranging from 130 cm to 5 meters, and is typically clay-textured. Its color ranges from red to brown to slightly yellowish, and it typically has a moderately acidic pH of 4.5-6.5. Meanwhile, alluvial deposits form from sediment, especially river mud that dries and builds up into compact layers. It is greyish-brown and rich in minerals, making it highly fertile and ideal for farming, especially rice cultivation. However, it's also relatively soft and easy to erode.

Surface Water Quality. In this regard, the baseline environmental study for water quality sampling was conducted at two points along the *Cikapundung* and *Citepus* Rivers, specifically in areas intersecting the planned BRT corridor, and the analytical results are presented below.

Table 32. Surface Water Quality of *Cikapundung* and *Citepus* Rivers

Parameter	Quality Standard (GR 22/2021-Annex VI)		Analytical Result	
			Citepus River	Cikapundung River
	Class II	Class II	26/7/2024	26/7/2024
Physical aspects				
TDS	1,000	1,000	447	390
TSS	50	100	38	21
Color	50	100	40	15
Inorganic Chemical				
pH	6 – 9	6 – 9	6.8	6.5
BOD5	3	6	<2	<2
COD	25	40	19.7	12.6
DO	4	3	3.4	3
Sulphate (SO ₄)	300	300	75	20
Chloride (Cl)	300	300	121	17
Nitrate (N-NO ₃)	10	20	5.2	4.3
Nitrite (N-NO ₂)	0.06	0.06	<0.002	<0.002
Ammonia (N-NH ₃)	0.2	0.5	0.029	0.002
Total Nitrogen (N-total)	15	25	3.7	2.23
Total Phosphate (P)	0.2	1	0.04	0.001
Fluoride (F)	1.5	1.5	0.48	0.03
Sulphide (H ₂ S)	0.002	0.002	<0.0002	<0.0002
Cyanide (CN)	0.02	0.02	<0.0001	<0.0001
Free Chlorine	0.03	0.03	<0.006	<0.006
Barium (Ba)	-	-	<0.002	<0.002
Boron (B)	1	1	<0.03	<0.03
Mercury (Hg)	0.002	0.002	<0.0005	<0.0005
Arsen (As)	0.05	0.05	<0.0005	<0.0005
Selenium (Se)	0.05	0.05	<0.0005	<0.0005
Iron (Fe)	-	-	0.068	0.034
Cadmium (Cd)	0.01	0.01	0.002	0.003
Cobalt (Co)	0.2	0.2	<0.003	<0.003
Manganese (Mn)	-	-	<0.003	<0.003
Nikel (Ni)	0.05	0.05	<0.005	0.006
Zinc (Zn)	0.05	0.05	<0.005	<0.005
Copper (Cu)	0.02	0.02	0.009	0.007
Lead (Pb)	0.03	0.03	0.008	0.005
Chrom Hexavalent (Cr ⁶⁺)	0.05	0.05	0.008	0.004
Organic Chemical	0.005	0.01	<0.0003	<0.0003
Phenol				
Oil & grease	1	1	0.48	0.22
Detergent	0.2	0.2	0.062	0.005
Faecal Coliform	1,000	2,000	601	224
Total Coliform	5,000	10,000	3,702	2,902

Source: Ministry of Transportation (2025)

Water quality in the *Citepus* and *Cikapundung* rivers during this monitoring period was relatively good, with most parameters remaining within applicable standards per GR 22/2021, Annex VI, for river Class II. However, Dissolved Oxygen (DO) levels were below the recommended 4 mg/L: 3 mg/L in the *Cikapundung* River and 3.4 mg/L in the *Citepus* River.

Groundwater Quality. Baseline condition was established through groundwater sampling at four locations to provide a general condition of groundwater characteristics within the proposed BBMA corridor area. These locations include Terminal *Cicaheum*, Terminal *Leuwipanjang*, Terminal *Antapani* and Terminal *Ledeng*. The monitoring results of the groundwater are shown in the following table. Groundwater quality at all monitoring locations was in good condition, where all parameters were within the recommended thresholds as regulated in the Minister of Health Regulation No. 2 of 2023 for sanitary hygiene. Nevertheless, the pH condition at Terminal Ledeng showed at 6.58, approaching the quality standard threshold of 6.5.

Table 33. Groundwater Quality Results

Parameter	Unit	Quality Standard*	Monitoring Results			
			Terminal Cicaheum	Terminal Leuwipanjang	Terminal Antapani	Terminal Ledeng
			29/7/2024	30/7/2024	29/7/2024	29/7/2024
Physical						
Total Dissolved Solids (TDS)	mg/L	<300	106	119	127	116
Turbidity	NTU	<3	1.2	1	1.1	2.1
Color	TCU	10	3.2	3.5	2.9	2.3
Chemical						
pH		6.5 - 8.5	7.25	6.83	7.03	6.58
Nitrate (NO3)	mg/L	20	2.1	2.6	1.7	2.4
Nitrite (NO2)	mg/L	3	<0.2	<0.4	<0.2	<0.1
Chrom hexavalent (Cr +6)	mg/L	0.01	<0.001	<0.001	<0.002	<0.001
Iron (Fe)	mg/L	0.2	0.022	<0.029	0.015	<0.008
Manganese (Mn)	mg/L	0.1	<0.002	<0.001	<0.002	<0.01
Microbiology						
E. Coli	MPN/100ml	0	0	0	0	0
Total Coliform	MPN/100ml	0	0	0	0	0

Source: (Kementrian Perhubungan, 2025)

Note: *Ministry of Health Standard No. 2/2023 on Water Standard for Hygiene Purpose



Groundwater sampling at the Terminals area was carried out by KAN-accredited laboratory personnel.

Figure 21. Groundwater and Clean Water Sampling Activities

5.1.7. Tree Species

Bandung city can be considered to have typically urban and artificial biodiversity and landscape. Furthermore, biodiversity and landscape is essentially represented by the

existence of vegetation along the BRT corridor. The BRT route will pass about 20 existing roads where part of these roads will be used as BRT corridors. A recent vegetation inventory along these roads, conducted by Dohwa – Lenggogeni JO, identified various trees that could potentially be affected by the BRT development, as follows:

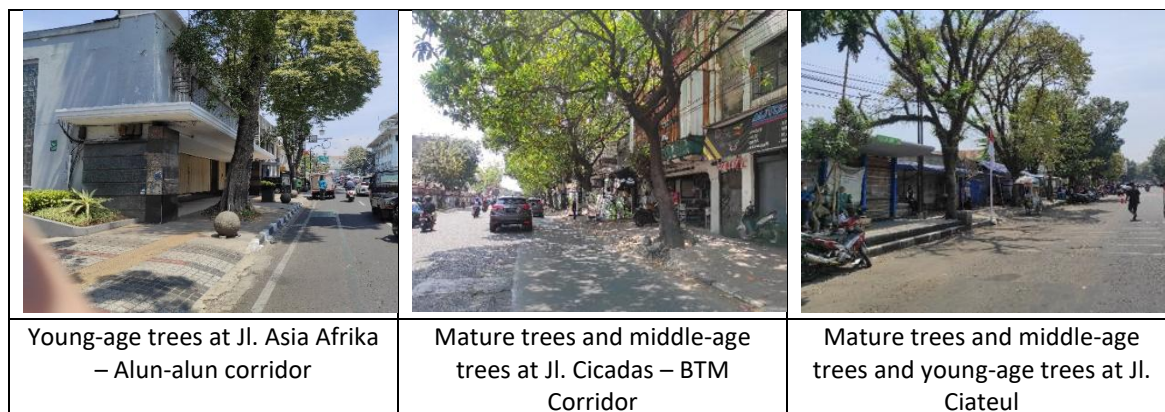


Figure 22. Some Existing Trees along BRT Corridor and Station Location

Most of these trees are not identified as protected species under MoEF Regulation No. 106/2018, except the Angsana tree (*Pterocarpus indicus*), and as vulnerable species, such as the cinnamon tree (*Cinnamomum spp.*). For palm trees, it was reported that these trees—especially located around future Bus Station (BS) 22 *Andir* and BS 26 Batas Kota—are presumably classified as protected species. However, further confirmation is required to accurately identify the species of these palm trees.

5.1.8. Greenhouse Gas Emissions

Bandung City has experienced rapid urbanization and motorization, with vehicle growth reaching 10% or more annually. This surge has significantly contributed to the increasing greenhouse gas (GHG) emissions. To estimate baseline GHG emissions, this study adopts the methodology used in a previous BRT project analysis by Restiana et.al (2023). Given that the primary source of emissions within the project's area of influence is associated with traffic and transportation-related activities, the estimation follows a Line Emission Source Estimation approach, which provides a reliable framework for quantifying emissions generated along major traffic corridors, as follows:

$$\text{GHG emissions} = Q \times L \times \text{EF} \times \text{GWP}$$

Where:

Q = Vehicles number based on traffic counting results (unit/day)

L = Approximation of total road length at intersection as traffic counting location (km),

EF = Emission factor (gr/km)

GWP = Global Warming Potential (tCO₂e/ton GHG) based on IPCC fifth assessment report.

Table 34. Traffic Counting Results at BRT Intersections

Code	Road Intersection at BRT Corridor	Road length (km)	Traffic Counting (unit) ¹				
			MC	PC	Para	Bus	Truck
SP01	A. Yani – St Yusuf	4.28	109,674	29,544	2,058	307	2,040
SP02	Kiaracondong	12.03	176,193	64,522	4,451	415	5,120
SP03	Jakarta – A Yani	6.33	200,557	49,384	18,418	552	4,998
SP04	Laswi	6.74	117,119	18,403	11,792	444	2,704
SP05	Simpang Lima	3.78	101,436	42,409	2,119	186	3,406
SP06	Lengkong Besar	2.85	107,114	27,155	2,668	363	1,501
SP07	Karanganyar	2.60	127,493	36,434	2,547	656	2,661
SP08	Gardujati	5.98	114,698	23,779	1,558	403	3,087
SP09	Jamika	7.02	69,018	13,865	5,633	212	5,112
SP10	Garuda	5.61	69,123	18,427	5,337	576	5,973
SP11	Bunderan Cibeureum	8.87	147,895	25,908	6,366	981	8,623
SP12	Cibeureum	4.24	132,306	19,880	5,738	714	10,559
SP13	Nurtanio	5.14	143,203	31,727	8,626	1,184	8,658
SP14	Pasirkaliki	7.32	133,275	30,409	4,830	490	3,751
SP15	Simpang Pasar Baru	1.64	70,716	24,923	3,887	594	2,391
SP16	Suniaraja	0.97	44,421	14,622	1,332	199	1,171
SP17	ABC	2.51	40,778	13,261	1,266	305	952
SP18	Naripan - Braga	2.39	44,785	15,518	618	69	748
SP19	Naripan	2.50	56,356	21,621	2,744	228	2,065
SP20	Veteran – A. Yani	8.30	69,682	21,268	1,491	192	1,560
SP21	Banceuy	0.78	107,183	32,886	2,681	856	2,054
SP22	Alun – alun Bandung	0.78	97,560	26,590	1,526	572	1,918
SP23	Dalem Kaum	1.89	43,420	14,529	2,005	171	1,416
SP24	Pungkur	3.45	49,386	13,318	2,698	280	1399
SP25	Balonggede	2.24	39,872	8,882	2,141	253	799
SP26	Inggit G – Moh. Toha	9.03	51,207	11,055	3,858	321	2,095
SP27	BKR – Moh Toha	11.52	165,942	29,956	6,303	966	5,365
SP28	BKR – Tegalega	10.4	242,659	35,963	9,130	1,361	5,580
SP29	Inggit – Otista	3.61	71,761	15,156	4,408	316	2,248
SP30	Jl. Pasirkoja	4.39	67,647	16,056	4,201	440	3,034
SP31	Tamblong	2.81	54,773	20,613	2,128	314	1,124
SP32	Gudang utara – A Yani	6.18	52,963	14,935	1,551	174	1,595
SP33	Ciroyom	0.32	38,070	8,589	2,522	177	1,387
SP34	Andir	0.55	51,766	9,599	1,652	224	2,556
SP35	Rajawali	2.89	123,366	22,857	4,221	584	8,130
SP36	Braga – Asia Afrika	1.92	86,869	22,098	617	331	1,254
SP37	Veteran – Sunda	1.5	68,435	26,800	1,855	316	1,625
SP38	Malabar	5.06	57,274	10,153	1,155	70	804
Total (unit)			3,545,995	883,094	148,131	16,796	121,463

Note: M: motorcycle; PC: personal car; Paratransit - *angkot*

The traffic counts in the table above represent the number of vehicles recorded on weekdays, as traffic volumes during these periods were typically higher than on holidays. Using these data, GHG emissions from various modes of transportation within the BRT BBMA on-corridor were estimated, applying composite emission factors from the International Vehicle Emission (IVE) model, as shown in the table below.

Table 35. Estimated Baseline GHG Emissions (tCO₂e/day) within On-corridor

Type of fleet	Emissions Factor ² (gram/km)			GHG Emissions (ton-GHG/day)			GHG Emissions (tCO ₂ e/day)
	CO ₂	N ₂ O	CH ₄	CO ₂	CH ₄	N ₂ O	
Motorcycle	69.4	0	0.41	1,338.8	7.91	0	1,560.28
Personal car	434	0.01	0.43	1,958.4	1.94	0.045	2,024.65
Paratransit - <i>Angkot</i>	406	0.01	0.58	344.6	0.49	0.008	360.44
Bus	1,789	0.09	0	158.4	0	0.008	160.52
Truck	1,330	0.015	0.375	895	0.25	0.01	904.65
Total							5,010.54

Emission factor from: Kimoanh et al (2018). * Dewanto (2020). in GIZ (2020)

Based on these calculations, daily GHG emissions within the BRT on-corridor and shown in the following figures are predominantly generated by private/passenger cars (PC), which contribute approximately 2,025 tCO₂e/day or 41% of total emissions. This is followed by motorcycles (MC) and trucks, which both contribute 1,560 tCO₂e/day (31%) and 905 tCO₂e (18%), respectively. Meanwhile, paratransit and buses combined account for the remaining 10% of total GHG emissions, as shown in the following figure.

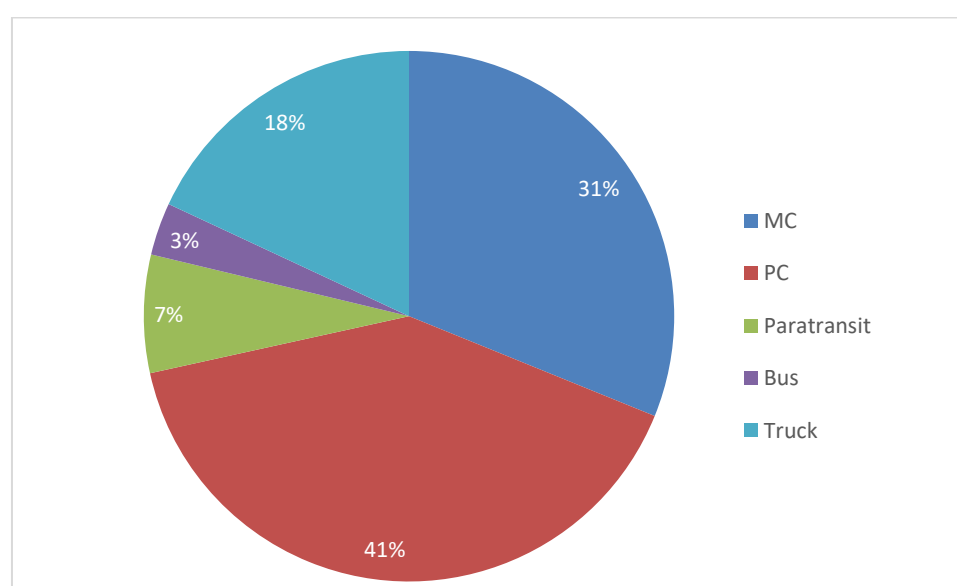


Figure 23 GHG Emission based on Transportation Modes

5.1.9. Disaster Risk Profile

As part of the ESIA of the BRT project, an initial natural hazard assessment in the Bandung area was conducted. This assessment was drawn up based on publicly available data related to the topography, geographic location, hazard intensity, and recurrence frequency. The proposed BRT networks in Bandung were then overlaid on these maps to highlight sections of the network that are exposed to specific risks. However, it's important to note that the analysis was based on an earlier version of the planned BRT network, which covers only about half of the current proposed routes.

Bandung faces multiple natural hazards, with flooding, earthquakes, and landslides being the most frequent, as shown in the figure below. While the city lies in the shadow of the *Tangkuban Perahu* volcano, which poses some volcanic risk, the topography and spatial layout of Greater Bandung result in distinct hazards affecting different areas of the region.

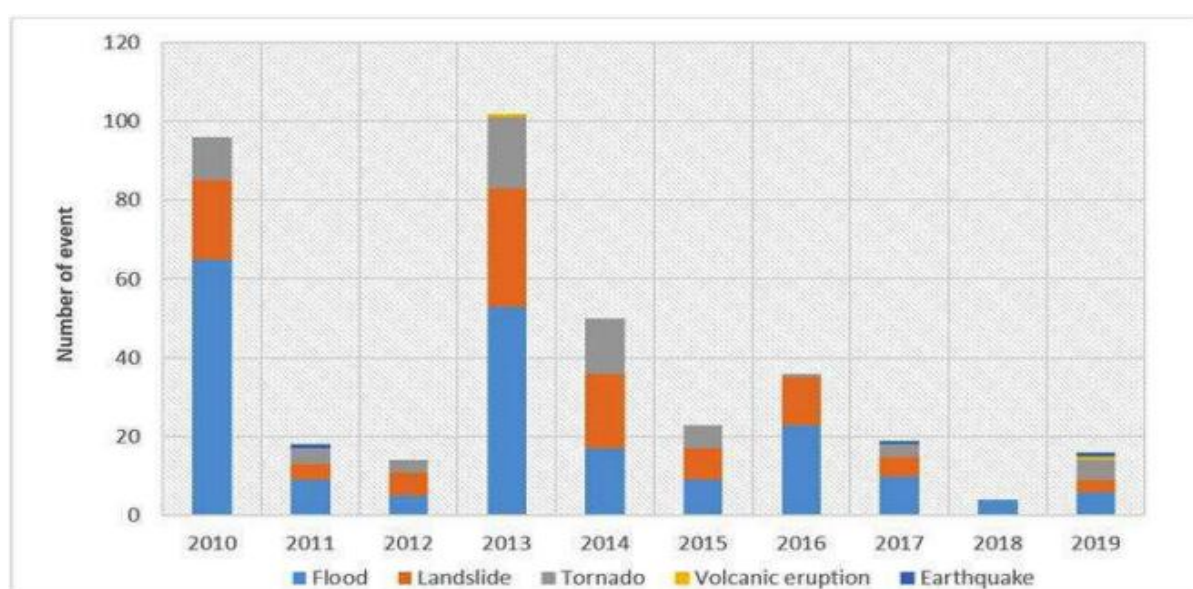


Figure 24. Occurrences of Natural Disasters in Bandung

The central area of Bandung is particularly prone to flooding due to its bowl-shaped topography, flanked by mountains to the north and south, and intersected by a network of rivers. This geography makes the city centre especially vulnerable to both flash floods caused by intense rainfall and more gradual flooding from accumulated rainfall. As a result, key sections of the proposed mass transit system are located in areas with a likelihood of frequent flooding. Much of Greater Bandung lies in an area of high seismic risk, although the southern part of the region tends to be less affected.

A summary of the BRT network's exposure to these natural hazards is presented in the table below. Each hazard is considered separately, as they occur in different locations and require distinct mitigation strategies.

Table 36. Natural Hazard Exposure of BRT Corridor

Location		Exposure			
Street	Station / bus stop	Volcanic Eruption	Landslide	Earthquake	Flood
Jl. A. Yani	B30 Cikaso	Low	Low	High	Medium
	B31 Cicadas	Low	Low	High	Medium
	B29 Bandung Juara	Low	Low	High	Medium
	B28 Kosambi	Low	Low	High	Medium
Jl. Jakarta	B32 Jl. Jakarta	Low	Low	High	High
Jl. Asia Afrika	B25 Simpang Lama	Low	Low	High	Low
	B17 Alun alun	Low	Medium	High	Low
	B24 Grand Preanger	Low	Low	High	Low
Jl. Naripan	B27 Click Square	Low	Low	High	Low
Jl. Otista	B22 Panjunan	Low	Low	High	Medium
	B20 Cibadak	Low	Low	High	Medium
	B18 Kebon Jeruk	Low	Low	High	Low
Jl. Dewi Sartika	B19 Kepatihan	Low	Low	High	Low
Jl. ABC	B26 ABC - Cikapundung	Low	Medium	High	Low
Jl. Banceuy	Banceuy Baru	Low	Low	High	Low

Source: Adapted from ITP for World Bank. 2021

On 11 - 12 December 2021, a field team conducted a street survey along the Bandung BRT route during periods of heavy rainfall. Based on observations, there were no major instances of road flooding observed along the BRT route during the survey. However, the survey team noted that during prolonged or intense rain, temporary surface flooding or water puddles can occur. This is mainly due to the limited number of drainage outlets resulting in water does not drain efficiently because the outlets are spaced too far apart. Compounding the issue, garbage often clogs these drains, further slowing the flow of rainwater and leading to water build up. Some areas were identified as more prone to surface flooding, especially around the Andir Market—specifically along Jl. Rajawali Timur and Jalan Sudirman. Similar issues were also seen along Jl. Otista/Kalipah Apo and near Kiara Artha station.

**Figure 25. Flooding and Water Puddles Sites within BRT On-corridor**

The problems of flooding and road puddles in Bandung City are primarily caused by, among others, watershed damage, unregulated agricultural practices, sporadic housing development, soil degradation, and land subsidence (exploitation of groundwater).

5.1.10. Existing Public Transport Services and Road Traffic

The baseline study of the existing public transport services and road traffic is documented and analyzed in the draft Traffic Impact Assessment (Andalalin) report of BBMA prepared by Egis et al. (2025). Relevant baseline aspects are summarized below and further described in the 'Rapid Cumulative Impact Assessment' section of the ESIA to avoid repetition.

Public transportation services in Bandung City are mostly provided by paratransit minibus or *angkot*, medium- and large-size buses operated by individual, local government-owned operators and state-owned bus company known as DAMRI¹. Based on this mode of transportation, there are 78 public transportation routes that will be intersected by the BBMA BRT routes.

Paratransit (*Angkot*). *Angkot* routes typically operate along secondary roads not served by buses, giving them different characteristics compared to BRT and conventional bus networks. Within the BBMA area, the *angkot* system comprises approximately 15,000 minibuses operating on 84 fixed routes, making it the most widely used mode of public transportation for Bandung residents. This system largely operates informally and is managed by two main organizations: Kobanter Baru (*Koperasi Jasa Angkutan Umum Bandung Tertib Baru*), which oversees 40 routes, and ORGANDA (*Organisasi Angkutan Darat*), which manages 80 routes. Based on the assessment, 40 *angkot* routes will have intersections with the planned BRT corridors, and seven of them were identified as having more than 80% overlap.

In addition to bus-based public transportation, the BBMA area is also served by local commuter trains operated by KAI Commuter. These include Bandung Raya, Cibatuan, and Garut Cibatuan local trains. Most of these services operate between *Cicalengka* station and *Padalarang* station, with some routes extending to Purwakarta, Cibatuan, and Garut City, providing important rail connectivity for daily commuters in the region. The following figure presents transportation modes serving BBMA.



¹ DAMRI: Djawatan Angkoetan Motor Repoebluk Indonesia



Figure 26. Public Transportation Modes in BBMA

Traffic surveys were performed to determine road service status (LOS) based on the amount ratio of vehicles upon the road capacity (VC Ratio). The category of LOS based on VC Ratio refers to the national guidance as stipulated in the *Manual Kapasitas Jalan Indonesia, 1997* which described below.

Table 37. Road Service Levels

Level of Service (LOS)	V/C Ratio	Traffic Flow Characteristics
A	0 – 0.19	Free traffic flow, low volume and high speed, and the driver can choose the desired speed.
B	0.20 – 0.44	The traffic flow is stable, the speed is slightly limited by traffic, but the driver can still freely choose their speed.
C	0.45 – 0.74	The traffic flow is stable, and the speed can be controlled by traffic
D	0.74 – 0.84	The traffic flow is unstable, the speed is low and varies, and the traffic volume approaches the road capacity.
E	0.85 – 1.00	Unstable traffic flow, low and variable speed, and the traffic volume approaches the road capacity.
F	>1.00	The traffic flow is hampered, low speed, the traffic volume is above its road capacity, and traffic jams often occur for relatively long periods.

Source: (Kementrian Pekerjaan Umum, SWEROAD, PT Bina Karya (Persero), 1997)

In the morning and evening peak hours, it can be seen that all road sections have reached a VC Ratio above 0.7, even some road sections have reached a VC Ratio above 1, requiring further handling of traffic conditions on these road sections. The results of the analysis of existing conditions at road intersections show that some intersections have vehicle delays that have reached level F. Meanwhile, intersections that are still in good condition are dominated by intersections without traffic lights, with a Level of Service (LOS) B.

5.2. Socio-economic and Public Health Profiles

This section describes the current socio-economic and public health profiles of BBMA area, namely Bandung City and Bandung Regency based on relevant secondary data. There are no customary communities (*masyarakat hukum adat*) identified within the BBMA – BRT Project area, and therefore, no description in this regard is provided in the ESIA.

5.2.1. Population Profile

Based on 2023 Statistics, the population of Bandung City and Bandung Regency exceeded 6 million, with approximately 50% female and 50% male. The population density in Bandung City is significantly higher than in Bandung Regency. Most of the population in Bandung City and Bandung Regency is in the productive age group of 15-64 years, accounting for approximately 70%. The age dependency ratio (% of working-age population) in Bandung City and Bandung Regency is around 41% and 45% respectively.

As of 2022, the percentage of poor people in Bandung City was 4.25% and in Bandung Regency 6.8%, which is below the national rate of 8.57% (BPS Statistic, 2024). These values increased relative to 2019 data, in which the percentage in Bandung City was 3.38% and in Bandung Regency was 5.94%. Demographic profile of Bandung City and Bandung Regency is summarized in the table below.

Table 38. Demographic Profiles

Parameter	Unit	Bandung City		Bandung Regency	
Population	people	2,461,553		3,718,660	
Female	% population	50.34		50.96	
Male	% population	49.66		49.04	
People with density	Person/Sq.km	14.72		2.08	
Population growth	annual %	0.35		1.3	
Age structure					
▪ 0 - 14 years	% population	Male:	11.35	Male:	13.21
		Female:	10.8	Female:	12.57
▪ 15 - 64 years	% population	Male:	35.62	Male:	35.08
		Female:	34.87	Female:	33.52
▪ ≥65 years	% population	Male:	3.37	Male:	2.67
		Female:	4	Female:	2.73
Dependency ratio	%	41.87		45.45	
Percentage of poor people	% population	4.25		6.8	

Source: Bandung City in Numbers, 2023 and Bandung Regency in Numbers, 2023

5.2.2. Education and Health

In Bandung City, the average years of schooling were approximately 11.06 years, whereas in Bandung Regency, they were 9.1 years. In Bandung City, the average years of schooling among individuals aged 25 and older is 10.71 years for women and 11.42 years for men. Gender inequality in education also exists in the Bandung Regency. The average years of schooling for individuals aged 25 and over in Bandung Regency are 8.93 years for women and 9.32 years for men.

The life expectancy at birth in Bandung City is 73.3 years for males and 76.93 years for females. Meanwhile, the average life expectancy in Bandung Regency was 74.27 years (72.5 for males and 76.2 for females). The under-five mortality rate for Bandung City and Bandung Regency is 15.77 and 12.96 deaths per 1,000 live births, respectively.

The maternal mortality ratios for Bandung City and Bandung Regency were 28 and 39 deaths per 1,000 live births, respectively.

Table 39. Education and Health Profiles (2022 – 2023)

Items	Year	Statistics	Bandung City	Bandung Regency
Average years of schooling				
Total	2023	Years	11.06	9.1
Male	2023	Years	11.42	9.32
Female	2023	Years	10.71	8.93
Life expectancy rate				
At birth	2022	Years	75.04	74.27
Male	2023	Years	73.30	72.50
Female	2023	Years	76.93	76.2
Under-five mortality rate	2020	Per 1,000 live births	15.77	12.96
Maternal mortality rate	2020	Per 1,000 live births	28	39

Source: <https://BPS Statistik.go.id/>, West Java Health Profile 2020, Bandung City in Numbers 2023, Bandung Regency in Numbers 2023, West Java Province in Numbers 2023

The table below shows that the average number of students per class at primary, middle, and high school levels at Bandung Regency is slightly higher than the National Education Standards, while at Bandung City is slightly lower². Furthermore, the number of universities in Bandung City is shown to be much more than in Bandung Regency (approximately more than 13 times).

Table 40. Number of Schools (2022)

Items	Bandung City	Bandung Regency
Primary school		
Number of primary school (SD+MI)	555	1,636
Average student per classroom. excluding MI	37	38
Middle school		
Number of junior high school (SMP+MTs)	312	581
Average student per classroom. excluding MTs	28	34
High school		
Number of senior high school (SMU+MA)	171	150
Average student per classroom. excluding MA	28.5	34.5
Vocational high school		
Number of vocational high school (SMK)	120	128
Average student per classroom	23.7	26
Number of Universities	96	7

Source: <https://disdik.jabarprov.go.id/>, Bandung City in Numbers 2023, Bandung Regency in Numbers 2023

² According to Regulation of the Minister of Education and Culture No. 23 of 2013, Regulation of the Minister of National Education No. 41 of 2007 and Regulation of the Minister of National Education No. 40 of 2008

Based on the Bandung City in Numbers 2023, Bandung Regency in Numbers 2023, the total number of hospitals are 48 units in Bandung City and Bandung Regency. The total number of hospital beds was around 5,421 and this equivalent to approximately 2.12 beds per 1,000 population³. Meanwhile, Bandung Regency requires at least 3.700 hospital beds, but only 1.200 beds are available currently. Hospital beds are used to indicate the availability of inpatient services.

Posyandu performs as a community-based healthcare unit at a grassroots level. Information and service on maternal and child health, immunization, nutrition, basic sanitation are usually conducted by local health cadres with regular visits by *Puskesmas* staff.

Table 41. Number of Health Facilities (2022)

Items	Bandung City	Bandung Regency
Health Center (Puskesmas)	75	134
Clinic (Balai Pengobatan)	121	126
Integrated Service Post (Posyandu)	2,034	3,899
Hospital	28	10

Source: <https://e-prodeskel.kemendagri.go.id/>, Bandung City in Numbers 2023, Bandung Regency in Numbers 2023

Based on a survey conducted in December 2021, approximately five (5) hospitals were observed along the Bandung BRT route in Jl. Rajawali Timur, Jl. Kebon Jati, and Jl. Lembong, with only one school on Jl. Rajawali Barat may experience a direct impact on their access due to the construction of the BRT. Based on the BPS Bandung City statistic data in 2021, there were 5 top sicknesses recorded in Bandung City. Aside from COVID-19, dengue was the second-highest disease burden, as shown in the following table.

Table 42. Number of Sickness Recorded in Bandung City (2021)

Sickness	No of Cases
Diarrhoea	177
Dengue	328
Covid 19	13,814
Others (Chikungunya, Leptospirosis, Cholera etc)	301
Malnutrition	138

Source: <https://bandungkota.bps.go.id/>

5.2.3. Employment and Livelihood

The table below shows that, in 2022, the labor force participation rates in Bandung City and Bandung Regency were estimated at 69.42% and 63.45%, respectively. During the same period, most employees in Bandung City and Bandung Regency were employed in the services sector, followed by industry and agriculture. Meanwhile, the open unemployment rate was estimated at 9.55% in Bandung City and 6.98% in Bandung Regency. The minimum wage in Bandung City was IDR 4.05 million/month. In Bandung Regency, the average monthly wage was 3.49 million, higher than the minimum wage in West Java Province, which is set at approximately IDR 2.0 million.

³ Dinas Kesehatan Kota Bandung. (2019). Profil Kesehatan Kota Bandung.
<https://dinkes.bandung.go.id/wpcontent/uploads/2020/09/Profil-Kesehatan-Kota-Bandung-Tahun-2019.pdf>

Table 43. Employment Rate of Bandung City and Bandung Regency

Items	Year	Statistics	Bandung City	Bandung Regency
Labor force participation rate	2022	Years	69.42	63.45
Open unemployment rate	2022	%	9.55	6.98
Formal labor	2020	%	53.51	48.62
Labor force by occupation:	-	-	-	-
Agriculture sector	2023	%	0.5	6.79
Industry sector	2023	%	23.34	37.59
Service sector	2023	%	76.22	55.61

Source: Bandung City in Numbers 2023, Bandung Regency in Numbers 2023, Labor Force Situation in West Java Province 2023

A Land Acquisition and Resettlement Action Plan (LARAP) serves as a Resettlement Action Plan (RAP), which was carried out to provide a baseline condition of community livelihoods, following the World Bank and AFD's requirements, as one of the project funders. This study focused on identifying people in the community who may be affected by the development and future operation of the BRT project, referred to as Project Affected Peoples (PAPs), as described below.

- *Parking attendants* - The presence of parking attendants who work on the parking areas along the planned BBMA BRT Corridor location—official parking attendants under the local government service agency—was identified to total 193 individuals, of which 188 (or approximately 97%) are male and also the heads of households. Based on the survey, their average monthly income ranges widely, from less than IDR 1,500,000/month to as much as Rp 6,000,000/month, as shown below.

Table 44. Average Monthly Income of Parking Attendants

Monthly Income in Average	Number of Parking Attendants	Percentage
< Rp 1.500.000	29	15%
Rp 1.501.000 - 2.500.000	108	56%
Rp 2.501.000 - 4.210.000	54	28%
Rp 4.211.000 - 6.000.000	2	1%
Total	193	100%

Source: LARAP document by Dohwa-Lenggogani, 2025

The distribution of respondents by their status and their average monthly income is presented in the following tables.

Table 45. Status of Parking Attendants

Respondent's Status in the Household	Number	Percentage
Husband and Head of Household.	188	97,4%
Wife and Head of Household	1	0,5%
Husband	1	0,5%
Wife	0	0,0%

Respondent's Status in the Household	Number	Percentage
Children	3	1,6%
Total	193	100%

Source: LARAP document of BBMA, Dohwa-Lenggogani, 2025

Furthermore, referring to Law No. 9 of 1999 on Human Rights, specifically Article 5, the distribution of vulnerable groups among the parking attendants affected by the project is as follows.

Table 46. Vulnerable Groups Among Parking Attendants

Category of Vulnerable Households	Number
Individuals over 79 years old	4
Women as heads of household	1
Individuals with income below the poverty line (< minimum wage) *	184
Individuals with disabilities	0

Source: LARAP document of BBMA by Dohwa-Lenggogani, 2025

- *Street Vendors* - Based on the LARAP survey, a total of 1,735 street vendors (PKL) were identified and categorized by zone according to Bandung City Regional Regulation No. 4/2011. This includes 331 vendors in green zones, 353 vendors in yellow zones, and 1,051 vendors in red zones. The zoning classification reflects the project's approach to managing affected street vendors in accordance with the Bandung City Regional Regulation No. 4/2011. Vendors located in green zones are permitted to continue operating without restrictions. In contrast, those in yellow zones are permitted to operate under specified time or location restrictions, in coordination with the local government. Vendors are situated in red zones, where street vending is prohibited. All affected PKL/street vendors are subject to relocation or livelihood restoration assistance in accordance with the approved LARAP (2025).

Table 47. Number of Street Vendors within BRT Corridors

Road Name	Green Zone				Yellow Zone				Red Zone			
	Left side		Right side		Left side		Right side		Left side		Right side	
	Kiosk	Non-Kiosk	Kiosk	Non-Kiosk	Kiosk	Non-Kiosk	Kiosk	Non-Kiosk	Kiosk	Non-Kiosk	Kiosk	Non-Kiosk
Moh. Toha	0	0	0	0	0	0	0	0	6	25	12	3
Pungkur	0	0	0	0	0	9	2	2	0	0	0	0
Dewi Sartika	0	0	0	0	0	0	0	0	0	13	1	4
Dalem Kaum	0	0	0	0	0	0	0	0	0	4	0	5
Alun-Alun Timur	0	0	0	0	0	0	0	0	0	1	0	0
Banceuy	0	0	0	0	10	40	0	21	0	0	0	0
Sunia Raja	0	0	0	0	0	0	0	0	0	11	5	10
Otto Iskandar Dinata	0	0	0	0	0	0	0	0	3	250	3	214
BKR	0	0	0	0	0	0	0	0	0	6	0	3
ABC	15	5	0	0	15	2	0	3	0	0	0	0
Naripan	0	0	0	0	0	0	0	0	14	25	10	25
Ahmad Yani	2	173	7	29	0	0	0	7	0	89	0	65
Ibrahim Adjie	0	0	0	0	0	0	0	0	15	14	30	2
Jakarta	0	0	0	0	3	9	2	0	4	5	4	2
Asia Afrika	0	0	0	0	0	0	0	0	1	44	1	3
Jenderal Sudirman	5	53	4	38	0	0	0	0	5	10	1	3
Rajawali Barat	0	0	0	0	0	0	0	0	10	28	3	4
Rajawali Timur	0	0	0	0	10	34	3	12	14	15	4	4
Kebon Jati	0	0	0	0	120	11	35	3	0	0	0	0
Sunda	0	0	0	0	0	0	0	0	0	2	0	0
Veteran	0	0	0	0	0	0	0	0	0	4	0	12
	22	231	11	67	158	105	42	48	72	546	74	359
	Total for Green Zone = 331				Total for Yellow Zone = 353				Total for Red Zone = 1,051			

Source: (Dohwa-Lenggogeni, 2024)



Figure 27. Street Vendors and Street Parking Conditions

- Kiosk Tenants and Owners** - Kiosk or stall tenants are located at several terminals designated as future depot and final terminal locations, namely: *Cicaheum* Terminal, planned as a depot; *Antapani* Terminal, planned as an end terminal (terminus), and *Ledeng* Terminal, planned as a terminal. Tenants at these locations are expected to be directly affected, as all existing terminals (except *Rancanumpang*, which will be newly developed on vacant land) are planned to undergo complete renovation. According to the LARAP survey (see table below), the number of respondents is significantly lower than the number of existing kiosks, as many kiosks were found inactive, permanently closed, or unavailable at the time of the census.

Table 48. Affected Kiosk Tenants

Location	Number of Kiosk Tenants/Owners
Terminal Cicaheum	59
Terminal Antapani	16
Terminal Ledeng	43
Total	118

Source: (Dohwa-Lenggogeni, 2024)

According to the LARAP survey conducted on October 31, 2024, the average monthly income of households renting land or kiosks ranges from less than Rp 1,500,000 up to Rp 7,500,000. The respondents' income distribution is presented below.

Table 49. Household Income of Affected Kiosk Tenants/Owners

No.	Household Income Range	Number of Respondent	Percentage
1	< Rp. 1.500.000	24	12%
2	Rp. 1.501.000 - 2.500.000	112	58%
3	Rp. 2.501.000 - 4.210.000	53	27%
4	Rp. 4.211.000 - 6.000.000	2	1%
5	Rp. 6.001.000 - 7.500.000	0	0%
8	No answer from the respondents	2	1%
Total		193	100%

Source: (Dohwa-Lenggogeni, 2024)

A total of 32 individuals among the land/kiosk tenants were identified as vulnerable, with the following breakdown.

Table 50. Vulnerable Individuals Among Affected Kiosk Tenants/Owners

No	Vulnerability Category	Number
1	Individuals over 79 years old	1
2	Women as heads of household	14
3	Individuals with income below the poverty line (< minimum wage) *	17
4	Individuals with disabilities	0
Total		189

Source: (Dohwa-Lenggogeni, 2024)

- *'Angkot' Drivers and Crews*- The development of the BRT system is expected to significantly affect the current public transportation system, particularly those operated by the private sector. GIZ (2020, p. 125) in the Bandung BRT Feasibility Study reported that *angkot* (public minivan) drivers will be among the most affected groups when the BRT becomes operational. According to the Systra study (2022), the proposed BRT routes will overlap with 48 *angkot* routes, with 8 of them showing high levels of overlap. A total of 1,554 vehicles is estimated to operate on these overlapping routes, and if BRT project is operational, would potentially impacting *angkot* cooperatives, drivers, and the families who rely on this livelihood. Study for the *angkot* drivers is addressed in separate project-level Public Transport Reform, as part of the MASTRAN project sub-component.

Table 51. Affected Angkot Drivers and Operators and their Households

Items	Unit	Scope			
		Core BRT	Core BRT + Extended BRT Network	Core BRT + Priority BRT Routes	Total
Impacted <i>angkot</i> fleet	number	858	1.093	1.228	1.554
Impacted workers (drivers & ticketing operators)	person	2.574	3.279	3.684	4.662
Timers	person	96	96	96	96
Maintenance staff	person	172	219	246	311
Approximate affected people	person	11.366	14.374	16.102	20.275
Approximate affected family members	household	2.842	3.594	4.026	5.069

Source: Preliminary Report by Dohwa-Lenggogeni based on Systra Study, 2022

Each *angkot* unit typically involves 3 workers—2 drivers and 1 ticketing staff—while maintenance needs are generally supported by 1 technician for every 5 vehicles. Additionally, each route involves 2 timers. With 48 routes confirmed to overlap with BRT corridors, it is estimated that the total number of individuals affected across the BRT-BBMA system could reach 5,069 households, or 20,275 people, assuming an average household size of 4.

Another group that may be impacted is paratransit drivers, including those working for ride-hailing services such as Grab and Gojek. A traffic count survey conducted on January 23, 2020, over a 17-hour period (5:30 AM – 10:30 PM), found that motorbike-based ride-hailing drivers typically account for 10 – 15% of all two-wheeled vehicles on several major roads in Bandung.

Table 52. Online Transport Drivers in the BRT Corridor

Road Segment (BRT Corridor)	Grab/Gojek Motorcycles	Percentage of Total Two-Wheelers
Jl. Asia Afrika	9,065	11.8%
Jl. Banceuy	3,906	15.3%
Jl. PETA	6,209	10.0%

Source: Bandung City Daily Video Traffic Output (2020), as cited in GIZ (2020, p. 126)

5.2.4. Community Perception

A community perception survey was conducted at and around several terminal locations, including Cicaheum, Leuwipanjang, Antapani, and Ledeng terminals, as well as informal terminals in Kebon Kalapa and Jalan Elang, and around BRT stop areas near Alun-Alun Bandung and Kebon Jati Hospital. The survey aimed to capture the public's awareness and attitudes toward the planned construction and operation of the Bandung BRT-BBMA project. A total of approximately 30 respondents participated, comprising terminal staff, kiosk traders,

Angkot drivers, passengers, and local residents including shopkeepers and hospital staff. The survey results among these respondents indicated that:

- 46% of respondents were not yet aware of the BRT Project
- Despite limited awareness, 92% expressed general support for the project
- 77% of respondents believed that BRT Project would bring benefits, particularly in enhancing accessibility and mobility for Bandung citizens, and potentially reducing traffic congestion
- 8% perceived potential negative impacts, primarily from *Angkot* drivers who were concerned about route competition and loss of income.
- 15% were not sure or had no opinion on the potential impacts of BRT BBMA.

These findings generally indicate a positive perception and expectation of public benefit, though also point to a need for broader information dissemination and engagement with affected stakeholders, especially the *angkot* drivers.



An interview-based survey using a structured questionnaire was conducted with Angkot drivers, kiosk vendors and terminal staff

Figure 28. Interview Survey Activities

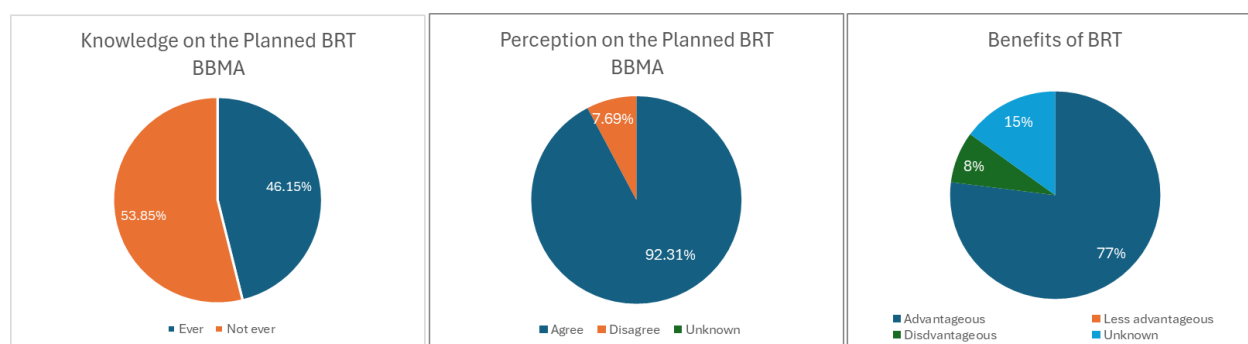


Figure 29. Public Responses to the BRT-BBMA Project

Meanwhile, the potential concerns regarding the construction and operation of the BRT–BBMA are presented in the following figure.

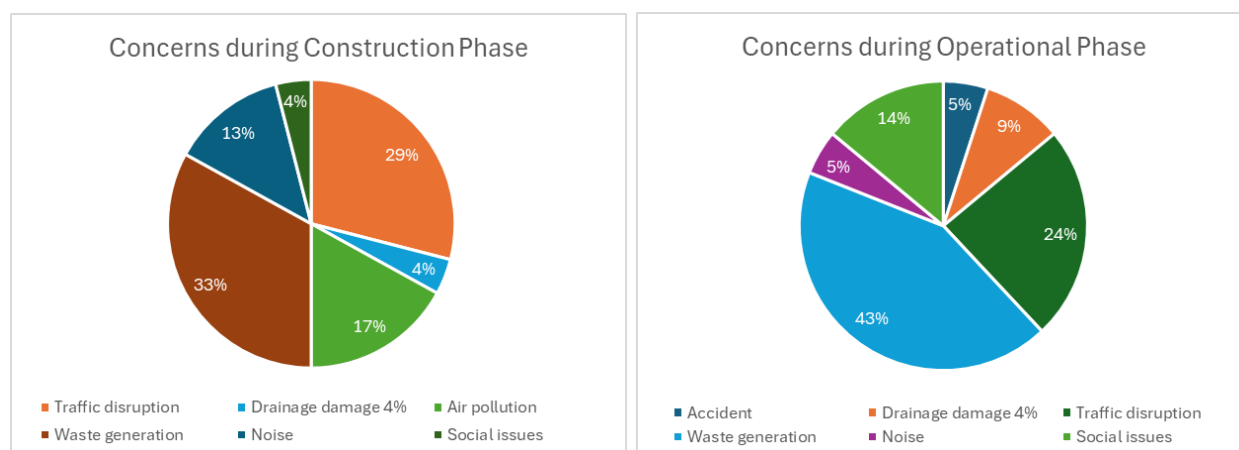


Figure 30. Community Concerns on E&S Impacts of BRT - BBMA Project

Based on the above figure, the main public concerns on BRT-BBMA construction activities include an increase in waste generation (33%), followed by traffic disruption (29%), air pollution (16.5%), and noise pollution (12.5%). During the operational phase, the primary concern remains waste generation (43%), followed by traffic congestion (24%), social issues (14%), and drainage disruption (10%). In terms of social concerns, communities living near the terminal expressed particular concern about a potential rise in street crime or gang-related activity. For kiosk vendors, the biggest concern is uncertainty over whether they will still be allowed to operate their business in the terminal area once the project is underway.

Despite these concerns, the dominant sentiment among respondents reflects expectation for a more comfortable and efficient transportation system that can connect people with various parts of Bandung more reliably. The community also sees potential in the BRT-BBMA project to create new job opportunities, both during the construction phase and operational phase.

5.2.5. Accessibility and Mobility Pattern

Employment Opportunities. A total of 3,272 activity centers has been identified as key generators of mobility within the BBMA. These include destinations for work, education, health services, and recreation. The three largest categories are educational facilities (32%), cafes and restaurants (23%), and offices (19%). Most of these activities are concentrated within Bandung City.

Table 53. Mobility Generators within the BBMA

Type of Activity	Number of Activities	Percentage of total
Shopping malls	48	1%
Shopping centers	44	1%
Convenience stores	365	11%
Traditional markets	78	2%
Offices	614	19%
Educational facilities	1,060	32%

Type of Activity	Number of Activities	Percentage of total
Health facilities	255	8%
Tourist attractions	64	2%
Cafes and Restaurants	745	23%
Total	3.273	100%

Source: The World Bank. 2020

Despite the high concentration of activities, access to employment by public transportation remains limited. Of the approximately 3.77 million jobs in the BBMA, only:

- 1 million jobs (27%) are accessible within 60 minutes via walking and public transport from Bandung Station;
- 1.5 million jobs (40%) are accessible within 90 minutes; and
- 1.75 million jobs (46%) are accessible within 120 minutes.

This highlights significant transportation challenges, particularly for low-income and transit-dependent populations. Long commute times reduce access to jobs and have been associated with increased stress, lower energy levels, and poorer sleep quality, as observed in comparative studies such as those conducted in Southern Sweden.

Accessibility to Public Facilities. Based on the BRT Feasibility Report (GIZ. 2020), the average travel times between sub-districts in Bandung are in a range of 7 to 21 minutes, with the highest accessibility sub-districts located in the center of the city and within the area of influence. However, this estimation does not consider delays due to traffic congestion effects. The latest administration of Bandung City has introduced new approaches by improving public transportation and promoting sustainable urban transportation to reduce auto dependency by, for example, providing subsidies for students who use public transport and promoting the wider use of bicycles.

Since 2015, Bandung City Government has launched 23 programs on poverty alleviation by providing access to basic services for the poor, including for street vendors:

- Structuring street vendors by relocating them to designated locations;
- Coaching street vendors through management organizations, business development, capital facilitation, providing identity cards to street vendors, and the establishment of street vendor forums in 27 sub-districts; and
- Renovation of traditional markets.

Accessibility for Persons with Disabilities and Other Vulnerable Groups. Community facilities and the mobility system should be accessible to all citizens, particularly people with reduced mobility such as people with disabilities, elderly, pregnant women or parents with baby strollers and people carrying groceries or packages. Issues faced by people with disabilities and other vulnerable groups in terms of access and their usage of public transport facilities and services may be improved by reviewing the current usage and issues experienced.

Several regulations and policies require consideration of the accessibility of public facilities for individuals with specific needs, such as people with disabilities and older adults. The first step in implementing national-level regulations and policies is typically the enactment of local regulations. The Regional Government (West Java Province and Bandung City) shows its commitment through the issuance of the following regulations:

- West Java Provincial Regulation No. 13 of 2013 concerning Buildings;
- West Java Provincial Regulation No. 7 of 2013 concerning the Implementation of Protection for People with Disabilities;
- West Java Governor Regulation No. 97 of 2015 concerning Accessibility for People with Disabilities; and
- Bandung City Regulation No. 15 of 2019 concerning Protection and Fulfillment of the Rights of People with Disabilities.

Bandung City has developed a network of Universal Access Design-based footpaths throughout the Central Business District. Trans Metro Bandung operates two buses that are accessible to People with Disabilities (PwD), which have been in service since 2018. In 2020, DAMRI operated 17 Scania buses that are considered friendly to people with disabilities and the elderly, but the service is still limited to the route of *Dipatiukur – Jatinangor*.

5.2.6. Cultural Heritage

Cultural heritage is an integral part of a people's and a country's cultural identity and practice and may be a source of valuable historical and scientific information, as well as an asset for economic and social development. Law No. 11 of 2010 on Cultural Heritage provides the legal basis for the preservation, management, development, and utilization of cultural heritage in Indonesia. The material of cultural heritage may be in the form of objects, structures, situs, buildings, and areas.

According to the Regional Regulation of Bandung City No. 7 of 2018, the BRT Corridor will traverse along 81 locations of cultural heritage buildings and structures listed in the Annex of the ESIA. According to this Bandung Regulation, demolition and/or changes to cultural heritage buildings are prohibited, particularly to cultural heritage building type A (article 44). Type B cultural heritage buildings are prohibited from demolition; however, rehabilitation and revitalization are permitted without altering the building's character (Article 45). Only the cultural heritage building type C can be changed for other functions according to the spatial plan (Article 46). In total, there are 1,759 cultural heritage buildings and 70 sites spread across 24 areas in Bandung City. Of that, there are seven cultural heritage areas that are in, nearby, or around the project sites (please refer to Table 54 on List of Cultural Heritage in BRT BBMA, which lists 27 bus stations that are present in/near/around the cultural heritage sites). Therefore, any construction activities that will result in disturbances and/or changes to cultural heritage buildings would need to be identified as early as possible, and an alternative is proposed. Classification of Cultural Heritage Buildings in Bandung City Areas is divided into 3 (three) groups, including:

- Class A Cultural Heritage Buildings are buildings that are at least 50 years old plus at least meeting 3 (three) other criteria.
- Class B Cultural Heritage Buildings are buildings that are at least 50 years old plus at least meeting 2 (two) other criteria.
- Class C Cultural Heritage Buildings are buildings that are at least 50 years old based on the regional regulations above.



A6-Merdeka Building (EX-Societeit Concordia) on Jl. Asia Afrika



A20- Hubdam III Siliwangi Office (EX-OSVIA) on Jl. Moh. Toha



A25- Gereja Kristen Pasundan on Jl. Kebon Jati



B30- Cup Dua Langit Shop on Jl. Jend. Sudirman



A7-Pikiran Rakyat Building on Jl. Asia Afrika, Braga



A16-Yayasan Pusat Kebudayaan Building on Jl. Naripan

Figure 31. Cultural Heritage Buildings Near BRT On-corridor

In BBMA, part of the proposed BRT corridor follows the west-east city axis passing the Bandung Cultural Heritage Area, where historic buildings are located, and also a tourist destination. Based on these considerations, the implementation of BRT corridor surveys on routes in historic/cultural heritage areas is technically the same as in other areas. Beside cultural heritage building, almost 90% of BRT corridor passes through the cultural heritage area of Bandung, termed as K1 (Old City Center Area), K2 (Sundanese Ethnic Area at Tegallega), K3 (Chinatown Area), K4 (Central City Government Area), K5 (Central Military Area), K6 (Kosambi Area), K8 (Rajawali Area) and K15 (Kiaracandong Industry). More information on cultural heritage is shown in the following tables.

Table 54. List of Cultural Heritage within the BRT Corridor

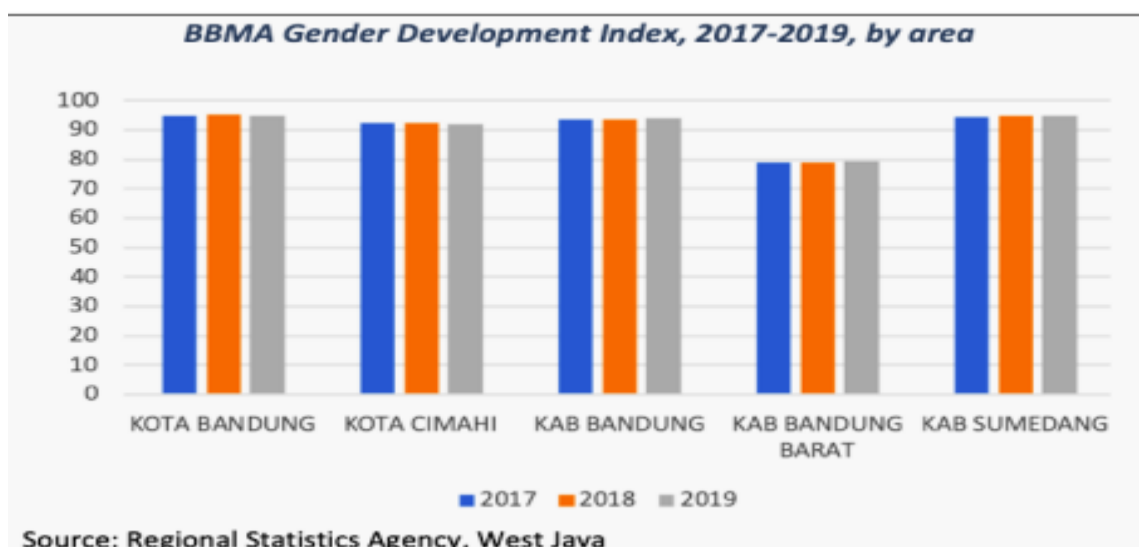
No	Bus Station	Cultural Heritage Area
1	Cicadas	K15 (Culture Heritage Area Kiaracandong Industry Area)
2	Jl. Jakarta	K15 (Culture Heritage Area Kiaracandong Industry Area)
3	Cikaso	K15 (Culture Heritage Area Kiaracandong Industry Area)

No	Bus Station	Cultural Heritage Area
4	Bandung Juara	K1 (Culture Heritage Area Kota Lama Center Area)
5	Pasar Kosambi	K6 (Culture Heritage Area Kosanobi Area)
6	Simpang 5	K1 (Culture Heritage Area Kota Lama Centre Area)
7	Asia Afrika	K1 (Culture Heritage Area Kota Lama Centre Area)
8	Alun-Alun	K1 (Culture Heritage Area Kota Lama Center Area)
9	Sudirman UBO	K3 (Culture Heritage Area Chinatown Area)
10	Sudirman Gamalier	K3 (Culture Heritage Area Chinatown Area)
11	Sudirman Mayapada	K3 (Culture Heritage Area Chinatown Area)
12	Sudirman Andir	-
13	Sudirman Grand Ballroom	-
14	Sudirman Elang	K8 (Culture Heritage Area Rajawali Area)
15	Sudirman Ujung	-
16	Rajawali Barat	-
17	Rajawali Elang	K8 (Culture Heritage Area Rajawali Area)
18	Kebun Jati Waringin	-
19	Ciroyom	-
20	Pabrikan	K3 (Culture Heritage Area Chinatown Area)
21	Rs. Kebun Jati	K3 (Culture Heritage Area Chinatown Area)
22	Stasiun Hall	K3 (Culture Heritage Area Chinatown Area)
23	Otista Pasar Baru	K3 (Culture Heritage Area Chinatown Area)
24	Kebon Jeruk	K2 (Culture Heritage Area Sudanese Etnich (Tegalega)
25	Cibadak	K2 (Culture Heritage Area Sudanese Etnich (Tegalega)
26	Panjunan	K2 (Culture Heritage Area Sudanese Etnich (Tegalega)
27	Taman Tegalega	K2 (Culture Heritage Area Sudanese Etnich (Tegalega)
28	M. Toha	K2 (Culture Heritage Area Sudanese Etnich (Tegalega)
29	Kebon Kalapa	K2 (Culture Heritage Area Sudanese Etnich (Tegalega)
30	Kepatihan	K2 (Culture Heritage Area Sudanese Etnich (Tegalega)
31	ABC	K1 (Culture Heritage Area Kota Lama Center Area)
32	Click Square	K1 (Culture Heritage Area Kota Lama Center Area)
33	BTM	-
34	Banceuy Center	K3 (Culture Heritage Area Chinatown Area)

Source: Dohwa – Lenggogeni, 2023

5.2.7. Gender Profile

The Gender Development Index (GDI) calculates the average of gender-based development achievements in three basic dimensions: life expectancy, level of participation in education, and the level of participation in the workplace. The higher the index, the greater the equality between males and females. The GDI for the BBMA suggests relatively high rates of equality and little inequality across locations from 2017 to 2019. As shown in the chart below, inequalities are greatest in Kabupaten Bandung Barat, which is also one of the areas in the BBMA with the highest distribution of low-income households.



Source: Regional Statistics Agency, West Java. in GESI report. 2021)

Figure 32. BBMA Gender Development Index 2017–2019

According to the Sexual Exploitation and Abuse/Sexual harassment (SEA/SH) Risk Prevention and Management Action Plan document, to address Gender-Based Violence (GBV) in the Bandung Metropolitan Bus Rapid Transit (BRT) Project. West Java Province is one of the provinces in Indonesia with a relatively high rate of violence against women. The Indonesian Women's National Commission noted that during 2020, about 2.738 women in West Java were victims of violence.

5.2.8. Harassment and Gender-Based Violence

A user survey related to Urban Mobility in the Bandung Basin Metropolitan Area (BBMA) done in 2021 shows that 13% of females report experiences of physical harassment, 4% report emotional abuse, 4% experience sexual violence, and 1% report physical violence when using Public Transport (GESI Report, the World Bank, 2021).

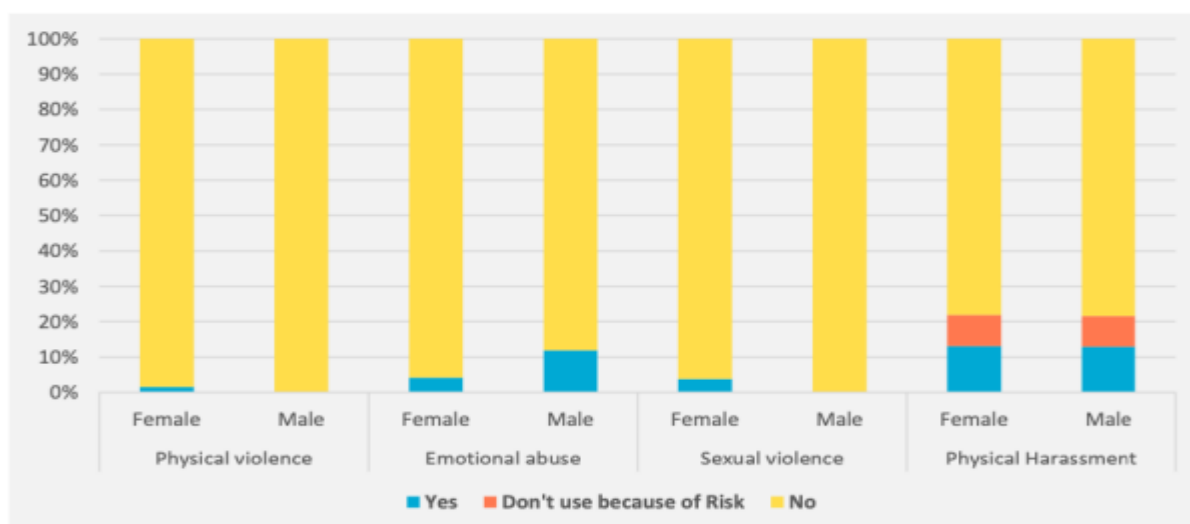


Figure 33. GESI Survey Results—Experience when Using Public Transportation

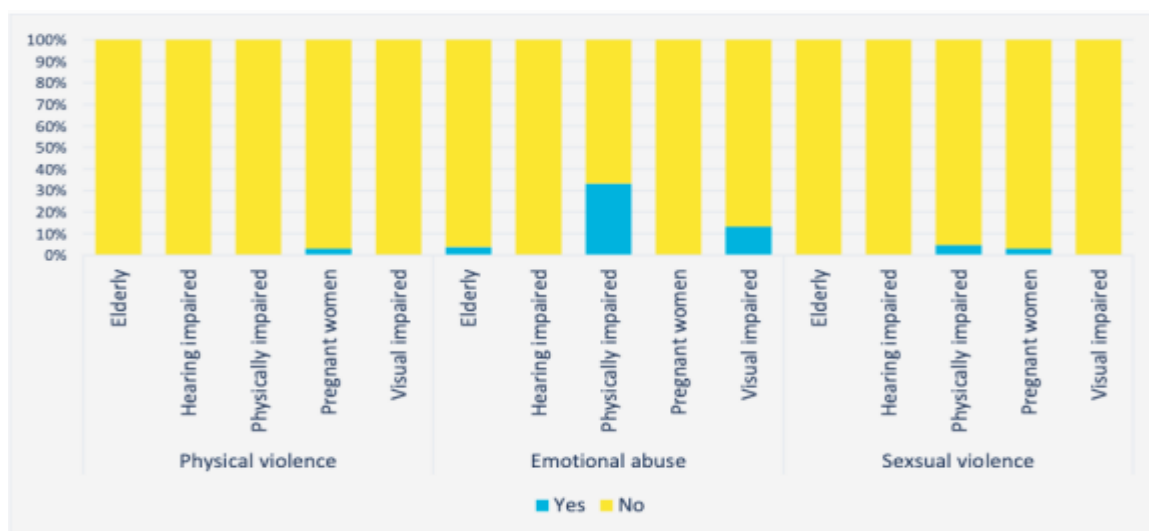


**Figure 34. GESI Survey Results Based on Mobility Impaired Respondents
(GESI Report, WB, 2021. p. 17)**

Nearly 33% of respondents who are physically impaired have experienced verbal harassment in public transport. Additionally, 2.5% of the elderly and 12.5% of visually impaired respondents reported cases of emotional abuse, 5% of physically impaired, and 3.5% of pregnant women have experienced sexual violence on public transport (GESI Report, WB, 2021, p. 16).

Furthermore, 84% of females and 72% of males state that if they have a GBV issue on public transport, they will raise it with the operator and/or the police nearby. 43% of females are confident that people would come to assist them in an event of violence (GESI Report, WB, 2021, p. 7). Respondents report a higher level of safety during daytime activities. Females feel less safe than males in most situations. Similarly, people feel less safe during nighttime activities (approximately two to three times as often). It seems that safety should be a primary concern for government and civil authorities, as the share of individuals who feel unsafe at night is substantial (GESI Report, WB, 2021, pp. 77-78).

Data from the Bandung City Women's and Children's Empowerment Service (DP3A) also shows an increase in cases of violence against women in 2020 compared to the previous year. During that year, there were 250 cases of violence against women handled by the Integrated Service Center for the Empowerment of Women and Children (P2TP2A) in Bandung City. They consist of 100 cases of sexual violence, 72 cases of psychological violence, 26 cases of physical violence, 7 cases of economic violence, 13 cases of neglect, 12 cases of trafficking (trafficking in persons), 8 cases of violence related to the struggle for child custody, and 12 other cases.

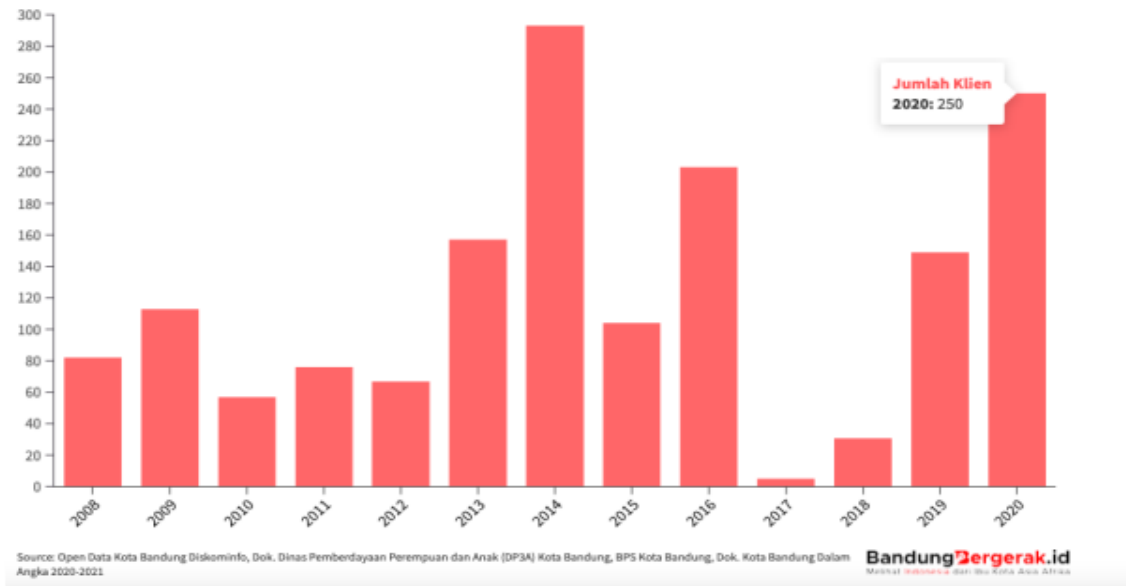


Figure 35. GBV Cases from 2008 - 2020 (Kota Bandung Diskominfo)

6. ENVIRONMENTAL AND SOCIAL RISK AND IMPACT ASSESSMENT

The implementation of BRT project, primarily during construction, will generate some adverse, temporary environmental and social (E&S) impacts but few others may be permanent one. In contrast, the BRT project is designed to provide an overall positive impact in providing a more efficient and reliable public bus service and reducing already congested traffic in BBMA in the medium- to long-term. Some cumulative impacts on E&S generated from prior and existing development and activities, BRT project implementation and those will be resulted from foreseeable future development within BBMA are also assessed in this section.

Potential types of E&S impacts likely to be generated through BRT project cycles are summarized in the following table to provide a snapshot and the assessment of each risk and impact is elaborated in the following sub-sections of the ESIA. The risk and impact assessment methods used in this ESIA are described in Section 4 of the ESIA. The risk level of an impact is determined as low, moderate, substantial or high-risk based on the criteria as follows:

- ‘Low risk’ if the impact is detectable but not considered significant and, therefore, mitigation measures are discretionary.
- ‘Moderate risk’ if the impact is evaluated as moderate, irreversible, or reversible and, therefore, can be mitigated using readily, common available measures to reduce the risk to an acceptable level.
- ‘Substantial risk’ if the impact is evaluated as significant, adverse, irreversible, or reversible and, therefore, should be mitigated using specialized measures to reduce the risk to as low as reasonably practicable.
- ‘High risk’ if the impact is evaluated as significant, adverse, widespread, and irreversible that cannot be mitigated and, therefore, alternatives to the project’s activities that are of less impact should be identified and adopted for the project.

Table 55. Identified Potential Environmental and Social Impacts

Activity E&S Aspects Affected	Pre-Construction	Construction						Operation & Maintenance
	Relocation of kiosks, street vendors, parking attendants	Project worker recruitment	Equipment, machinery & vehicle operations	Contractor basecamp operations	Civil & landscaping works	Transportation/ storage of construction materials, fuels & construction wastes	Quarries, asphalt & concrete plant operations (Suppliers)	BRT system operation & maintenance
Environment								
Ambient air quality	-	-	√	√	√	√	√	√
Noise & Vibration	-	-	√	√	√	√	√	√
Greenhouse gas emission	-	-	√	√	√	√	√	√
Surface water quality	-	-	-	√	√	√	√	√
Soil and Groundwater	-	-	-	√	√	√	√	√
Road traffic/infrastructure	-	-	√	-	√	√	-	√
Affected trees/City landscape	-	-	-	-	√	-	√	√
Social, Cultural and Health & Safety								
Local economy	-	√	√	-	√	√	√	√
Access and road traffic	-	—	√	-	√	√	√	√
Livelihood	√	√	√		√	-	-	√
Vulnerable groups of peoples	√	√	-	√		-	-	√
Cultural heritage	-	-	√	-	√	-	—	-
Labor and working conditions	-	-	√	√	√	√	√	√
Community health and safety	-	-	-	-	-	-	—	√

Source: Dohwa - Lenggogeni Team Concensus, 2025

6.1. Pre-Construction Phase

6.1.1. Livelihoods and Access Restriction

Overview. The potential impacts on livelihood disruption and access restriction of project affected peoples (PAPs) due to relocation of kiosk tenants, street vendors and parking attendants from the land and/or areas they currently use including payment of associated compensation are evaluated as substantial risk in the absence of any mitigation measures. However, upon consistent and effective implementation of the mitigation measures described below, the residual risk of the above impact could be reduced to moderate risk as described below.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Livelihood and access restriction for kiosk tenants, street vendors and parking attendants	Medium	Likely	Substantial	Minor	Possible	Moderate

Risk and Impact Assessment – Livelihood and Access Restriction. Although the BRT project does not require the acquisition of privately-owned land, the project activities require the use of government-owned lands and areas currently used by kiosk tenants, street vendors, and parking attendants as the PAPs. Therefore, the kiosk, street vendors, and parking attendants will need to be relocated elsewhere and compensated through cash payment and/or other benefits. This situation will impact the existing livelihood and access restrictions to PAPs within the dedicated BRT corridor, the adjacent bus stops, depots at *Cicaheum* and *Leuwipanjang*, parking lots, and bus terminals at *Ledeng* and *Antapani*, and BRT terminus/end stations. It is identified in the project's LARAP (dated March 2025) that the BRT project will affect approximately 4,802 PAPs, comprising 1,735 street vendors, approximately 120 kiosks, and 193 parking attendants.

Kiosk tenants and street vendors will experience relocation and restricted access to their existing economic activities, resulting in a loss of income if they cannot be relocated and continue to earn a living elsewhere. These impacts, if not timely and properly mitigated, could lead to grievance against the BRT project. Furthermore, the BRT corridor development will also affect on-street parking areas along Jl. Jenderal Sudirman, Jl. Ahmad Yani, Jl. Rajawali and Jl. Kebon Jati, affecting the parking attendants (official workers of the local government service agency), with loss of income if they cannot be accommodated by the government with work relocation. Although the BRT project area may cover four administrative regions, in terms of geographical context, the impact area is considered local and concentrated in Bandung urban areas along the designated BRT on-corridor and off-corridor, as well as within the existing terminals.

Based on the above assessment, the impact severity on livelihood disruption and access restrictions is evaluated as medium, and the likelihood of the impact can be considered as

certain because relocation of kiosk, street vendors, parking attendants, and associated compensation will occur as part of the BRT project implementation. Therefore, the inherent risk, without mitigation measures in place, of the above impacts is evaluated as substantial.

Mitigation Measures. To minimize the above impacts, the BRT project is recommended to implement the following mitigation measures, among others:

- The Livelihood Restoration Programs (included in the project's LARAP) for the PAPs should be disseminated early, prior to land acquisition, and then implemented prior to any construction activities in a transparent and timely manner, with active participation from the PAPs, the Borrower, and related local government agencies.
- The Project's Stakeholder Engagement Plan (SEP) should be implemented through proactive and regular engagement and disclosure of relevant project information to PAPs and other interested parties.
- A functional Grievance Redress Mechanism (GRM) should be established and implemented to address concerns, expectations, and inputs from PAPs and other interested parties. The GRM requirement is summarized in the ESIA and detailed in the project's LARAP.
- Complementary to ESIA, a Public Transport Reform will be undertaken under the project subcomponent 1. Concerning the *angkot* reorganization. This Angkot Reform will lay out the detailed planning of integration of *the angkot system and its drivers to the BRT services in respective cities*, including options such as upskilling and recruitment of drivers, integration of *angkot* and cooperatives to be feeder and end-point providers, etc.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the above impacts could be reduced from substantial risk to medium risk. Moreover, these impacts are expected to be localized, temporary, with livelihood and access restrictions for PAPs and the public are anticipated to gradually recover upon completion of construction.

6.1.2. Vulnerable People

Overview. The potential impacts on marginalization of vulnerable groups of people and potential for gender-based violence (GBV), including sexual exploitation and abuse and sexual harassment (SEA/SH), due to relocation of kiosk tenants, street vendors and parking attendants from the land and/or areas they currently use including in the payment process of associated compensation are assessed as moderate risk in the absence of any mitigation measures. However, with proper and consistent implementation of mitigation measures and monitoring plans, the residual risk of these activities could be reduced to low as described below.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Marginalization of vulnerable groups of people and potential for gender-based violence	Medium	Possible	Moderate	Minor	Possible	Low

Risk and Impact Assessment – Vulnerable People. Marginalization of vulnerable groups (i.e., women, low-income households, the elderly, and people with disabilities) and potential for GBV risk are anticipated to occur due to the relocation of their kiosks, street vendors, and parking areas that are required for construction of BRT on-corridor and off-corridor bus stations and stops, and related depots and terminals. These impacts are likely to arise during consultations and the payment of compensation to PAPs. They could disproportionately affect vulnerable groups, particularly female and elderly people, who account for 10% of the total PAPs. The vulnerable group of PAPs may have more constraints than other PAPs in their ability to participate and raise their concerns during consultation and/or have more challenges for their livelihood restoration. The loss of income or restricted access to community spaces could further disrupt their income-generating activities and livelihoods. The vulnerable groups, due to their lower levels of social and/or economic power, are at an elevated risk of GBV.

The Project's impact on vulnerable groups, including gender, is assessed as adverse and temporary, but potentially reversible. The scale of these impacts remains localized, centered on the Project's construction areas.

Based on the above assessment, the likelihood is considered possible, with the severity of the impact rated as medium, given the number of vulnerable PAP groups. Therefore, the inherent risk of the impact on vulnerable people due to the project's pre-construction activities are evaluated as moderate, especially if mitigation measures are not implemented in a consistent and effective manner.

Mitigation Measures. To minimize the vulnerable people and gender impacts on the PAPs, including vulnerable groups of people and potential GBV risk, the BRT project is recommended to implement the following mitigation measures, among others:

- The Livelihood Restoration Programs (included in the project's LARAP) for the vulnerable PAPs should be disseminated early prior to land acquisition, with an approach that account for the specific constraints faced by the PAPs, and then implemented in a transparent timely manner, and is accessible to the vulnerable PAPs, with the active participation from the Borrower and related local government agencies.
- The Project's Stakeholder Engagement Plan (SEP) should be implemented through proactive regular engagement and disclosure of relevant project information and updates to the vulnerable PAPs.
- A functional and accessible Grievance Redress Mechanism (GRM) should be established and implemented to address concerns, expectations, and inputs from vulnerable PAPs and other interested parties. The GRM requirement is described in related sections of the ESIA and detailed in the LARAP document.
- GBV prevention code of conduct and its violation sanctions should be socialized and acknowledged by each project worker and socialized to all relevant PAPs. A dedicated and survivor-centered approach of GRM for GBV cases must be established and implemented

to ensure the confidential handling of information related to GBV incidents that may occur during the project implementation.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the impact described earlier could be reduced from moderate risk to low risk. These impacts are expected to be limited to PAPs.

6.2. Construction Phase

6.2.1. Ambient Air Quality

Overview. The potential air quality impacts on the human receptor and the environment due to the BRT project construction activities and the operation of supporting facilities, such as basecamps, asphalt, and concrete mixing plants, are evaluated as substantial risk without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of the air quality impacts due to construction activities could be reduced to medium risk as described below.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Increased airborne dust and fugitive gas emissions exceeding the ambient air quality baseline level	Medium	Likely	Substantial	Medium	Possible	Moderate

Risk and Impact Assessment – Ambient Air Quality. The project's construction activities would impact the ambient air quality within and beyond the BRT on-corridor and off-corridor, as the air pollutants from earthworks and fugitive gaseous emissions from the project's vehicles and equipment would be easily dispersed depending upon the weather and climatic conditions. No air pollutant dispersion modelling of the project has been undertaken as part of the ESIA and/or DED.

The impact on air quality would be primarily generated from the operation of construction equipment, machinery, and project vehicles, activities within contractor basecamps, the transportation of construction materials and fuels from the suppliers to project sites, and the storage and transportation of wastes (hazardous, non-hazardous, and construction waste) from project sites to landfills or third-party vendors. These project activities collectively increase airborne dust/particulate matter (e.g., PM₁₀, PM_{2.5}) and exhaust gas emissions (e.g., NO_x, SO₂, CO) beyond baseline levels. Additionally, ancillary facilities such as asphalt and concrete mixing plants operated by the contractor or subcontractors used to support the project construction would contribute to elevated pollutant levels in the areas where they operate. Reduced ambient air quality would pose impacts on nearby sensitive receptors, including potential health risks to the residents living within the BRT project areas, quarries and concrete plants.

Furthermore, demolition of existing structures that may contain asbestos materials at *Leuwipanjang* and *Cicaheum* terminals poses additional risks to air quality and public health if not properly managed. Microscopic asbestos fibers are highly resistant to degradation and can remain suspended in the air for prolonged periods, increasing the potential for severe health impacts on workers and surrounding communities.

The nature of the project's impact on air quality would be adverse during construction but then it is anticipated to gradually improve once the BRT is in operation. The duration of the air quality impact is considered medium-term as the construction activities of the BRT project are currently scheduled within 12 to 15-month period. During this period, intermittent spikes of air pollutant concentrations may occur, especially during peak construction works.

On a magnitude scale and in the absence of air pollutant dispersion modelling for the BRT project, the concentration of ambient air quality parameters within the project areas could exceed the national air quality standard stipulated in the Government Regulation No. 22 of 2021 (Appendix VII) and/or the WHO Global Air Quality Guidelines (2021). However, these exceedances are possible to occur during prolonged dry seasons and intense construction activities.

Considering the above assessment and in the absence of air pollutant dispersion modelling conducted for the BRT project, the severity of the air quality impact is considered medium, and the likelihood of this impact occurring is likely since air pollutant emissions are an inherent part of common construction activities. Therefore, the inherent risk of the impact on air quality, including nearby sensitive receptors, is evaluated as substantial risk if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation Measures. To minimize the air quality impacts due to the construction activities, the BRT project is recommended to implement the following mitigation measures, among others:

- Air pollutant dispersion modelling should be undertaken for the project to enable an adequate assessment of whether the airborne particulate matters and fugitive gaseous emissions generated by the project's construction activities would cause further impacts on the existing air quality within the project's area of influence within Bandung city.
- Land clearing, demolition and earthworks should be limited to areas that are immediately required for construction to reduce unnecessary exposure of subsurface soil to wind.
- A temporary fence (e.g. usually made of zinc-alum sheet or other materials of similar function) of approximately 3-m high should be installed within of the perimeter of construction sites in order to minimize dust and gaseous dispersion.
- Vehicles/trucks transporting soil and other construction materials should not be overloaded and the loads should be properly covered with tarpaulin.
- Management for material mobilization which scheduled in night-time (22.00 – 05.00 WIB) instead of day-time if practicable.

- Project vehicles/trucks should use the designated roads commensurate with the tonnage of the vehicles and adhere to the determined speed limits.
- Open burning of construction and solid waste at construction sites and supporting facilities is strictly prohibited.
- Should there be asbestos-containing materials (ACM) found during demolition activities, inform and coordinate with PIU to ensure that such materials are handled, stored, and disposed of in accordance with applicable health, safety, and environmental regulations. Licensed contractors and certified disposal facilities must be engaged to prevent exposure and contamination.
- The contractor shall conduct regular monitoring (e.g., on a quarterly basis) of air quality at the construction sites and other areas where sensitive receptors such as residential and public facilities exist; and the monitoring results should be analyzed against the Indonesian Government and WHO guidelines.

Residual Risk. If the above mitigation measures and air quality monitoring plan are implemented in a consistent and effective manner, the ambient air quality impact on the sensitive receptors during construction could be reduced from substantial risk to medium risk. Moreover, these impacts are expected to be temporary and reversible, with air quality likely to return to the pre-construction baseline level upon completion of construction activities.

6.2.2. Noise and Vibration Level

Overview. The potential noise and vibration impact on the human receptor and the environment due to the BRT project construction activities and the operation of supporting facilities such as basecamps, asphalt, and concrete mixing plants is evaluated as moderate risk without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented consistently and effectively, the residual risk of this impact from construction activities could be reduced to low risk, as described below.

Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Elevated noise and vibration levels at construction sites and sensitive areas receptors above the baseline level	Minor	Possible	Moderate	Minor	Unlikely	Low

Risk and Impact Assessment – Noise and Vibration. Construction activities for the BRT Project would generate elevated noise and vibration levels, resulting in exceedances of the noise baseline at on- and off-corridor bus stops and in the vicinity of the *Cicaheum* and *Leuwipanjang* terminals, where the BRT bus depots will be constructed. The increase in noise

levels would result from the operation of construction equipment, machinery, and project vehicles; activities at the contractor's base camp; civil works; and the transportation and storage of construction materials, fuels, and waste from suppliers to project sites. Collectively, these activities are expected to raise noise levels above the current baseline conditions. Whilst the vibration is derived from piling activity at the depot and terminal construction. Furthermore, ancillary facilities such as asphalt mixing and concrete batching plants that support the construction process would also contribute to elevated noise in their respective areas of operation.

The use of equipment such as dozers, piling machines, motor graders, wheel loaders, excavators, vibro-compactors, and jackhammers contributes to elevated noise levels, particularly during ground-breaking, demolition of existing roads and buildings at terminals, foundation work, and road surface treatments. Simultaneously, the movement of dump trucks and other construction vehicles carrying materials, fuels, and wastes along construction routes adds intermittent peaks in noise and vibration, especially when operating near community settlements, schools, hospitals, and other sensitive areas. At contractor basecamp, which often serves as a hub for equipment storage, vehicle maintenance, and temporary worker accommodation, constant operational activity may lead to sustained background noise, especially during early morning or late evening hours.

Noise propagation from the construction equipment is calculated as a proxy that determines the noise level at a distance from the noise source using the following formulae:

$$L_p(x) = L_p(x_o) + 10 \lg \left(\frac{x_o}{x_p} \right)$$

Where:

- $L_p(x_o)$ = Sound Pressure Level (SPL) at distance x_o , dB(A)
 x_o = distance where sound pressure level (SPL) is measured, $x_o = 2$ meter
 $L_p(x)$ = Noise level at distance x , dB(A)
 x_p = Distance from the source to the calculation point

The noise levels generated by different types of equipment and machinery typically used by the construction industry and measured at a certain distance from the sources are presented in the following table.

Table 56. Noise Level of Construction Vehicle and Equipment

Equipment and Machinery	Calculated noise at different distances, dB(A)			
	50ft ^a	25m	50 m	100 m
Bulldozer of 100 – 150 PK	85	81	75	69
Bore pile	95	91	85	79
Dump truck 10-ton	84	80	74	68
Motor grader 100 PK	85	81	75	69
Wheel loader 1.0 – 1.6 m ³	80	76	70	64
Excavator 80 – 140 PK	85	81	75	69
Vibro compactor	80	76	70	64

Equipment and Machinery	Calculated noise at different distances, dB(A)			
	50ft ^a	25m	50 m	100 m
Truck mounted with concrete mixer	85	81	75	69
Water pump 70 – 100 mm	77	73	67	61
Jack hammer	85	81	75	69

Note: ^a50 feet was determined based on FHWA Roadway Construction Noise Model User's Guide (2006); 50 feet equals to approximately 15.2 meters.

The noise level presented in the above table suggests that construction noise will have a direct impact not only on project workers but also on communities living within the proximity of the construction sites. Prolonged exposure to high noise levels, especially in the absence of proper noise control measures or protective equipment, can pose serious health risks to workers. These may include hearing impairment, stress-related impacts on the central nervous system, and other adverse health effects. However, it is noted that all construction machines are less likely to operate for the same duration and amount at all construction sites, and therefore, the total noise level will be spread out across construction periods and the construction sites.

Furthermore, the projection of the noise level of several vehicles and equipment operating at similar times at particular locations is calculated, and the result is presented below. According to the aforementioned data, the noise level in the construction phase will be contributed from heavy equipment at some construction spots, and is in a range of 74.3 to 75.9 dB(A) within a 21 – 30 m distance from the noise sources.

Table 57. Projection of Accumulative Noise in the Construction Phase

Type of Heavy Equipment	Number of Equipment Operating in Parallel	Specific noise level	Equivalent noise level
		(dBA)	(dBA)
Dump truck	4	76	82
Excavator	1	81	81
Loader	1	80	80
Grader & vibroroller	2	80	83
Asphalt machine	1	80	80
Concrete mixer pump	1	81	81
Accumulative noise level (logarithmic based calculation)			89
Accumulative noise level at 21 m from source			75.9
Accumulative noise level at 21 m from source			74.3

Source: Dohwa – Lenggogeni calculation, 2023

Similar with the noise impact, vibration impacts would be felt within nearby buildings or potentially affect sensitive structures, especially when civil works with the vibration most certain activities as foundation installation with piling construction by spun pile methods and soil compaction by using motor grader. Although vibration intensity typically decreases with distance from the source, structures located near the construction sites, particularly older or structurally fragile buildings, may be more vulnerable to structural damage, wall cracking and other damages compared to newer building and physical structures.

Therefore, the nature of the project's noise and vibration impacts on the sensitive receptors and physical structures during the construction phase is considered adverse but reversible, with levels expected to gradually return to pre-project conditions once construction activities conclude. The duration of these impacts is classified as intermittent during bore piling and use of hammer drills as the construction activities at a particular site may be in a range of 12 to 15 months unless the construction experiences some delays.

The severity of noise and vibration impact is considered minor and its likelihood to occur is possible to occur, as these are inherent to the project's normal operations. Therefore, the inherent risk of the impact on construction workers and nearby sensitive receptors due to the construction activities is evaluated as moderate risk if relevant mitigation measures are not implemented in a consistent and effective manner. Further this moderate risk is justified in the absence of adequate baseline noise level and noise modelling undertaken for the project.

Mitigation measures. To minimize potential noise and vibration impacts described earlier and ensure compliance with the noise and vibration standards set by the Government of Indonesia (Gol), the BRT project is recommended to implement the following mitigation measures, among others:

- Noise dispersion modelling should be conducted to enable assessment of whether the construction activities would generate elevated noise level that may increase the baseline noise level within the project's area of influence and also define what and where proper mitigation measures are needed both in construction and operation phase.
- Construction activities that are near community settlements, public facilities such as educational facilities, healthcare facilities, worship places, and other sensitive receptors should be implemented during daylight hours (e.g., 6.00 to 18.00), and more attention should be paid to the operations of noisy machinery.
- The basecamp and worker accommodation should be situated at a sufficient distance from local communities, public amenities, and other sensitive areas to minimize potential disruptions.
- A temporary fence should be installed around construction sites, particularly those near residential areas or other sensitive locations.
- All equipment used on-site must be adequately maintained and shall undergo regular service throughout the construction phase.
- Construction workers working near noisy equipment and machinery should be equipped with silencers or mufflers.
- The contractor shall conduct regular monitoring of noise and vibration at the construction sites and their supporting facilities, as well as the nearest sensitive receptors, every quarter at a minimum. The results should be compared against Gol standards and documented to verify the effectiveness of implemented control measures and inspections.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the noise and vibration impact on sensitive receptors due to the construction activities can be reduced from moderate risk to low risk upon the completion of construction activities.

6.2.3. Greenhouse Gas Emission

Overview. The potential greenhouse gas (GHG) emissions impacts on the atmosphere due to construction activities are assessed as a moderate risk without the implementation of any mitigation measures. With consistent and effective implementation of mitigation measures and monitoring plans, the residual risk of GHG impacts is evaluated as a low risk. The following summarizes the risk and impact assessment of GHG due to the construction activities.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
GHG emissions due to BRT construction activities, contributing to a temporary rise in GHG concentrations in the atmosphere	Minor	Likely	Moderate	Incidental	Possible	Low

Risk and Impact Assessment – Greenhouse Gas. The construction activities of the BRT project are expected to temporarily increase greenhouse gas (GHG) concentrations in the atmosphere. These emissions primarily arise from the use of fossil fuels to operate construction equipment, machinery, and vehicles. Additionally, fugitive GHG emissions would arise from activities at the workers' basecamp, including air-conditioning and cooking, and operation of the asphalt mixing plant and concrete batching plant supplying the materials for the BRT project. Direct GHG emissions for the ESIA are calculated using the following formula:

GHG emissions (tCO₂e) = Activity Data x Emission Factor x Global Warming Potential (GWP)

Table 58. Estimated GHG emissions during BRT construction phase

Items	Estimated Total Use ¹	Estimated GHG Emissions (tCO ₂ e)
Diesel fuel	39,000 liters per month	1,263.47
Lubricating oil	260 liters per 3 months	2.83

¹GHG emissions are estimated by assuming that the construction phase will last for 12 months

Based on the estimated fuel consumption data presented in the table above, the total emissions from construction activities over the entire construction phase are approximated to be at least 1,266.29-tCO₂ equivalent. Emissions from air-conditioning and wastewater treatment could not be quantified because of limited data. However, they are expected to be considerably smaller than those from fuel consumption. Consequently, the overall magnitude of GHG emissions during construction is considered small.

From a temporal perspective, despite adverse conditions, the GHG impact during the construction phase is considered short-term as the construction period is expected to last approximately 12 months, unless it experiences some delays. Importantly, the impact is also considered reversible, given the BRT system's long-term goal is to provide a sustainable, low-emission public transport solution, thereby reducing reliance on existing public transport and private vehicles that burn fossil fuels. Over time, the operation of the BRT system is anticipated to offset and ultimately exceed the temporary rise in emissions during construction.

From a geographical perspective, the GHG impact is considered localised and concentrated mainly along the BRT services corridors, contractor basecamps, quarries, and concrete plants supporting the project. Nevertheless, owing to the global nature of GHGs and their long atmospheric lifetimes, emissions from the project will still contribute incrementally to the overall concentration of GHGs within the BBMA regional area.

Taking the above assessment into account, the severity of the GHG impact is classified as minor. Their relative contribution to climate change is modest in comparison with existing urban, transport and industrial emissions sources. Nonetheless, the likelihood of this impact occurring is likely as the use of fossil fuel-based machinery and equipment during construction is needed as there is no immediate alternative fuel for them to use. Accordingly, the inherent risk associated with GHG emissions during the construction phase is evaluated as medium risk if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation Measures. To minimize the impacts on the local atmosphere due to GHG emissions from construction related to the BRT project, it is recommended to implement the following mitigation measures, among others:

- Mitigation measures designated for minimizing air quality impacts, particularly from the operation of equipment, machinery, and vehicles, and other relevant sources, should be implemented.
- Regular GHG inventory and associated calculations should be conducted to track and recognize the sources and scales of actual GHG emissions during the construction phase. The inventory includes regular monthly monitoring of fuel and electricity consumption at construction sites and their supporting facilities.
- Open burning of construction and solid waste at construction sites and supporting facilities is strictly prohibited.
- All machinery equipment used on-site must be adequately maintained and shall undergo regular services to the manufacturer's specifications throughout the construction phase.
- The contractor is encouraged to use energy-efficient appliances and vehicles, including selecting the most feasible routes for the project's vehicles to minimize unnecessary use of fuels and electricity.

Residual Risk. If the above mitigation measures are implemented effectively and consistently, the GHG impacts resulting from construction activities could be reduced from medium risk to low risk. Moreover, GHG levels would resume to a similar baseline level at pre-construction upon completion of construction activities.

6.2.4. Stormwater Runoff

Overview. The potential impacts of uncontrolled stormwater runoff from the BRT construction sites to existing drainage channels near the BRT project area, contractor basecamps, and supporting facilities, such as asphalt and concrete suppliers, are evaluated as moderate risk without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of this impact is reduced from Moderate to Low risk, as described in the following.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Water pool/flooding and siltation on existing road drainages due to uncontrolled stormwater runoff discharges	Minor	Likely	Moderate	Incidental	Possible	Low

Risk and Impact Assessment – Stormwater Runoff. The BRT project area in close proximity to water bodies is the BRT bus stops at Jl. ABC around 40m to *Citepus* river and Bus Stop Alun-Alun around 100m to *Cikapundung* river. Other locations, such as *Ledeng*, *Antapani*, *Cicaheum*, and *Leuwipanjang* terminals, are close to the drainage channel. Based on the DED study, the area at Jl. Naripan has the highest potential runoff discharge of about 0.77 m³/s and indicates that the overall conditions and dimensions of stormwater drainage channels within the BRT project areas are in poor condition, filled with sediments and trash, and of inadequate capacity to accommodate the current surface runoff discharge rate. The stormwater drainage conditions and rivers within the proximity of the future contractor basecamp, and asphalt as well as concrete mixing plants that will supply construction materials, are not yet known at the time of ESIA preparation.

Stormwater runoff from construction sites within the BRT project area and supporting facilities mentioned earlier, which are not well-controlled and discharge into the existing drainage channels, may increase the potential for inundation and flooding. In BBMA areas, besides high, prolonged rainfall due to climate change, flooding and inundation due to stormwater runoff have been occurring due to poor drainage conditions. The presence of rubbish and shallowing of channels that have already occurred can reduce the capacity of the channels to receive stormwater discharges from the roads and other built areas.

Additionally, potential leakage resulting from improper hazardous and construction waste storage and transportation may contaminate stormwater runoff, thereby degrading the water quality of nearby surface waterbodies.

As the construction activities are not anticipated to undertake large-scale clearing for the construction of BRT depots and terminals and given that the conditions of the water bodies within the project area are not directly encountered and it is already reported as slightly to moderately polluted, the impact on surface water quality is considered minor, if any.

Considering the above assessment, the severity of the overall impact on surface water quality due to BRT Project construction activities is considered minor, and the likelihood of this impact occurring is likely. Therefore, the inherent risk of this impact on surface water quality is evaluated as moderate risk if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation Measures. To minimize the above surface water quality impacts, including inundation as well as flooding due to the construction activities, the BRT project is recommended to implement the following mitigation measures, among others:

- Preparation and implementation of a site and stormwater discharge-controlled system, including practical measures to control stormwater runoff from the construction sites into nearby drainage channels.
- Include a temporary settling pond at the time of terminal and depo construction to collect and precipitate materials/soil particles carried by the water flow, and periodically cleaned.
- Coordination with the local people and related government institutions prior to construction activity in order to obtain endorsement regarding channeled rainwater runoff.
- Ensure suitable culverts and other infrastructure for drainage are included in the DED of the BRT Project based on the requirement to enlarge the existing drainage channel at Jl. Rajawali Timur, Jl. Kebonjati, Jl. Naripan, Jl. Simpang Lima – Jl. Asia Afrika, Jl. Simpang Lima – Jl. Ahmad Yani, Jl. Sudirman, Jl. Kiaracondon/Jl. Ibrahim Adjie, Jl. Otista, Jl. Pungkur, Jl. Moh. Toha.

Residual Risk. If the above mitigation measures are implemented in a consistent and effective manner, the residual risk of the impact occurring on surface water quality, including flooding, could be reduced from moderate risk to low risk. Moreover, these impacts are expected to be localized, temporary, and reversible.

6.2.5. Soil and Groundwater

Overview. The potential for soil and groundwater contamination due to past and current use of the existing land and the planned construction activities, particularly on the land for future BRT depots, is evaluated as a substantial risk without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of the above is evaluated as medium risk as described in the following.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Potential for soil and ground water contamination at future BRT depots	Major	Possible	Substantial	Medium	Unlikely	Moderate

Risk and Impact Assessment – Soil and Groundwater Quality. The potential for soil contamination due to fuel and lubricant leaks and/or baseline conditions from past and current activities at the *Cicaheum* and *Leuwipanjang* bus terminal that will be constructed/expanded to also serve as future BRT depots is unknown at this stage. Construction activities in the future depot and terminals may cause fuel and lubricant spills, and poor waste management practices, including domestic sanitation and the storage and transportation of hazardous and construction waste, could also cause some contamination during construction. The essential issue that makes contamination of soil and groundwater such a significant impact is that it is irreversible, and the contaminated groundwater may disperse to the adjacent area.

Waste and sanitation are common problems in both construction activities. Waste generated includes solid waste and liquid waste from domestic workers' activities, as well as hazardous and toxic waste from construction activities. Solid waste may also originate from construction materials such as wood scraps, used paint and metal fragments. Domestic waste is closely related to the sanitation conditions of toilets and waste management facilities in construction sites. Poor sanitation conditions can lead to uncontrolled waste disposal, resulting in environmental pollution, reduced aesthetics and hygiene quality, and potential soil and groundwater contamination.

Civil works such as excavation and grading can disturb soil structure, increasing the risk of subsurface contamination from accidental spills of hazardous materials like fuels, lubricants, solvents, and concrete admixtures. Improper handling or storage of materials, fuels, and waste can lead to leaching of the spills and leaks and become contaminants, percolating into shallow groundwater tables, especially during rainfall. Additionally, runoff from asphalt and concrete batching plants may also infiltrate the soil, potentially affecting groundwater quality.

Furthermore, demolition of existing structures that may contain asbestos materials at *Leuwipanjang* and *Cicaheum* terminals may generate asbestos-contaminated dust and debris. If not properly managed, asbestos fragments can settle onto soil surfaces or be transported by stormwater runoff, leading to localized soil contamination and posing long-term environmental and health risks. Proper asbestos identification, removal, handling, and disposal procedures are essential to prevent such contamination during demolition activities.

Therefore, the soil and groundwater contamination impacts, if they occur, are considered adverse and irreversible. The overall severity of soil and groundwater contamination due to past, present, and future activities, if they occur, is considered major and possible to occur.

Thus, the inherent risk of the impact on the environment and human health is evaluated as substantial risk if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation Measures. To minimize contamination of soil and groundwater impacts and understand the baseline condition of such contamination, if any, the BRT project is recommended to implement the following mitigation measures, among others:

- Soil and groundwater investigation as well as identification of Asbestos Containing Material (ACM) should be conducted prior to commencing construction, particularly at the existing land at *Cicaheum* and *Leuwipanjang* Terminals where future BRT depots will be developed. These investigations are necessary to identify whether past and present activities have caused contamination, particularly hydrocarbon pollutants, in subsurface soils and shallow groundwater, and to confirm the presence of any ACM at the proposed terminals; If contamination is identified, appropriate mitigation measures, such as removal of contaminated soils and shallow groundwater pumping, will be required. Likewise, if ACM is detected, licensed contractors and certified disposal facilities must be engaged to ensure safe handling, removal, and disposal.
- Emergency Preparedness and Response Plan (EPRP) shall be developed and implemented as guidance to prevent as well as handle if oil/chemical spills/leakage occur, with provision of adequate spill kit response equipment. The EPRP should also include management and control measures for other risks, such as fire incidents, natural hazards, etc.
- Sewage and wastewater from toilets and bathrooms in the workers' accommodation should be managed using a modular wastewater treatment unit (commonly referred to as a biofilter system) along with a filtered seepage system.
- Land clearing, including vegetation and subsurface removal, should occur in stages, focusing only on areas needed for immediate construction work to minimize unnecessary land disturbance.
- Disturbed or exposed areas that are no longer needed for construction should be promptly reinstated and landscaping works conducted in a gradual manner, rather than waiting for the entire BRT corridor, stations, and terminals to be fully completed.
- Oil, fuel, and other hazardous substances must be stored separately in bunded, secure areas with waterproof flooring, overhead cover, restricted access, and drainage systems connected to an oil-water separator.
- Manage hazardous and non-hazardous waste generated separately including handling, storage and disposal by complying with the requirements of the Government Regulation No. 22/2021 and/or good international industry practices.
- Any leaks from construction vehicles or equipment must be addressed and repaired without delay.
- Providing dedicated hazardous substance as well as hazardous waste storage shelter and SOP for hazardous waste handling and disposal. .

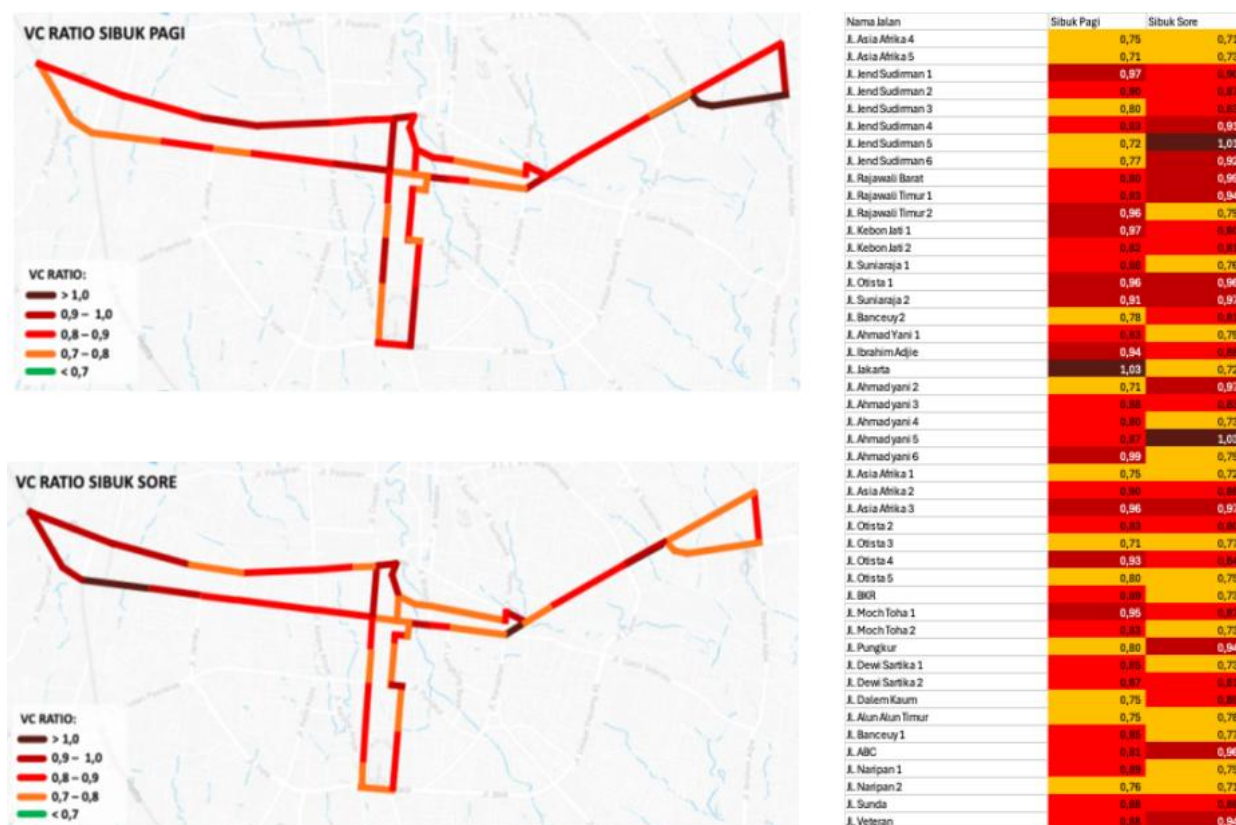
Residual Risk. If the above mitigation measures are implemented, the residual risk due to soil and groundwater contamination could be reduced from substantial risk to moderate risk.

6.2.6. Road Traffic and Infrastructure

Overview. The impacts anticipated on road traffic and infrastructure due to construction activities associated with BRT on-corridor and off-corridor are evaluated as substantial risk causing pressures on the already congested road traffic within Bandung City without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of this impact is evaluated as moderate risk. The following summarizes the related risk and impact assessment results.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Road traffic disruption and pressure on road infrastructure along BRT on-corridor as well as off-corridor	Medium	Likely	Substantial	Medium	Possible	Moderate

Risk and Impact Assessment – Road Traffic and Infrastructure. The recent traffic was conducted as part of the traffic impact assessment by measuring the existing traffic condition at 48 points on 14 roads within BRT corridor as shown in the following figure. Congested road traffic is commonly as urban problems, especially in Bandung city and its sub-urban areas. Baseline traffic study shows that traffic volume at the future intersections with BRT on-corridor has road volume/capacity (V/C) ratio of 0.7 at peak traffic (morning and evening) and even some have reached above 1.0. These circumstances lead to the LOS (Level of Service) value of 'F' that indicates traffic flow is hampered and critical to traffic jams.



Source: (EGIS, 2025)

Figure 36. Traffic Load at Morning and Evening Busy Hours 2024

A high V/C ratio shows an indication that the road capacity is no longer suitable to accommodate the traffic volume. This condition may cause worsened traffic conditions contributed by the project on top of existing heavy congestion in Bandung City and neighboring areas, which leads to disturbance for citizen activities and urban function capacity. At the construction stage of the BRT project, a potential traffic jam is anticipated to occur when construction activities use the main road, both asphaltting and rigid pavement, along the 21.7 km dedicated BRT on-corridor and the relocation of 3 stations/bus stops.

Conditions may become quite critical, especially on Jl. A. Yani, Jl. General Sudirman, Jl. Kebon Jati and Jl. BKR Road has traffic characteristics with high levels of congestion (LOS Category of F). Likewise on Jl. Asia, Africa, and Jl. M. Toha, where there will be a relocation of the existing bus stations. Furthermore, during the construction phase, traffic congestion may worsen due to projected increases in traffic volume and factors such as paratransit (*angkot*) operations and on-street parking. In terms of spatial context, the impact of the worst traffic conditions due to high traffic volume against road capacity may become a serious disturbance for the public.

Considering the above assessment, the severity of road traffic impact solely from the project construction activities (excluding the existing road congestion of Bandung City) is considered as medium, and the likelihood of this impact occurring is likely. Therefore, the inherent risk

of this impact is evaluated as substantial risk if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation Measures. To minimize the impact on road traffic and infrastructure due to the construction activities, the BRT Project is recommended to implement the following mitigation measures, which has also been determined in the related traffic impact assessment (Andalalin document):

- Implement the Traffic Management Plan and traffic engineering during construction according to the approved ANDALALIN or similar plan required by the Project.
- Close work areas located in the middle or on the left side of the road required for construction.
- Provide warning signs or notifications to avoid the road section because there is construction work at the BBMA BRT bus stops.
- Clarify existing road markings so that traffic conditions are more orderly.
- Provide signs indicating alternative routes that are planned to take up the road body during construction.
- Provide pedestrian access and temporary facilities to safely walk around the construction sites.
- Control street vendors who use sidewalk areas to sell.
- Re-setting signals at intersections to improve performance at intersections.
- During the construction period, heavy vehicles are only allowed to operate at agreed times where road traffic is low, and businesses are closed, such as in late evening or early morning as agreed by the relevant agencies.
- Strict sanctions for vehicles that violate traffic signs and markings.

Residual Risk. If the above mitigation measures and application of traffic management and monitoring (as referred to ANDALALIN) are well-implemented, then the impact of inherent risk could be reduced from substantial risk to moderate risk. Moreover, these impacts are expected to be localized and relatively short- to medium-term, especially when construction activity takes place.

6.2.7. Affected Trees/City Landscape

Overview. The potential impacts of tree cutting and pedestrian landscape to facilitate the construction of bus stops and BRT corridors are evaluated as 'moderate risk' without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of these impacts is evaluated as low risk. The summary of the related risk and impact assessment is presented below.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Affected trees and pedestrian landscape during construction	Minor	Likely	Moderate	Minor	Possible	Low

Risk and Impact Assessment – Affected Trees and Pedestrian Landscape. As an urban, well-developed area, some tree cuttings and subsequent relocation elsewhere, if feasible, would be required for constructing sidewalks adjacent to BRT bus stops and on-corridors. These trees are the asset of Bandung Municipality and hence, coordination and obtaining written approval from the Bandung Municipality will be required. The areas identified for the tree relocation will need to be discussed and agreed by the mentioned municipality.

The baseline survey conducted as part of the DED design identified about 140 trees will require cutting and relocation particularly within the BRT corridor of Jl. Jenderal Sudirman. Affected trees would primarily include 42 Blackboard trees (Pulai), 25 Mahoni trees and 24 Ketapang trees. Other areas may have affected vegetation within Antapani Terminal dedicated as one of BRT terminal where Angsana tree (*Pterocarpus indicus*) which listed as endangered species and Cinnamon tree (*Pterocarpus indicus*) which classified as vulnerable are identified.

Trees provide shade and serve as natural air filters that capture pollutants to some extent, so removing them leads to hotter air and increased carbon dioxide in the atmosphere within the proximity of the trees to be cut and removed. Cutting or removing trees makes the soil more susceptible to erosion from wind and rainfall, leading to contaminated runoff and sediment buildup in waterways. Most importantly, the loss of trees and shade would reduce the aesthetic value of the city landscape and could have some unfavorable physiological effects for those using the pedestrian.

The above impacts would be adverse but temporary as landscaping works including some tree planting will be undertaken as integral part of the project construction to establish a favorable city landscape including dedicated sidewalks along the on-corridor in the medium-term. Therefore, the impact on affected trees and city landscape during construction is evaluated as minor and the likelihood to occur as certain. Therefore, the inherent risk of this impact is evaluated as moderate if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation measures. To minimize the impact on affected trees and city landscape, the BRT Project is recommended to implement the following mitigation measures, among others:

- Coordinate with the related agency of Bandung Municipality in charge of the trees and landscape to obtain prior approval prior tree cutting and replanting them elsewhere.
- Every tree loss or removal due to project construction is expected to be compensated by a ratio of 1:5 (i.e., 1 tree felled should be replaced with 5 new trees). However, this ratio

and type of trees to be replaced and planted will still need to be discussed and mutually agreed by the Project and Bandung Municipality.

- Adequately map with location and photo of trees to be cut and then replanted elsewhere - particularly for mature trees.
- Install demarcation/barriers for the trees that should not be disturbed during construction.
- Especially for Angsana tree (*Pterocarpus indicus*) and Cinnamon tree (*Cinnamomum spp.*) that should be preserved in situ whenever possible, and ensure that those trees will be relocated and/or replaced elsewhere with care and close supervision if removal is required.
- Conduct vegetation maintenance and monitoring for new trees to be planted and existing trees removed and replanted elsewhere according to the requirements of the civil work contract.

Residual Risk. If the above mitigation measures with vegetation maintenance and monitoring are conducted in consistent and effective manner, hence the risk level can be reduced from 'medium risk' to 'low risk'. Moreover, these impacts are expected to be localized, and temporarily during construction activity before there will be recovered by the landscaping works included in the civil work contract.

6.2.8. Local Economy

The project construction activities are overall expected to generate some positive impacts on local economic development during construction and, therefore, the risk and impact assessment as conducted for the other impact is not required herein. The positive impact expected during construction would be, among others, some employment and business opportunities for some community members as service providers or suppliers within the project's area of influence.

To ensure positive impacts are encouraged for the local economy development, the recruitment of project workers would be prioritized from BBMA area if they meet the skill and requirements of the project. The emergence of small-scale business opportunities as vendors and providers of goods and services is anticipated as another benefit. These opportunities may include the provision of basic needs of workers, building materials (e.g., sand and rocks, wood, iron, cement), daily goods and services (e.g., house rented for the worker's accommodation, workshops, kiosks, and food stalls). Considering this potential for local economic development, the BRT Project is recommended to implement measures, among others:

- Employment and business opportunities with the project, including its requirements and qualifications, should be communicated in a transparent, timely and easily understood manner to local communities and vendors.
- The local governments should be informed and involved regarding the need for workers for the while promoting equal opportunity and non-discrimination for the poor, disadvantaged, and women.

- Prioritizing local manpower, local entrepreneurs, small- and medium-sized enterprises for the opportunity to be part of the workforce, to participate in supplying goods and services for the project, if they meet the specified criteria.
- The project should implement the SEP and GRM, including disclosure of project-related information in a timely and effective manner.

6.2.9. Restriction to Buildings and Traffic Congestion

Overview. The potential impacts on access restriction and traffic congestion due to the construction of the project are evaluated as substantial risk without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of these impacts is evaluated as moderate risk. The following describes the related risk and impact assessment results.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Access restriction and increased traffic congestion primarily within the BRT on-corridor	Medium	Likely	Substantial	Minor	Possible	Moderate

Risk and Impact Assessment – Access Restrictions and Traffic Congestion. Construction activities, primarily for the BRT on-corridor and bus stop platforms, depots, and terminals within highly dense urban areas of Bandung City, will adversely impact existing traffic by increasing congestion, travel time, and delays, while also reducing road capacity and access to some shops, houses, and government offices within the on-corridor. Furthermore, access restrictions and increased traffic congestion result in long, time-consuming queues on the road. However, the long-term goal of the project is to improve accessibility, economic productivity, and mobility for people in BBMA through the implementation of the BRT.

Another considerable impact is increased traffic congestion due to partial closures or barricades of road segments required for the construction of bus stops and for improvements to the existing road lane for dedicated BRT on-corridor. People commuting to/from, and within, Bandung City and the wider BBMA will experience longer travel times, resulting in reduced productivity, fatigue, and increased fuel costs. In terms of spatial context, this impact is considered adverse, covering considerable areas and affecting a significant number, e.g., millions of people commuting and/or conducting their jobs and businesses in BBMA for approximately a 12-month construction schedule. Nevertheless, the existing road traffic within BBMA, particularly Bandung City, has been considerably congested most of the time, including weekends.

Considering the above assessment, the severity of the impacts on access restriction contributed by the project is considered medium, and the likelihood to occur is likely, and therefore the inherent risk is considered substantial without implementation of any mitigation measures.

Mitigation measures. To minimize the risk level of the above impacts, the BRT Project is recommended to implement the following mitigation measures, among others:

- A site-specific Traffic Management Plan (TMP) should be developed and approved by the Implementing Agency for mitigating and monitoring road traffic and transportation impacts during mobilization/demobilization and construction of the BRT project based on the results of the Traffic Impact Assessment (ANDALALIN).
- Conduct socialization (i.e., consultation, providing banners and leaflets) to potentially affected parties (*angkot*, adjacent road users, and business owners) prior to any construction activities that may result in livelihood impairments, access restrictions, and traffic disruptions
- Analyze through perception survey and media analysis the concerns of affected parties (e.g., business owners, street vendors, and ‘angkot’ operators) on the access and traffic congestion resulting from the project.
- Provide temporary access or alternative route information for the public to access the location or areas that may be restricted due to partial road closures or installation of barriers required for construction and safety purposes. This temporary access is to be given especially to critical facilities such as hospitals/medical facilities, schools, markets, etc.
- Implement a functional Grievance Redress Mechanism (GRM) with a clear timeline and accountability of the party in charge.

Residual Risk. If the above mitigation measures are implemented in a consistent and effective manner, the risk level of livelihood impairment, access restriction, and traffic disruption can be expected to be reduced to ‘moderate risk’. However, these mitigation measures will require support from all project stakeholders, including the Borrower, the Bandung City Government (particularly the Traffic Safety and Traffic Management Agency), and the police.

6.2.10. Vulnerable People

Overview. The potential impacts of the construction of the project on vulnerable people, including gender-based violence, are assessed as a moderate risk in the absence of any mitigation measures. However, with proper and consistent implementation of mitigation measures and monitoring plans, the residual risk from these activities could be reduced to low risk. The following describes the related risk and impact assessment results.

Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Marginalization of vulnerable people including gender-based violence risk	Medium	Possible	Moderate	Minor	Possible	Low

Risk and Impact Assessment – Vulnerable People. Construction activities, particularly recruitment/employment of project workers for construction, pose physical as well as social risks to vulnerable people, including, among others, female workers, low-skilled workers, and workers with disabilities through marginalization, discrimination, and unfair treatment. During the construction works, the vulnerable project workers may be marginalized in the provision of facilities in the workers' basecamp, for example, in the provision of a separate sanitation facility and rooms (i.e., toilet, bathroom, bedroom) for female workers, or an accessible facility for workers with disability, as applicable. They also may face discrimination in the workplace, be pressured to perform beyond their capacity, and feel less protected than their counterpart in the workforce. This situation could lead to a high level of stress due to a lack of autonomy and control over their work.

Moreover, the vulnerable project workers could be exposed to a higher risk of gender-based violence (GBV), including sexual exploitation and abuse (SEA) and/or sexual harassment (SH), resulting in physical and/or psychological trauma, economic and social loss, or other similar issues in the absence of strict enforcement of codes of conduct for project workers. The risk of GBV to the vulnerable community can also increase if the contractor basecamps are situated near residential areas, particularly if the project lacks GBV risk mitigation strategies.

Therefore, the nature of the impact of the project on vulnerable groups including gender-based violence, including SEA/SH, is evaluated as adverse but expected to be reversible and intermittent throughout the construction period. The area of these impacts remains localized in scale, centered around the Project's construction areas and the contractor basecamps. Influx of migrant workers is unlikely as most of the project workers can be mobilized from BBMA and neighboring areas, with a few workers with highly specialized skills being mobilized from elsewhere in Indonesia and abroad. Considering this, the severity of the impacts is considered medium, and the likelihood to occur is possible and therefore the inherent risk is moderate if mitigation measures are not applied effectively and in a timely manner.

Mitigation Measures. To minimize the above impacts, the BRT project is recommended to implement the following mitigation measures, among others:

- The appointed contractor should develop a contractor environment and social management plan (CESMP), adopting the project Labor Management Plan (LMP), which includes provision to protect the vulnerable workers and GBV prevention code of conduct that will need to be socialized and acknowledged by all project workers. The code of

conduct (CoC) includes provisions on preventing and enforcing sanctions on gender-based violence (SEA/SH) cases among the workers and communities near the construction sites.

- Dissemination of the above CoC and gender-based violence, including SEA/SH, including sanctions and work terminations applied if violations occurred, should be acknowledged and communicated to all workers prior to starting work on the project.
- In the presence of vulnerable workers, the project ensures provision and/or availability of accommodating facilities that can address specific needs of these vulnerable workers (i.e., universal access for workers with disabilities, separated women's facilities with sufficient lighting, etc.). The provision and/or recommendation of accommodation will be arranged with the contractor.
- Establish/implement a grievance redress procedure with a clear timeline and accountability specific to logging complaints on employment matters, and this procedure is separate from the project's GRM.
- Establish a dedicated and survivor-centered approach of GRM for GBV cases to ensure the confidential handling of information related to GBV incidents that may occur during the project implementation.
- Establish coordination with external service providers who are experienced in GBV incident mitigation (i.e., government agency or NGO) as a referral for GBV case handling.
- Improve the living standards of vulnerable people, including women, children, and people with disabilities, at least in accordance with national minimum standards, including access to social protection systems.
- Increase representation of women in the decision-making levels of the project.
- Appropriate level of background checks for all project workers should be conducted.
- A supportive work culture where workers feel comfortable reporting issues without fear of retaliation.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the impacts on vulnerable people, including gender-based violence, could be reduced from moderate risk to low risk.

6.2.11. Cultural Heritage

Overview. The potential impacts on cultural heritage, particularly historical buildings along Asia Afrika and Jenderal Sudirman Streets which are the planned BRT on-corridor, due to construction of BRT on-corridor and bust stop platforms (to be constructed) are evaluated as moderate risk without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual impacts on cultural heritage is evaluated as low risk.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Structural damage from vibration of construction activities	Medium	Unlikely	Moderate	Minor	Rare	Low

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
and degraded aesthetic and convenience values of heritage buildings						

Risk and Impact Assessment – The impact of disturbance to the cultural heritage in construction activities can be considered as a moderate risk, not significant due to its low risk possibility. The scale impact that can be recognized as local impact is unlikely to degrade the aesthetic and convenience value of those cultural heritage areas. In BRT Bandung Basin Metropolitan Area (BBMA) development planning, part of the proposed corridor follows the west-east city development axis crossing through the Bandung Cultural Heritage Area, where there are historic buildings. In fact, the heritage area will be set as “The Old City” area of Bandung, envisioned as a tourist destination.

Cultural heritage buildings and areas that are adjacent to the BRT-BBMA corridor are described in sub-chapter 5.2.6. The planned corridor of BRT-BBMA does not directly impact any cultural heritage buildings, but will certainly cross through some cultural heritage areas. In terms of spatial context, the impact of cultural heritage disturbance in the BRT-BBMA project may not be considered as a serious disturbance, both in local areas and broadly. The planned crossing will be a localized impact with no alteration of the cultural heritage building and will not affect the integrity of the broader cultural heritage area.

Therefore, considering the above assessment, the severity of cultural heritage disturbance is considered as medium, and the likelihood of this impact occurring is considered unlikely. The inherent risk of cultural heritage disturbance impact on any receptor in local and broader areas due to the project’s construction activities is evaluated as ‘low risk’ if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation Measures. To minimize the above impacts, the project is recommended to implement the following mitigation measures, among others:

- A Heritage Impact Assessment (HIA) prior to the commencement of the Project construction phase is highly recommended to provide a thorough analysis on the physical condition of each historic buildings, identify the potential impacts of the Project activities, and recommend strategies to avoid, reduce, or compensate for any negative impacts on heritage sites.
- The Contractors should take into account any mitigation measures proposed in the HIA when undertaking construction activities in proximity to heritage sites.
- Regular visual inspections and photographic documentation should be conducted prior and after the construction works to identify any early signs of structural stress, cracking, or surface damage.
- Construction sites should be delineated and clearly marked to minimize potential disturbance to unknown cultural resources and heritage that may exist in the area.

- Development of a 'Chance Find Procedures' for the unexpected discovery of cultural resources and heritage during construction activities, if they are excavated or discovered, should be developed and disseminated to all parties involved in the Project.
- Any findings on cultural resources and heritage within the Project area should be immediately reported to the Project's supervisor and implementing agencies, and the construction activities in that area should stop for an interim period.
- The contractor should adopt low-vibration construction techniques and restrict the movement of heavy construction equipment, machinery or vehicles to minimize physical stress on the buildings due to ground-borne vibration and air-borne dust when working near the sensitive building.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the convenience value of the cultural heritage area can be preserved. The risk level can remain as 'low risk' with the severity of risk reduced to minor and with rare likelihood. Moreover, these impacts are expected to be localized and temporary during construction activity.

6.2.12. Labor and Working Conditions

Overview – The impacts on labor and working conditions, including exposure to occupational health and safety risk due to the project's construction activities, are evaluated as 'moderate risk' without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of labor and working condition problems due to the mentioned activities is 'moderate risk', with minor severity and unlikely chance to occur.

Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Labor and working condition issue which including occupational health and safety	Medium	Possible	Moderate	Minor	Unlikely	Moderate

Risk and Impact Assessment – The impact of mis-management of labor and working conditions may cause working incident and disease problem in working area. The impacts may include fatalities or outbreak of disease with wide ranging consequences. In construction stage, potential work incidents may occur due to lack of safety assessment and incompliance of implementation safety plan. Construction work activities at terminal and depot sites poses a high risk of work incidents, such as from heavy equipment mobilization and utilization, manual handling, hot work, lifting, etc., impacting all construction workers including the primary supply workers. Work incidents may also be the result of workers' lack of skills in performing their work safely and/or having little to no experience working on construction sites where many unsafe conditions exist.

Therefore, the BRT-BBMA construction project must be prepared with HSE plan, which comprises Hazard Identification, Risk Assessment and Control (HIRAC) and Job Safety Analysis (JSA) prior to any ongoing construction activities. Any injury or fatality may result in significant liability for the contractor as the project construction authority and violate the regulation.

Other issues, such as health problems, may occur due to poor sanitation conditions in the working area and basecamp. Unhygienic and improper working environmental conditions can lead to the spread of disease and reduce worker productivity. Disordered and disorganized working areas, with accumulation of materials and wastes, can easily become the breeding site of mosquitoes. Furthermore, inappropriate hiring practice, unfair working terms and conditions, recruitment of child labor and forced labor can also become a serious issue if labor management practices are not adequately prepared by the project.

In terms of spatial context, the impact on labor and working conditions may be considered a local issue. However, considering the above assessment, the severity of the labor and working condition problems is considered medium, and the likelihood of this impact is possible since all mitigation should have already been planned with the HSE plan and conducted by the HSE unit.

Therefore, the inherent risk of labor and working condition problems to the workers, including due to the project's construction activities, is evaluated as 'moderate risk' if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation measures. To address the labor and working condition issues during construction activities, the project is recommended to implement the following mitigation measures, among others:

- An OHS management system should be established, and a Construction OHS expert needs to be appointed and assigned at construction sites by the Contractor and the Supervision Consultant.
- Labor Management Procedure (LMP) of MASTRAN should be adopted and further specified by the Contractors under the rating of civil and landscaping works.
- Providing the CESMP doc prior to the commencement of construction activity, which included the EHS General Guidelines for construction activity.
- Provide and prioritize job opportunities for local laborers. Such as construction workers and the employees of the BRT entities (e.g. drivers, maintenance, or management employees);
- Contractors' environment and social management plan should be developed, incorporating the requirements of LMP.
- Prepare and implement an OH&S Management Plan, including training for all workers on all relevant aspects associated with their daily work, including emergency arrangements, working at height, etc.
- Provide safe and secure access to the construction sites.

- Provide basecamp with good sanitation facilities, such as clean water, hygiene facilities, and proper air circulation in order to provide comfortable in resting time and maintain the workers health;
- Implement good housekeeping practices in the working site and base camp
- Providing workers with written contract that has a clear working terms of employment, to ensure reasonable working hours and wages, adequate rest days and insurance coverage in the event of incidents/accidents
- Conduct a risk hazard assessment (RHA) and develop a detailed hazard map within the BRT corridor. Structures need to be designed to minimize the earthquake risks and the impedance or redirection of flood flows and support drainage.
- Prepare and implement an OHS management plan, including training for all workers on all relevant aspects associated with their daily work, including emergency arrangements.
- Implement age verification to prevent child labor and ensure fair hiring practices in accordance with each worker's competence.

Residual Risk. If the above mitigation measures for labor and working conditions are conducted in a consistent and effective manner, the risk can be reduced from 'medium risk' to 'low risk'. Moreover, these impacts are expected to be localized, temporary, and reversible.

6.2.13. Community Health and Safety

Overview. The impacts on community health and safety due to the construction of the project are evaluated as substantial risk without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk can be reduced to moderate risk. The related risk and impact assessment are described in the following.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Community exposure to health and safety risks from construction activities	Medium	Likely	Substantial	Minor	Possible	Moderate

Risk and Impact Assessment – Community Health and Safety. Community working, living, and commuting within the BRT construction sites would be exposed to health and safety risks inherent in the construction activities of the project. The most common risk to the community is traffic accidents due to increased traffic and possible collisions between construction vehicles, private vehicles, and motorcycles within the construction sites.

The operation of heavy equipment, working at heights, and working with live electricity may introduce some safety risks to pedestrians and nearby public services and business activities due to poor design and safety mitigation measures. Falls, slips, and trips for the public could happen due to unstable ground, debris, and uneven surfaces within the temporary access provided for the public to avoid directly entering the construction sites.

Construction activities generate elevated dust and fumes that could lead to respiratory problems for nearby residents. Improper waste disposal could lead to soil contamination, affecting the local environment and potentially harming human health, who are unintentionally in contact with such wastes. Machinery generating elevated noise and increased traffic due to construction causes excessive noise, which can lead to stress and long-term health effects like hearing loss. Anxiety and fear related to health and safety concerns due to construction activities can lead to mental-related issues like depression.

Interactions between local communities and construction workers may pose a risk to community health, safety, and GBV, especially if the workers are not from the local area and/or not adapted to the local social and cultural norms. Spread of communicable diseases, social conflicts that threaten the safety and security of the community, as well as harassment of vulnerable communities, may occur when there are no preventive measures established by the project. However, the project will prioritize the recruitment of local manpower within the BBMA area. The recruitment of migrant workers will be kept to a minimum, except for specific skills that are unavailable in the local workforce.

Considering the above, the severity of impacts on community health and safety issues is evaluated as medium, and the likelihood of occurrence is possible; therefore, the inherent risk is substantial without the implementation of any mitigation measures.

Mitigation measures. To minimize the above impacts, the project is recommended to implement the following mitigation measures, among others:

- The appointed contractor should develop a contractor environment and social management plan (CESMP), which includes the health and safety management system to mitigate risk for the community. The CESMP should also comply with the requirements of the Ministry of Public Works and Housing Regulation No. 10/2021 on *Pedoman Sistem Manajemen Keselamatan Konstruksi* and Circulate Letter of the same ministry No. 10/2022 on *Panduan Operasional Tertib Penyelenggaraan Keselamatan Konstruksi*.
- Project to socialize the GBV prevention Code of Conduct (CoC) that covers the workers' limitations in their interactions with communities and sanctions for violation, to all project workers prior to starting work on the project, and ensure that workers understand and acknowledge this CoC.
- Provide and prioritize job opportunities for local laborers. Such as construction workers and the employees of the BRT entities (e.g. drivers, maintenance, or management employees);
- Full-time, certified construction H&S experts should be stationed during construction activities to supervise and improve the health and safety practices of the project.
- Adopt and apply the EHS General Guideline for construction activity published by the World Bank Group (i.e., IFC Guidelines).
- Providing good sanitation facilities and safety signboards at construction sites.
- Empowering communities through inclusive implementation of SEP regarding the potential health and safety risks associated with construction activities.

- The Traffic Management Plan should be implemented, including putting up warning signs and assigning traffic wardens to regulate traffic within construction sites.
- Emergency Preparedness and Response Plan (EPRP) should be developed as part of the CESMP, socialized to nearby communities, and a related exercise or drill undertaken.

Residual Risk. If the above mitigation measures are conducted in a consistent and effective manner, the possibility of a community incident due to the project's construction activities can be reduced from substantial risk to moderate risk.

6.3. Operational Phase

6.3.1. Ambient Air Quality

Overview. Despite positive contributions to the overall air quality impacts, the operation of mixed electric- and fuel-powered BRT buses may still generate negative impacts on the human receptor and the environment, which was initially evaluated as 'Moderate Risk' without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of the air quality impacts due to the operational BRT buses could be reduced to 'Low Risk' as described below.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Air quality impacts from the operation of internal combustion engine (ICE) buses	Minor	Likely	Moderate	Incidental	Possible	Low

Risk and Impact Assessment – Ambient Air Quality. The operation of the BRT system within BBMA, which involves a fleet of 77 buses consisting of both electric and internal combustion (diesel-fuel) engine ("ICE") buses, is expected to generate a combination of positive and negative impacts on air quality. Positive impacts are anticipated as the project aims to reduce traffic congestion, and enhanced public transport reliability is expected to result in long-term improvements in ambient air quality.

However, negative impacts remain present from the tailpipe emissions of the ICE buses, which will emit pollutants such as nitrogen oxides (NO), sulfur dioxide (SO₂), carbon monoxide (CO), particulate matter (PM₁₀, PM_{2.5}), and volatile organic compounds. Although modern bus engines that comply with stricter emissions standards can significantly reduce pollution levels, the presence of ICE buses can still create local air quality pressures, especially during peak hours when bus frequency increases. These emissions are expected to be concentrated and localized in areas with high bus activity, particularly at terminals and depots, bus stations, and bus stops located in densely populated areas.

Considering the above assessment, the severity of negative impacts from BRT operations is considered minor, and the likelihood of the negative impact occurring is likely given the ICE buses must emit pollutants as part of their normal operation and these emissions will occur daily across repeated routes. Therefore, the inherent risk of the negative impacts on air quality including nearby sensitive receptors is evaluated as moderate risk if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation Measures. To minimize the air quality impacts due to the operation of ICE buses, the BRT project is recommended to implement the following mitigation measures, among others:

- All internal combustion engine (ICE) buses must be required to meet stringent emissions standards, preferably Euro IV or higher compliance standard.
- Vehicles condition, particularly engines, fuel systems, and exhaust systems, should be maintained in good mechanical condition through regular services.
- Anti-idling policies at terminals, depots, and major stations should be introduced and enforced to reduce localized pollutants.
- Deployment of electric buses should be prioritized in densely populated zones, near school or hospital, or narrow road segments where pollutants can easily accumulate.
- Ventilation and emissions control measures within depots can be installed to ensure adequate air circulation.
- Integrating BRT system with feeder services and gradually reorganizing informal paratransit (*angkot*) will help achieve full emissions reduction benefits of the BRT system by lowering the total volume of traffic on the BRT corridor.
- Regular ambient air quality monitoring should be undertaken at critical points along the corridor, particularly around terminals and in BRT corridor areas with vulnerable populations.

Residual Risk. If the above mitigation measures and air quality monitoring plan are implemented in a consistent and effective manner, the negative impact of ICE buses operations on the human receptors and environment during BRT operation phase could be reduced from moderate risk to low risk. Moreover, the BRT system will inherently offer opportunities for air quality improvement in the long-term only once the operational and management measures such as traffic integration, fleet maintenance, and system optimization are implemented.

6.3.2. Noise Level

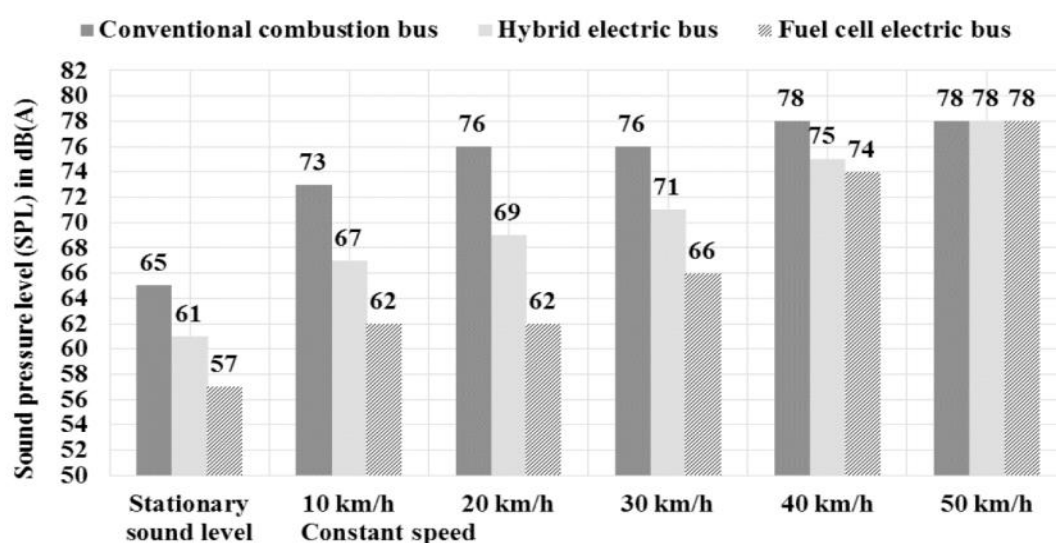
Overview. The potential noise impacts on the human receptor and the environment due to operational BRT system, particularly from bus depot and terminals activities, are evaluated as 'moderate risk' without the implementation of any mitigation measures. However, If related mitigation measures and monitoring plans are implemented in a consistent and effective

manner, the residual risk of the noise impacts are anticipated to reduce to 'low risk', as described below.

Assessment Impact	Without Mitigation Measures			With Mitigation Measures		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Overall reduction in noise level	Minor	Likely	Moderate	Incidental	Unlikely	Low

Risk and Impact Assessment – Noise Level. The operation of BRT system within BBMA will influence noise environment in several ways, depending on location, timing, and receptor sensitivity. As the BRT system will deploy 77 buses, comprising a combination of electric and internal combustion engine (ICE) buses, its noise profile will differ from baseline mixed traffic conditions and will be experienced differently along the corridor, at bus stations/stops, and around depots and terminals.

As an analogy, a study conducted in New Zealand by Doran et.al (2022) revealed that noise generated from electric buses is generally smaller than that produced by conventional buses. Noise level vary according to the vehicle speed as presented below.



Source: Doran et.al (2021)

Figure 37. Noise Level of Electric-Bus Compared with Conventional Bus

Based on the figure, noise levels from electric buses are lower than those from conventional buses and hybrid buses. However, at speed of 50 km/h, the noise levels of all bus types become comparable. By using this reference, the noise levels from the operation of BBMA BRT buses are estimated under two conditions: (a) when buses are queueing at a station, with approximately 3 buses idling simultaneously, and (b) when buses are moving along the corridor at an approximate speed of 50 km/h.

Table 59. Projected Noise Levels during the Operation of BRT Buses

Location at BRT Corridor	Unit	Threshold according to Kep.Men-LH no.48/1996	Baseline condition	Projection noise		Total accumulative noise	Noise area at 21-30m from source	Noise area status according to Keputusan Direktur Jenderal Bina Marga Departemen Pekerjaan Umum No. 076/Kpts/Db/1999	Area activity status
BKR Street	dBA	60	74,36	1*	88,64	88,8	74,03 - 75,58	Noise Moderate Area	Construction phase
				2*	61,77	74,6	59,83 - 61,38	Noise Safe Area	Operation phase
				3*	78	79,6	64,83 - 66,38	Noise Moderate Area	Operation phase
Alun-alun near Grand Mosque	dBA	60	72,61	1*	88,64	88,7	73,98 - 75,52	Noise Moderate Area	Construction phase
				2*	61,77	73,0	58,18 - 59,73	Noise Safe Area	Operation phase
				3*	78	79,1	64,33 - 65,88	Noise Moderate Area	Operation phase
Jl. Elang	dBA	60	72,93	1*	88,64	88,8	73,87 - 75,42	Noise Moderate Area	Construction phase
				2*	61,77	73,3	58,48 - 60,03	Noise Safe Area	Operation phase
				3*	78	79,2	64,41 - 65,95	Noise Moderate Area	Operation phase
Terminal Cicaheum	dBA	60	76,91	1*	88,64	88,9	74,15 - 75,70	Noise Moderate Area	Construction phase
				2*	61,77	77,0	62,27 - 63,82	Noise Safe Area	Operation phase
				3*	78	80,5	65,73 - 67,28	Noise Moderate Area	Operation phase
Terminal Leuwipanjang	dBA	60	75,57	1*	88,64	88,8	74,08 - 75,63	Noise Moderate Area	Construction phase
				2*	61,77	75,7	60,98 - 62,53	Noise Safe Area	Operation phase
				3*	78	80,0	65,23 - 66,78	Noise Moderate Area	Operation phase
Terminal Ledeng	dBA	60	67,31	1*	88,64	88,7	73,9 - 75,45	Noise Moderate Area	Construction phase
				2*	61,77	68,4	53,61 - 55,16	Noise Safe Area	Operation phase
				3*	78	78,4	63,58 - 65,13	Noise Moderate Area	Operation phase

Source : Dohwa – Lenggogeni, 2023

Note: 1 = route corridor and station during construction phase; 2 = Queueing at station with an approximation of 3 buses idling simultaneously; 3 = Bus moving along BRT corridor at an approximate speed of 50 km/h; and 4) The estimation is presented in Annex 11.

As shown in the above table, the results indicate that noise levels generated by BRT buses, both during idling at bus stations and while moving at approximately 50 km/h, show a consistent reduction at a distance of 21 – 30 meters. Noise levels during idling conditions generally fall within the range of 58.1 – 63.8 dBA, while noise levels during bus movement range from 63.5 – 66.8 dBA. These values indicate that, even with bus movements generating higher noise than idling, the attenuation over distance reduces overall exposure to levels that are generally below or close to the 60–70 dBA thresholds stipulated in Minister of Environment Regulation No. 48/1996, depending on the land-use category (e.g., 55 dBA for residential/sensitive receptors, 60 dBA for public facilities, and 70 dBA for commercial, industry or recreation).

Given these projected noise levels, the operational noise from the BBMA BRT system is not expected to significantly increase the overall ambient noise environment along the corridor, particularly in locations where existing mixed traffic already produces relatively high background noise. Under such conditions, the additional noise contribution from BRT buses, whether from idling queues at stations or from vehicle movement, will generally be limited to short distances and largely masked by the prevailing traffic noise.

Considering that mixed traffic remains the dominant contributor to the BBMA noise environment, the severity of incremental noise from BRT operations is assessed as ‘minor’, and the likelihood of this impact is considered ‘likely’, given that BRT buses will operate under normal conditions. Therefore, the inherent risk of the noise impact due to the operation of

BRT buses is evaluated as ‘moderate risk’ if relevant mitigation measures are not implemented in consistent and effective manner.

Mitigation Measures. To minimize the noise impacts due to the operation of BRT buses, the project is recommended to implement the following mitigation measures, among others:

- Station layouts should be designed to minimize sound-reflective surface, e.g. avoiding hard concrete walls that amplify sound.
- Landscaping buffer may be enhanced through vegetation/trees at the surrounding terminal and depot location.
- Regular maintenance, including lubrication, brake inspection, tire pressure checks, and exhaust systems, should be carried out to keep buses in good condition.
- Install low-noise tires on BRT buses to reduce rolling noise at higher speeds.
- Speed control in sensitive segments should be maintained (e.g., 30 km/h near schools, hospitals, residential clusters)
- Optimize scheduling to prevent long idling or overlapping bus arrivals that can increase cumulative noise.
- Provide training for drivers regarding eco-driving and noise-minimizing driving behaviors
- Regular monitoring of noise levels should be conducted to identify potential hotspots along the BRT corridors, and to support the timely implementation of mitigation measures if exceedances against the noise standard are observed.

Residual Risk. If the above mitigation measures and noise monitoring plan are implemented in a consistent and effective manner, the noise impact on the sensitive receptors during operation could be reduced from ‘moderate risk’ to ‘low risk’. Residual impacts would be limited, localized, and unlikely to cause significant disturbance to surrounding communities, ensuring that the overall acoustic environment along the BRT corridors remains acceptable throughout the operational phase.

6.3.3. Greenhouse Gas Emissions

Overview. The GHG impacts due to the operation of the BRT system, mainly from direct impacts generated by the operation of both electric- and diesel fuel-powered BRT buses, including their air conditioning system as well as the operation of BRT bus depots, charging stations, and terminals, are evaluated as ‘moderate risk’ in the absence of any mitigation measures. However, with consistent and effective implementation of mitigation measures and monitoring plans, the residual risk from these activities could be reduced to a low risk. The risk and impact assessment in relation to GHG in the operation phase is described below.

Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Direct GHG emissions from the operation of BRT buses, depots, charging stations, etc	Incidental	Likely	Moderate	Incidental	Possible	Low

Risk and Impact Assessment – The implementation of the BRT system is anticipated to contribute to a reduction in greenhouse gas (GHG) emissions. This is because the BRT will operate using electric buses, and the overall purpose of the system is to provide a low-emission, sustainable mode of transport, thereby reducing dependence on public transport and private vehicles that continue to rely on fossil fuels. Nevertheless, a small amount of GHG emissions is still expected from the overall operation of the BRT system. These would mainly originate from exhaust emissions from diesel-fuel power buses and be associated with air-conditioning in the buses, as well as the operation of depots, terminals, and the bus operator and maintenance buildings. In addition, indirect emissions from electricity use will also contribute to the project's overall footprint.

Given limited data availability to estimate GHG emissions from the operational phase of the project, the magnitude of the impact of the GHG emissions due to BRT operation is expected to be adverse but minor, given their relatively small scale compared with the emissions savings generated by replacing fossil-fueled vehicles. The impact is also reversible, as emissions will decrease if cleaner energy sources and efficiency improvements are adopted, and an increasing public shift from using private vehicles to public transport over time.

From a temporal perspective, the GHG impacts are expected to be long-term, persisting throughout the operation of the BRT system. Meanwhile, based on geographical extent, the GHG emissions will be localized and occur mainly at BRT corridors, depots, terminals, and office facilities. Indirect emissions from electricity will also occur, but remain relatively modest if compared with other urban energy demands.

Based on the above assessment, the severity of the GHG emissions during BRT operation is assessed as incidental. The project overall is expected to yield a net environmental benefit, as long-term emissions from the operation of electric and conventional-engine BRT buses will outweigh the residual emissions from ancillary activities. Likewise, the likelihood of the impact is assessed as a certain amount of direct GHG emissions from air conditioning and wastewater treatment operations at the depot would be generated in a marginal volume. Combining the severity and likelihood of this impact, the inherent risk of GHG impacts on the atmosphere due to BRT operation is evaluated as medium risk if further mitigation measures are not implemented in a consistent and effective manner.

Mitigation Measures. To minimize operational-phase GHG impacts, the BRT project is recommended to implement the following mitigation measures, among others:

- Air conditioning systems used in buses, terminals, depots, and office facilities should be optimized through regular maintenance and the use of low-GWP refrigerants.
- Energy efficiency in depots, terminals, and offices should be optimized through the use of, among others, LED lighting, smart building controls, good insulation, and operating air-conditioners at optimum temperature.
- Source electricity from cleaner grids where possible, either through rooftop solar PV installations or other renewable energy options for depots and terminals.

- Proper waste management treatment plants should be provided at depots and terminals to avoid unintended release of methane and nitrous oxide emissions from untreated wastewater.
- GHG inventory plan and monitoring should be established to track energy use, refrigerant leaks, and wastewater management practices.

Residual Risk. If the above mitigation measures are implemented effectively and consistently, the residual GHG emissions are expected to reduce from moderate risk to low risk. Their contribution of GHG emissions is considered negligible compared to that from household, industrial, and transportation emissions from the overall BBMA areas.

6.3.4. Stormwater Runoff

Overview. The potential impacts of higher stormwater runoff carrying potential contaminants due to the operation of the BRT system to existing drainage channels are evaluated as ‘moderate risk’ without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk is anticipated to reduce to ‘low risk’.

Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Higher stormwater runoff carries potential contaminants	Minor	Possible	Moderate	Incidental	Unlikely	Low

Risk and Impact Assessment. The operation of the BBMA BRT system has the potential to influence runoff dynamics within the BBAM corridor areas. This impact is introduced through additional impermeable surfaces on the associated infrastructure, such as dedicated lanes, stations, terminals, and depots, that can alter drainage patterns and increase the volume and speed of surface runoff. The stormwater flowing over these paved surfaces will carry higher volumes of water and potential accumulated pollutants into existing drainage systems. These pollutants may originate from hydrocarbons, oils, brake dust, tire residue, sediment and even waste (liquid, solid, and/or hazardous waste) if not properly managed. While the concentration of such pollutants can be generally low during regular operations, cumulative wash-off over time may contribute to a localized reduction in water quality of nearby waterbodies if the drainage system is not adequately maintained.

These stormwater-related impacts are anticipated to occur intermittently, driven by rainfall events rather than continuous operations. Operational activities such as bus washing, cleaning, and maintenance at the depots may also have the potential to generate runoff containing detergents or oils, but these impacts can be avoided since such processes will be conducted in controlled areas connected to the wastewater treatment system rather than

storm drains. From a spatial perspective, these impacts are primarily confined to areas immediately surrounding BRT infrastructures, such as along dedicated lanes, at stations, at terminals where large passenger platforms are present, and especially at depots where bus storage, refueling, and maintenance occur.

Considering the above assessment, the severity of the impact is assessed as minor, and the likelihood of such an impact occurring is possible, given the high rainfall intensity in BBMA and the presence of aging drainage infrastructure in parts of the BBMA corridor. Therefore, the inherent risk of this impact on stormwater runoff and surface water quality due to the operation of the BRT bus is evaluated as 'moderate risk' if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation Measures. To minimize the impacts on stormwater runoff and surface water quality due to the operation of BRT system activities, the project is recommended to implement the following mitigation measures, among others:

- The drainage system surrounding BRT infrastructure, especially within terminal and depot areas, should be designed and maintained to ensure sufficient capacity to manage stormwater runoff during heavy rainfall events, thereby preventing localized flooding and potential operational disruptions.
- Oil separators should be installed at bus depots and washing areas to capture hydrocarbons and lubricants from runoff during rainfall.
- The use of permeable paving or green buffer strips around the perimeter is encouraged to increase infiltration and reduce overall runoff volume.
- Implement operational practices in accordance with established procedures, such as conducting bus washing and maintenance activities only in contained areas equipped with wastewater treatment systems, to prevent detergents, oils, waste, and other contaminants from entering storm drains.
- Regular cleaning of platforms, parking areas, and track surfaces will reduce the accumulation of pollutants during the dry season, thereby reducing the pollutant load carried during rainfall.
- Ensure bus depot wastewater is properly collected in storage tanks and treated via dedicated bus-washing WWTPs and collector basins before discharge into the municipal sewer network.
- Conduct routine inspections, maintenance, and performance checks of WWTPs at *Leuwipanjang* and *Cicaheum* depots to maintain treatment efficiency and regulatory compliance.
- Solid waste should be placed in properly covered and segregated containers, while hazardous waste should be stored in designated, covered, and impermeable containment areas to minimize exposure to rainfall and prevent potential wash-off by stormwater.

Residual Risk. If the above mitigation measures and monitoring plan are implemented in a consistent and effective manner, the residual stormwater runoff impacts during the operation phase of the BRT system could be reduced from ‘Medium risk’ to ‘Low risk’.

6.3.5. Soil and Groundwater

The potential cumulative pressure on local aquifers due to groundwater abstraction required for the operation and maintenance of the BRT system is evaluated as a substantial risk without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk of the above are evaluated as moderate risk, as described in the following.

Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Groundwater abstraction to meet water supply demand for the operation of BRT systems	Medium	Likely	Substantial	Minor	Possible	Moderate

Risk and Impact Assessment – During the operation phase of BBMA BRT system, groundwater will be used as one of water sources to support daily BRT depots activities, including bus washing, routine maintenance, cleaning of operational facilities, and meeting basic sanitation needs for depot staffs. The estimated demand for clean water supply to support the operation of BRT system (depots, terminals and end-stations) is approximately 493 m³/day, where 4.8 m³/day will be used for bus washing. Although the source of clean water supply will be primarily from PDAM and 60% of the treated effluent from the bus-washing WWTP will be recycled and recirculated for washing incoming BRT buses, additional water supply from groundwater extraction will be required to meet the overall water demand.

Small-scale groundwater abstraction can contribute to cumulative pressure on local aquifers, particularly in the BBMA where groundwater resources are already under significant stress. Historical studies and regional hydrological assessments⁴ show that groundwater levels in parts of the BBMA continue to decline due to over-extraction, while certain zones—particularly low-lying areas—have experienced land subsidence linked to prolonged groundwater depletion. In this context, any additional abstraction, regardless of scale, requires careful consideration.

⁴ Taufiq, A., Hosono, T., Ide, K. *et al.* Impact of excessive groundwater pumping on rejuvenation processes in the Bandung basin (Indonesia) as determined by hydro geochemistry and modeling. *Hydrogeol J* **26**, 1263–1279 (2018). <https://doi.org/10.1007/s10040-017-1696-8>; Abidin, H.Z., Gumilar, I., Andreas, H. *et al.* On causes and impacts of land subsidence in Bandung Basin, Indonesia. *Environ Earth Sci* **68**, 1545–1553 (2013). <https://doi.org/10.1007/s12665-012-1848-z>

The duration of the impact is considered long-term, given that the abstraction required for BRT operation is expected to be continuous throughout the BRT operation phase, with higher usage anticipated to occur during peak operational demand. However, the magnitude of the impact is expected to be low at the project scale, given the relatively limited daily water requirement alongside PDAM supply and water recycling. From the geographical context, the impact will be largely localized around the depots and the immediate aquifer zone where the groundwater bore is located. However, because groundwater systems are interconnected, the effects of sustained abstraction may potentially extend beyond the project boundary.

Considering the above assessment, the severity of the impact is assessed as medium, and the likelihood of the impact is considered likely given that the groundwater abstraction will occur under normal operating conditions unless an alternative water source from PDAM or recycling systems is utilized. Therefore, the inherent risk of the impact due to groundwater abstraction during the operation and maintenance of the BRT system is evaluated as 'Substantial risk'.

Mitigation Measures. To minimize the impacts due to groundwater abstraction during the operation and maintenance of the BRT system, the project is recommended to implement the following mitigation measures, among others:

- The project should prioritize water efficiency by incorporating low-flow fixtures, efficient washing systems, and routine leak detection to minimize unnecessary water use.
- Where feasible, the depot should develop a rainwater harvesting system, particularly for non-potable uses such as vehicle washing or surface cleaning, thereby reducing reliance on groundwater during rainy months.
- Groundwater extraction should be conducted only with a valid permit from the relevant authority, and abstraction volumes must be monitored and reported regularly to ensure compliance with licensed limits.
- Establish groundwater monitoring wells at or near the depots to allow tracking changes in groundwater levels over time, so that early detection of declines can be identified and operational adjustments can be prepared.

Residual Risk. If the above mitigation measures are implemented consistently and maintained throughout the operational phase, the residual risk associated with groundwater abstraction is expected to be reduced from 'substantial' to 'moderate'.

6.3.6. Road Traffic

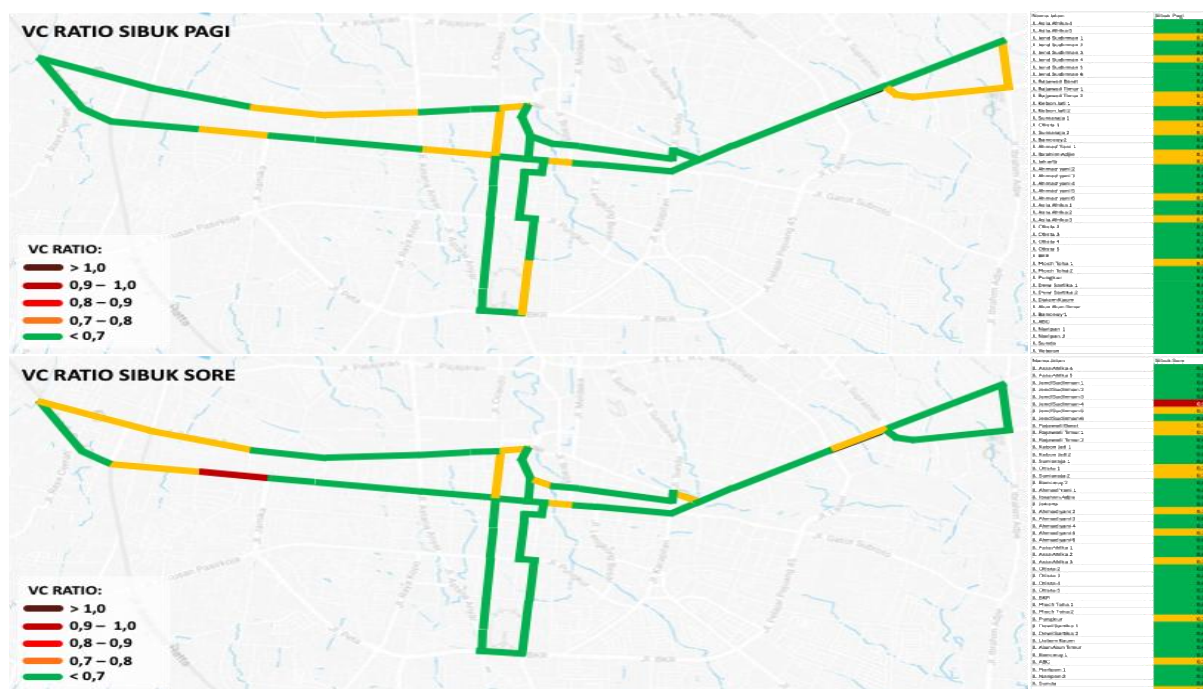
Overview – The implementation of the BRT project during its operational phase will affect the allocation of road space and traffic patterns along the corridor. These changes are expected to generate positive impacts, such as reducing traffic congestion, decreasing the number of private vehicle users who shift to the BRT, and shortening travel times for road users. Although the operation of the BRT is anticipated to deliver overall benefits, some negative

effects on road and traffic conditions may still arise, including queueing at intersections, curbside conflicts, and temporary pedestrian crowding at stations. The risk and impact assessment in relation to traffic conditions during the operation of BRT is summarized in the following.

Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Remaining localized traffic congestion at certain road sections during peak hours due to the operation of BRT	Incidental	Possible	Low	Incidental	Unlikely	Low

Risk and Impact Assessment – Based on the results of traffic impact modelling presented in the ANDALALIN document, traffic conditions during BRT operations are projected to improve overall, with the volume-to-capacity (VC) ratio expected to decrease by approximately 8% compared with current conditions, improving the Level of Service (LOS) from Category E to Category C. Nevertheless, localized congestion may persist at certain points along the main BRT corridor, particularly on Jl. Sudirman – Segment 4, where the estimated VC ratio remains at 0.97 (see red line in Figure 38).

Based on these findings, the impact of BRT operations on traffic conditions is assessed as largely beneficial, as the system is designed to promote efficient and sustainable mobility while reducing the reliance on private vehicles. The adverse impacts at certain road sections are expected to be minor and reversible. In terms of impact duration, the negative impacts are expected to be intermittent and largely limited to peak periods. While geographically, the impacts will be localized, occurring along the BRT corridor, primarily at intersections, within stations, and at curbside pick-up and drop-off points. Some minor spillovers may occur on connecting roads as traffic patterns adjust, but such effects are not expected to be significant. Predicted traffic volume within the dedicated on-corridor upon the operation of the BRT system is presented in the following table.



Source: ANDALALIN BBMA BRT, 2024

Figure 38. Forecasted Traffic Load within Peak Hours - BRT Operation

Table 60. Estimated Road Traffic Volume – Without (Existing) vs With BRT Operation

No.	Point of survey	Existing condition (without BRT)			Future condition with BRT in operation		
		Volume LHR (PCU/hour)	VC Ratio		Volume LHR (PCU/hour)	VC Ratio	
			Morning	Evening		Morning	Evening
1	Jl. Asia Afrika 4	55,730	0.75	0.71	51,361	0.58	0.55
2	Jl. Asia Afrika 5	52,431	0.71	0.73	48,321	0.55	0.56
3	Jl. Jend Sudirman 1	44,048	0.97	0.9	40,595	0.74	0.69
4	Jl. Jend Sudirman 2	22,730	0.9	0.87	20,948	0.69	0.67
5	Jl. Jend Sudirman 3	28,408	0.8	0.83	26,181	0.61	0.64
6	Jl. Jend Sudirman 4	29,784	1	1.26	27,449	0.77	0.97
7	Jl. Jend Sudirman 5	38,053	0.72	1.01	35,070	0.55	0.78
8	Jl. Jend Sudirman 6	46,338	0.77	0.92	42,706	0.59	0.71
9	Jl. Rajawali Barat	50,575	0.8	0.99	46,610	0.62	0.76
10	Jl. Rajawali Timur 1	33,489	0.83	0.94	30,863	0.64	0.72
11	Jl. Rajawali Timur 2	24,154	0.97	0.79	22,261	0.74	0.61
12	Jl. Kebon Jati 1	24,039	0.97	0.8	22,155	0.75	0.62
13	Jl. Kebon Jati 2	34,802	0.82	0.81	32,074	0.63	0.62
14	Jl. Suniaraja 1	26,265	0.88	0.76	24,206	0.67	0.58
15	Jl. Otista 1	32,664	0.96	0.96	30,104	0.74	0.73
16	Jl. Suniaraja 2	30,697	0.91	0.97	28,291	0.70	0.75
17	Jl. Banceuy 2	14,178	0.78	0.81	13,067	0.60	0.62
18	Jl. Ahmad Yani 1	60,472	0.83	0.79	55,731	0.64	0.60
19	Jl. Ibrahim Adjie	58,081	0.94	0.88	53,528	0.72	0.67
20	Jl. Jakarta	73,383	1.03	0.72	67,630	0.79	0.55
21	Jl. Ahmad yani 2	48,871	0.71	0.97	45,040	0.54	0.74
22	Jl. Ahmad yani 3	34,666	0.88	0.83	31,949	0.67	0.63
23	Jl. Ahmad yani 4	26,689	0.8	0.73	24,597	0.62	0.56

No.	Point of survey	Existing condition (without BRT)			Future condition with BRT in operation		
		Volume LHR	VC Ratio		Volume LHR	VC Ratio	
		(PCU/hour)	Morning	Evening	(PCU/hour)	Morning	Evening
24	Jl. Ahmad yani 5	24,609	0.87	1.03	22,680	0.66	0.79
25	Jl. Ahmad yani 6	30,615	0.99	0.79	28,215	0.76	0.60
26	Jl. Asia Afrika 1	25,684	0.75	0.72	23,670	0.58	0.55
27	Jl. Asia Afrika 2	42,975	0.9	0.86	39,606	0.69	0.66
28	Jl. Asia Afrika 3	57,639	0.96	0.97	53,121	0.73	0.75
29	Jl. Otista 2	35,792	0.83	0.8	32,986	0.64	0.62
30	Jl. Otista 3	32,813	0.71	0.77	30,241	0.54	0.59
31	Jl. Otista 4	33,030	0.93	0.84	30,441	0.72	0.64
32	Jl. Otista 5	20,063	0.8	0.75	18,490	0.61	0.57
33	Jl. BKR	62,848	0.89	0.73	57,921	0.68	0.56
34	Jl. Moch Toha 1	27,174	0.95	0.87	25,044	0.73	0.67
35	Jl. Moch Toha 2	14,264	0.83	0.73	13,146	0.64	0.56
36	Jl. Pungkur	21,794	0.8	0.94	20,086	0.61	0.72
37	Jl. Dewi Sartika 1	26,382	0.85	0.73	24,313	0.65	0.56
38	Jl. Dewi Sartika 2	27,380	0.87	0.81	25,234	0.67	0.62
39	Jl. Dalem Kaum	29,005	0.75	0.85	26,732	0.57	0.65
40	Jl. Alun Alun Timur	22,873	0.75	0.78	21,080	0.57	0.60
41	Jl. Banceuy 1	19,724	0.85	0.77	18,178	0.65	0.59
42	Jl. ABC	15,053	0.81	0.96	13,873	0.62	0.74
43	Jl. Naripan 1	22,236	0.89	0.75	20,493	0.68	0.58
44	Jl. Naripan 2	8,251	0.76	0.71	7,604	0.58	0.54
45	Jl. Sunda	37,345	0.88	0.88	34,417	0.68	0.68
46	Jl. Veteran	28,786	0.88	0.94	26,530	0.68	0.72
Average		33,845	0.85	0.85	31,192	0.65	0.65

Source: ANDAL Lalin BRT-BBMA, 2024

Note: Operational stage under scenario of “Do Something” according to ANDAL Lalin study. Remarks on traffic status is represented as color below:

■ = LOS: C, ■ = LOS: D, ■ = LOS: E, ■ = LOS: F

LOS category description may refer to Table 37 in Sub Chapter 5.1.10

Taking these considerations into account, the severity of negative impact that may arise from the operational of BRT system is assessed ‘incidental’, compared to the significant benefits arising from reduced congestion and improve network performance. The likelihood of the impact is ‘possible’ as congestion would remain exist at only a few locations during peak hours. Therefore, the inherent risk of the project is evaluated as moderate.

Mitigation Measures. To minimize the severity and likelihood of the negative impact on road and traffic conditions during the operational phase of BRT system, the project is recommended to implement the following mitigation measures, among others:

- Recommendations as proposed in the ANDALALIN should be implemented to optimize traffic circulation and ensure the efficient operation of the BRT system.
- Strict parking and stopping prohibitions should be enforced within stations and BRT corridors to maintain unobstructed bus lanes and traffic flow.
- Regulate and manage street vendors occupying sidewalks to minimize obstruction and preserve pedestrian accessibility.

- Enforce rigorous control and monitoring of roadside obstructions, including vehicles violating prohibitory signage and unauthorized street vendors to restore and maintain the optimal functionality of roadways and associated facilities, particularly at intersection entrances where prior congestion and encroachments were prevalent.
- Coordinate with traffic police and local authorities to enforce traffic rules and respond to congestion hotspots.
- Awareness campaigns encouraging responsible behavior should be conducted towards passengers, pedestrians, and drivers near BRT stations and corridors.
- Impose strict penalties and corrective measures on vehicles found in violations of traffic regulations
- Implement strategic interventions by government authorities through Transportation Demand Management (TDM) initiatives designed to incentivize and promote public adoption of communal transportation systems, including the electric BRT bus.

Residual Risk. If the above mitigation measures are implemented effectively and consistently, the residual impacts on traffic conditions are expected to remain low risk, with the likelihood of the impact occurring being reduced from likely to unlikely.

6.3.7. Labor and Working Conditions

Overview. The impacts on labor and working conditions, including exposure to occupational health and safety risk due to the BRT operation, are evaluated as ‘moderate risk’ without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented in a consistent and effective manner, the residual risk can be reduced to ‘low risk’ as described in the following.

Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Labor and working condition issue, which include occupational health and safety	Medium	Possible	Moderate	Minor	Unlikely	Low

Risk and Impact Assessment – Labor and Working Conditions. In the operation stage, the project will have lower risks of labor and working conditions than in the construction stage, due to the lower number of required workforce and the level of hazards that are present in the work activities. Workers will be recruited for the operation and maintenance needs of the bus stop, end station, terminal, and depot. Skilled and semi-skilled positions will be prioritized from the local workforce. However, in this operation stage, there will be a higher demand to recruit migrant workers with relevant skillsets and experience that are not yet available from the local workforce. Unclear or non-transparent work and skill requirements for job openings have the potential to give rise to grievances or protests from the local workforce or previously hired workers from the construction stage who wish to

extend their contracts. Labor issues may also arise from unclear working terms and conditions, unequal opportunities, and/or disproportionate benefits given to workers with the same skillset and experience. Workers with vulnerabilities, such as female workers and workers with disabilities, may have been marginalized in the recruitment opportunities and/or discriminated in the work. Discrimination in the workplace can also be encountered by migrant workers.

In operational stage, the physical work demands will be less than those required during the construction stage. The presence of hazards from machinery, manual equipment and hazardous materials during this stage will also be at a lower level than in construction stage. However, there will still be hazards that pose risks to workers and require adequate mitigation measures. The operational workers may encounter the possibility of injury from moving vehicles and electricity, traffic violations that result in traffic incidents at terminals and depots, work stress or fatigue due to inadequate working space for bus stations operators due to high volume of passengers, spread of communicable diseases among workers and passengers, illness due to poor sanitation and inadequate ventilation system, near-miss or incidents due to the absence of safety barriers, signage, warning systems to communicate hazards, adequate lighting, and/or emergency exits for emergencies, poor work scheduling of workers, as well as SEA/SH risks at works. In addition, hazards may also be present from potential earthquakes and flooding events that have been recorded in the proposed project area. Thus, the BRT system's operation workers and also the passengers might face a safety risk if these flood and earthquake disasters occur.

If not adequately managed, project operational workers may face consequences from working incidents, accidents, and diseases in their working area. These consequences may include physical injuries and occupational diseases; however, they are not considered to have the potential to cause fatalities, considering the more advanced and automated technology and infrastructure that apply at the BRT and less exposure to high levels of hazards (i.e., disaster). Therefore, the inherent risk of labor issues and working condition problems to the workers, including due to the project's construction activities, is evaluated as 'moderate risk' if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation measures. To reduce labor and working condition risks from operational activities, the project is recommended to implement the following mitigation measures, among others:

- Provide good work conditions and environments to workers. This includes adequate sanitation, ventilation, and/or air conditioning system, procedures, and good housekeeping practices, and a dedicated room for a smoking area.
- Establish work procedures that incorporate a comprehensive Health, Safety, and Environmental (HSE) management system to ensure all workers are systematically protected from occupational hazards.

- Provide workers with appropriate terms and conditions of employment, equal opportunities, fair benefits, insurance coverage, etc., following the prevailing regulatory practice.
- Provide vulnerable workers with adequate accommodating facilities that can address their specific needs, such as separate sanitation facilities for female workers, universal access or working space arrangements for workers with disabilities, minimize night working hours for female workers, etc.
- Conduct a thorough Risk Hazard Assessment (RHA) and develop a detailed hazard mapping framework along the entire BRT corridor, ensuring that structural designs incorporate earthquake resilience measures and do not impede or redirect natural flood flows, while facilitating adequate stormwater drainage.
- Provide and socialize a hazard and emergency warning system, safety barriers, signage, and emergency exits and scenarios.
- Prepare and implement OHS training for all workers on all relevant aspects associated with their daily work, including emergency arrangements.
- Implement fair and equitable hiring practices, overseen by the Project Manager, to prevent the engagement of unqualified personnel.
- Establish an accessible and functional worker Grievance Redress Mechanism (GRM) separate from the community GRM to address concerns, expectations, and inputs from workers.
- Establish a GBV prevention Code of Conduct to be understood and acknowledged by project workers, provide and socialize GRM channels for GBV incidents that can be used by workers or passengers experiencing these risks while utilizing the BRT services.

Residual Risk. If the above mitigation measures for labor issues and working conditions are implemented consistently and effectively, work incidents and disputes arising from project operations can be reduced from ‘moderate risk’ to ‘low risk’.

6.3.8. Community Health and Safety

Disturbances to community health and safety may occur in communities adjacent to the BRT-BBMA project operational locations due to operational activities. Impacts to community health and safety are evaluated as ‘moderate risk’ without the implementation of any mitigation measures. If related mitigation measures and monitoring plans are implemented consistently and effectively, the residual risk to community health and safety can be reduced to ‘low risk’ as described below.

Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
Community health and safety issues	Medium	Possible	Moderate	Minor	Rare	Low

Assessment Impact	Without Mitigation Measures			Mitigation Measures Implemented		
	Severity	Likelihood	Inherent Risk	Severity	Likelihood	Residual Risk
during operational activity						

Risk and Impact Assessment – The Most common safety incident to the community could be traffic incidents/accidents due to the operation of the BRT-BBMA buses. Significant health impacts to adjacent communities may occur if poor environmental management is implemented by the project, such as in dust and air quality management and waste management. Decreased air quality and uncontrolled dust could possibly cause respiratory disease in the community, while poor waste management could possibly cause contamination to water and soil that pose risks of waterborne diseases, spread of vector-borne illnesses, or create breeding habitats for flies, rodents, and other disease-carrying animals.

The increasing number of BRT passengers may increase the number of visitors to the community area. While this may improve the accessibility and economy of the community within the BRT service area, an increase in the number of visitors may also have unintended consequences on community safety. Increased rates of crime and violence, including GBV, may occur at open terminals and bus stations, especially those located in disadvantaged neighborhoods or areas occupied by a high number of vulnerable communities, areas with a lack of adequate lighting and poor visibility, and/or limited police presence. Earthquakes and flooding events have been recorded in the proposed project area. Thus, the BRT system might face endurance challenges and face a safety risk from these disaster events and may further worsen the disaster impact to the communities in the vicinity of the to the BRT system's location, for example a collapse of BRT infrastructure could impede access for evacuation or the delivery of supplies, directly affecting community structures and potentially causing injuries to the community.

Due to the above-mentioned possible scenarios affecting community health and safety, the inherent risk due to the project's operational activities is evaluated as 'medium risk' if relevant mitigation measures are not implemented in a consistent and effective manner.

Mitigation measures. Regarding maintaining the community health and safety issue due to its potential disturbance by operational activities, the project is recommended to implement the following mitigation measures, among others:

- Implement good monitoring and evaluation of environmental mitigation measures implementation, preventing the environmental impacts from affecting community health.
- Enhance lighting and security features at bus stops and terminals, as well as coordinate with local police in the provision of a contact number for response or guard, especially if there is a heightened risk of security.

- Establish and implement good housekeeping and good sanitation practices at BRT facilities and service areas
- Establish and socialize functional and accessible GRM channels for all passengers and adjacent communities
- Conduct a risk hazard assessment (RHA) and develop a detailed hazard map within the BRT corridor. Structures need to be designed to minimize earthquake risk, mitigate flood flow impedance or redirection, and support drainage.
- Prepare and implement an OHS management plan and training for all workers, including on emergency scenarios and evacuation procedures, and provide contact numbers for emergency response.
- Provide officers stationed at the entry/exit of the bus stop and terminal who will also conduct routine inspection and patrol to monitor the safe and secure condition of buses and passenger traffic.

Residual Risk. If the above mitigation measures for community health and safety are implemented consistently and effectively, the likelihood of community incidents and health issues arising from the project's operational activities can be reduced from 'moderate risk' to 'low risk'.

6.3.9. Livelihoods

The BRT operation (on-corridor and off-corridor) is not anticipated to fully displace the paratransit angkot operators on the routes that would overlap with the BRT routes. Instead, partial economic displacement stemming from market competition with the BRT services is anticipated to occur during operation. Assuming better services with affordable prices as per the public transport reform design, passengers are likely to choose BRT services, which would reduce the number of angkot passengers, which, in turn, could lead to reduced income earned by the respective operators and hence, affect their livelihoods.

Approximately 1,554 *angkot* fleet are being operated, which impacted 20,275 persons (or around 5,069 households), comprising the drivers, ticketing operators, timers, and maintenance staff that are associated with such operation. In Bandung, one fleet is commonly owned and used by one '*angkot*' operator (also as the driver). Hence, most drivers are also fleet owners. The impact of the BRT operation on the *angkot* operators will depend on the overlap with the BRT routes to be constructed. It is estimated that there are 48 *angkot* routes that will overlap with BRT routes. A separate study on the *angkot* operators in Bandung Basin Metropolitan Area (BBMA) was undertaken by the consultant, the Regional Economic Development Institute (REDI) in 2023. This study will complement the transport modelling undertaken by consultant SYSTRA to understand the likelihood and scale of impact on the *angkot* drivers/operators during the project implementation. Several options as mitigation measures are still being discussed. At this stage, there are several framework-level options to be considered and implemented by the Government, including:

- **Gradual Angkot Reform Option** - Inviting operators of all *angkot* routes that are impacted by the project to become BRT operators by establishing a consortium or other business entities within a five to seven-year time frame (gradually). As such, the *angkot* drivers can be employed by the consortium to be the feeder operator as part of the BRT system.
- **BRT Feeder Operator Option** - Inviting all affected *angkot* operators to become BRT feeder operators (provide services from and to BRT stations) and provide employment opportunities for *angkot* drivers. The detailed mitigation measures will be presented in a separate project-level *angkot* integration plan/public transport reform, which is part of **the project's sub-component 1. C on Angkot Reorganization of the overall MASTRAN project**. This document shall include details on the establishment of the subnational public service enterprise (*Badan Layanan Usaha Daerah* or BLUD) to govern and manage the BRT operations and action plans to mitigate adverse impacts on the affected *angkot* drivers in the Bandung Basin Metropolitan Area (BBMA).

6.4. Cumulative Impact Assessment

This document presents the cumulative impact assessment of the BBMA BRT Project, in accordance with the World Bank Environmental and Social Standard 1 (WB ESS 1). The assessment encompasses a comprehensive evaluation of all pertinent direct, indirect, and cumulative environmental and social risks and impacts associated with the project, while also considering influences from other relevant historical, ongoing, and reasonably foreseeable future developments within the project's area of influence.

The cumulative impact assessment implemented for this Environmental and Social Impact Assessment (ESIA) is characterized as a Rapid Cumulative Impact Assessment (RCIA). The procedural steps for executing the RCIA are outlined as follows:

- Step 1: Identification of spatial and temporal boundaries of the study;
- Step 2: Identification of Valued Ecosystem Components (VECs), other developments, and external stressors;
- Step 3: Establishment of baseline information concerning VECs;
- Step 4: Evaluation of the project's contribution to the anticipated cumulative impacts;
- Step 5: Assessment of the significance of predicted cumulative impacts on the viability and sustainability of the affected VECs; and
- Step 6: Formulation and implementation of mitigation measures aimed at managing the project's contribution to cumulative impacts and associated risks.

Spatial and Temporal Boundaries. The spatial boundary of the CIA is defined as the Area of Influence (AoI) associated with the BRT BBMA project presented in Section 4 of ESIA. The AoI includes both current and projected developments within the Bandung Metropolitan Area, with a focus on regions adjacent to the project footprint.

A comprehensive delineation of the Aol is articulated in a designated section of the ESIA, which encompasses five municipalities: the City of Bandung, the City of Cimahi, the Bandung Regency, the West Bandung Regency, and the Sumedang Regency.

In addition to spatial considerations, the CIA necessitates the definition of a temporal boundary. However, the establishment of this boundary presents challenges due to the uncertain nature of prospective developments and the unpredictable influence of both natural and social stressors. To address this challenge, a temporal boundary of three years has been adopted, in accordance with the relevant guidelines for the CIA pertaining to this project.

Existing and Foreseeable Future Development and Activities. The RCIA took into account external factors, including anticipated future actions stemming from surrounding activities and existing or planned major projects that may affect the same Valued Environmental Components (VECs). Such considerations include projects and activities situated within the project's Aol, evaluating potential environmental and social impacts arising from the BRT and its ancillary facilities. Information regarding significant existing and planned activities and/or projects pertaining to the BRT BBMA Project has been gathered from desktop research and is summarized in the following table.

Table 61. Existing Activities and Foreseeable Future Development within BBMA Area

Administrative Area	Existing Activities	Foreseeable Future Development
Bandung city	The main activities in Bandung City are dominated by: ▪ Trade and services, with activity centers located in the Alun-Alun Bandung area, Jalan Asia Afrika, Jalan Braga, Jalan Riau (RE Martadinata), Dago, Cihampelas, and the Sukajadi–Pasteur corridor. ▪ Education and government, concentrated around the Taman Sari, Dipatiukur, Gedung Sate, Cibiru, and Setiabudi areas. ▪ Tourism and creative industries, spread across the Braga, Asia-Afrika, and Dago areas.	Road infrastructure developments are planned, but the definitive schedule for the implementation is not yet confirmed and subject to funding: ▪ Bandung Intra-Urban Toll Road (BIUTR): This toll road will connect Pasteur and Cileunyi via Pasupati and Gasibu, with alternative routes through Cicaheum or Supratman–Antapani, and a branch toward Gedebage linking to the Padalarang–Cileunyi Toll Road. As of 2025, the project is in the Detailed Engineering Design and investment auction stage, with construction expected to start in 2026 and completion targeted for 2029. ▪ Bandung Raya LRT: Planned to serve two priority corridors—Tegal Luar–Leuwipanjang and Leuwipanjang–Babakan Siliwangi. By 2025, the project is in the final feasibility and engineering design phase, with land acquisition targeted for 2026, construction in 2027–2028, and operations by 2030.

Administrative Area	Existing Activities	Foreseeable Future Development
Cimahi city	The main activities in Cimahi City are dominated by manufacturing and garment industries, primarily in the Leuwigajah Industrial Area, as well as educational and military facilities.	No significant future developments have been identified within Cimahi area
West Bandung Regency	Padalarang and Cimareme serve as hubs for trade and logistics activities due to their proximity to the Cipularang Toll access. The presence of the high-speed rail station in Padalarang also drives increased economic activity and mobility for both visitors and residents. Meanwhile, Lembang, Maribaya, and Ciater are primarily driven by nature-based, agro, and culinary tourism activities. Additionally, there are industrial and manufacturing activities around the Batujajar industrial area.	No significant future developments have been identified within West Bandung area
Bandung Regency	Existing activities in Bandung Regency, particularly in the southern and southeastern corridors of the BBMA project area, are dominated by trade and service activities, with main hubs in Soreang, Baleendah, and Banjaran. Meanwhile, the areas of Rancaekek, Dayeuhkolot, and Majalaya serve as centers for manufacturing and garment industries.	Integrated with Bandung City's LRT through Leuwipanjang Terminal connectivity, the Bandung Regency LRT project is planned to serve the Bojongsoang (Podomoro Housing) – Leuwipanjang Terminal – Soreang route. As of November 2024, the project has entered the investment auction stage, but no information has been available on the start of construction.
Sumedang Regency	The Jatinangor area, targeted for off-corridor BBMA development, currently serves as a center for educational activities, hosting several major universities.	No significant future developments have been identified within Sumedang (Jatinangor area)

Identification of Valued Environmental Components (VECs). The VECs are defined as environmental and social attributes that are crucial for evaluating risks associated with physical features, habitats, wildlife populations, ecosystem services, natural processes, social conditions, and cultural elements. The data utilized for identifying VECs corresponds with the sources used in the Environmental and Social Impact Assessment (ESIA), comprising publicly available information obtained through systematic online research of pertinent literature, articles, and media. Additionally, insights gathered during public consultation efforts conducted as part of the Land Acquisition and Resettlement Plan (LARP) and the ESIA development phases, scheduled for 2025, also contribute to this identification process.

The selection of VECs is further guided by the outcomes of the risk and impact assessment pertinent to the Bus Rapid Transit (BRT) project, as detailed in the respective sections of the ESIA. In light of these considerations, the VECs designated for the Rapid Cumulative Impact

Assessment (RCIA) of the BRT BBMA Project, including the justification for their selection, are delineated as follows:

- *Air quality* – The Bus Rapid Transit (BRT) project, particularly throughout its construction phase, is anticipated to produce heightened levels of particulate matter and fugitive emissions in the surrounding areas. The consequent impact on air quality is regarded as a significant risk. Furthermore, similar emissions from other existing activities and projects, including urban mobility initiatives and industrial zones in Majalaya, Leuwigajah, Kopo, and Dayeuhkolot, will cumulatively exacerbate air pollution within the Area of Interest (Aoi), thereby increasing the potential risk to public health.
- *Noise* – The BRT project is anticipated to elevate noise levels attributed to the operations of both on-road and off-road vehicles during the construction phase, along with the activities associated with the workers' base camp and earthworks. This resultant noise impact is evaluated as a significant risk. Furthermore, the noise generated by existing projects and activities, predominantly linked to vehicular movement, may synergistically augment noise levels along the routes that coincide with the proposed BRT corridors, thereby exacerbating potential community health issues and nuisance concerns.
- *Greenhouse gas (GHG)* – GHG resulting from the BRT project, in conjunction with other current and forthcoming developments and activities within the Project's Aoi, will be released into the global atmosphere. These emissions may persist over extended periods, potentially contributing to warming effects and alterations in the regional climate, thereby impacting both present and future generations.
- *Surface water quality* – The potential for runoff, fuel spills, and waste generated during the construction of the BRT project may cumulatively interact with additional pollutants produced from other ongoing activities and planned developments within the Project's Area of Influence (Aoi). Such interactions may surpass the assimilative capacity of adjacent rivers, thereby increasing risks to aquatic ecosystems and public health, especially for communities dependent on surface water sources located downstream of the river.
- *Road traffic and infrastructure* – Changes in traffic flow from the BRT initiative, such as the establishment of dedicated lanes, restructuring of traffic layouts, enlargement of roads, and creation of supporting infrastructures—could collectively impact other current activities and planned projects within the project's Aoi. These effects might lead to increased pressure on roadways, reduced access in certain areas, and worsened traffic delays, especially throughout the construction period.
- *Local economic development* – The BRT project is anticipated to generate positive outcomes through enhanced accessibility, provision of employment and business opportunities for the local communities, both during construction and operation phases. However, there may be short-term negative effects mainly during construction, caused by restricted access, possible job competition, and tensions surrounding perceived opportunities and advantages resulting from the influx of migrant workers.

- *Community health and safety* – During the construction phase, the BRT project will impact the health and safety of nearby communities. Along with other current and planned developments in the project's area of interest, this could lead to increased pressure on community health and safety, potentially causing long-term health issues and greater susceptibility to risks.

Cumulative Impacts. The rapid assessment of cumulative impact was undertaken for the VECs, and the results are presented in the following table.

Table 62. Environmental and Social Cumulative Impacts

Potential Impacts of BRT BBMA Project	Impacts from Existing and Future Activities and Development	Impacts due to Natural Disaster and Climate Change Risks	Potential Cumulative Impacts
Ambient Air Quality			
The BRT Project is not anticipated to considerably affect the ambient air quality in the BBMA area due to dust and transient gas emissions, as it intends to improve public transit and alleviate traffic congestion, which should help decrease air pollution overall. However, there might be a temporary rise in emissions around the project site during the construction period.	Emissions of dust and gases from urban and industrial regions, mainly linked to road traffic and industrial outputs in the BBMA area, are projected to greatly affect air quality deterioration in the region. Furthermore, the upcoming construction of LRT and inner-city toll roads could negatively influence air quality in zones that overlap with BRT operation.	The climate change risk induced by temperature rise and the urban heat island effect may elevate ozone and secondary air pollutant levels within the BBMA area, potentially worsening respiratory health risks. While most natural disaster-induced risks are not expected to directly cause long-term air pollution, volcanic activities from Mount Tangkuban Perahu can temporarily increase SO ₂ concentrations and particulate levels, particularly in the northern Bandung area.	Based on the assessment described herein, the cumulative impact on air quality within the BBMA area is evaluated as major in term of its severity and the impact is likely to occur without enforcement of the regulatory requirements and, therefore, the impact is ranked as high risk.
Greenhouse Gas Emissions			
During construction phase of the BRT project emissions from machinery and transportation will increase GHG emissions in the BBMA area. However, in operation, the BRT is expected to reduce emissions by shifting commuters from private vehicles to mass transport.	Ongoing operations in this area are a major source of GHG emissions due to industrial processes and urban transportation.	Climate change induced by temperature rise and the urban heat island effect can intensify energy demands (e.g., cooling in the building and transportation) which lead to spike in GHG emissions.	Based on the assessment described herein, the cumulative impact on GHG emissions within the BBMA area is evaluated as moderate in term of its severity and the impact likelihood to occur is possible without enforcement of the regulatory requirements and, therefore, the impact is ranked as medium risk.

Potential Impacts of BRT BBMA Project	Impacts from Existing and Future Activities and Development	Impacts due to Natural Disaster and Climate Change Risks	Potential Cumulative Impacts
Noise Level			
The noise emissions from the Project are not expected to increase the ambient noise within 250 from the nearest sensitive receptors.	Noise emissions from the urban and industrial areas are expected to significantly impact ambient noise levels within the BBMA area as they may originate from multiple sources such as traffic, commercial areas, trade and services, residential and non-residential development.	None.	Based on the assessment described herein, the cumulative impact on ambient noise level within the BBMA area is evaluated as moderate in term of its severity and the impact likelihood to occur is possible and, therefore, the impact is ranked as medium risk.
Surface Water Quality			
Potential contamination from runoff, fuel spills, and waste during construction of the BRT project could reduce water quality on nearby surface water bodies.	Urban and industrial activities often carries runoff with pollutants, especially in areas with poor drainage and waste management	Intensified rainfall may increase surface runoff and erosion, worsening surface water quality. Flooding events during rainy season can spread contaminants into water bodies	Based on the assessment described herein, the cumulative impact on surface water quality within the BBMA area is evaluated as moderate in term of its severity and the impact likelihood to occur is possible without enforcement of the regulatory requirements and, therefore, the impact is ranked as medium risk.
Road Traffic and Infrastructure			
The BRT project has a long-term goal of alleviating traffic congestion in the BBMA area once it becomes operational. However, the project will also cause disruption to current traffic and transportation, particularly during the construction phase.	High intensity of traffic and transportation within the BBMA area has caused traffic congestion and may reduce road integrity. This condition is likely to worsen, especially when the BIUTR and Bandung Raya LRT construction projects commence, considering the	Extreme weather conditions such as prolonged dry period, hotter temperature, and rainstorm events would reduce the life of the road pavement and structure and also causes traffic congestion and blockage in the event of flooding.	The cumulative impact of the BRT project and other activities could result in significant traffic congestion, increased strain on existing infrastructure, and disruptions to mobility, especially during the construction phase. Temporary detours and construction zones may

Potential Impacts of BRT BBMA Project	Impacts from Existing and Future Activities and Development	Impacts due to Natural Disaster and Climate Change Risks	Potential Cumulative Impacts
	potential for lane closures, heavy equipment mobilization, and increased construction-related traffic that intersect with the BBMA corridor area.		hinder traffic flow, while the demand for road space could rise due to the addition of transport systems and industrial traffic. Hence, the impact is evaluated as moderate in term of its severity and the impact likelihood to occur is possible without enforcement of the regulatory requirements and, therefore, the impact is ranked as substantial risk.
Economic Development			
The project is anticipated to deliver positive economic impacts, particularly through the creation of employment and business opportunities for local communities, especially Project-Affected Persons (PAPs) and individuals of productive working age within the project's area of influence, and potentially in other regions of West Java. Recruitment of workers will prioritize local residents who meet the required skills and qualifications. Furthermore, the project is expected to encourage the growth of small-scale enterprises by generating demand for local goods and services, thereby contributing to broader economic benefits.	Urban development is expected to generate positive impacts on the local economy, including job creation, enhanced economic activity, and expanded business opportunities.	Rising temperatures and more intense rainfall are likely to primarily affect agricultural productivity, while also increasing energy costs due to greater demand for cooling. These climate shifts may also influence employment patterns, as people migrate to areas with lower climate risks. Moreover, natural disasters can cause significant economic disruption, particularly for informal workers, low-income households, and those already living below the poverty line.	The combined effects of the BRT project and other concurrent activities are expected to generate positive contributions to local economic development, including improved infrastructure, job creation, and enhanced access to key areas. To maximize these benefits, targeted enhancement measures should be implemented to promote sustainable economic growth within the BBMA area.

7. STAKEHOLDER ENGAGEMENT AND INFORMATION DISCLOSURE

7.1. Consultation with Stakeholders and Project Affected Peoples (PAPs)

As summarized from the LARAP of the BRT-BBMA (June 2025), stakeholder consultations for the project were conducted in July 2024 - January 2025 as shown in the table below.

Table 63. Consultation with Project's Stakeholders and PAPs

Date and Venue	Participants	The discussion topics in the forum
Consultations conducted in 2024		
Outreach and consultation with local governments July 10, 2024 Mercure Bandung Nexa Hotel at Jl. Supratman	74 participants represented among others: – Ministry of Transportation represented by PMC – Regional Development Planning Agency of West Java Province – Office of Highways and Spatial Planning of West Java Province – Transportation Office of West Java Province – Related offices and agencies from Bandung City, Cimahi City, Bandung Regency, Sumedang Regency and West Bandung Regency – PLN (state-owned electricity) – UPTD BLUD Parking of Bandung City – State-owned railway company (PT KAI) – 9 Heads of sub-districts passed by the BRT corridor – Team Leader of DED BRT BBMA	– Government policy on MASTRAN – BBMA BRT project plan, including overview, project location, project components, design plan, risks and impacts and its mitigation measures, land affected by the project, and list of PAPs, and Project's Grievance Redress Mechanism (GRM). – LARAP as part of the process of preparing guidelines or policy frameworks for implementing land acquisition and resettlement.
Consultation meeting at the Community Level:	Community leaders and PAPs	– BBMA BRT project plan including overview, project location, project components, draft design, land affected by the project, and PAPs, – LARAP activities as part of the process of preparing guidelines or policy framework for the implementation of land acquisition and resettlement. – Inputs, Aspirations, and perceptions related to the BBMA BRT Project, land
– Andir Subdistrict on June 13 th , 2024	19 Participants (2 Female and 17 Male)	
– Balonggede Subdistrict on July 12 th , 2024	18 Participants (7 Female and 11 Male)	
– Astana Anyar Subdistrict on July 25 th , 2024	14 Participants (1 Female and 13 Male)	
– Batununggal Subdistrict on July 29 th , 2024	15 Participants (2 Female and 13 Male)	

Date and Venue	Participants	The discussion topics in the forum
– Lengkong Subdistrict on August 21st, 2024	23 Participants	acquisition, income restoration and handling mechanisms to be carried out.
– Cicadas Subdistrict on August 29th, 2024	16 Participants (1 Female and 15 Male)	
Consultations Conducted in 2025		
The plenary meeting of the socialization of the BBMA BRT project LARAP document January 16, 2025 Mercure Bandung Nexa Supratman Hotel	74 participants (28 females and 46 males) represented stakeholders and agencies from Bandung City, Cimahi City, Bandung Regency, Sumedang Regency and West Bandung Regency, as well as all sub-district heads, and village head	– Socialize the results of the LARAP study covering the social and economic conditions of the PAPs, including land and other assets affected by the project. – Deliver the PAPs' perceptions and aspirations on the presence of the BBMA BRT project based on the results of the socio-economic survey. – Socialize, obtain inputs and agree on the action plan concept for land acquisition and resettlement.

Source: Dohwa-Lenggogeni Notes from Public Consultation, 2025

7.2. Future Engagement and Information Disclosure

Recognizing this, a series of public consultations involving relevant stakeholders, including the head of the subdistrict and affected communities, will be held throughout the project lifecycle. These consultations aim to gather feedback from affected communities, address their concerns, and ensure transparency in the land acquisition process. A range of stakeholder engagement and information dissemination methods that could be implemented by the Project are, among others, through the distribution of newsletters, flyers, posts on the website, and formal and informal meetings/discussions.

Upon endorsement by the Implementing Agencies and the Banks, the E&S safeguard documents and other related documents prepared for the Project will be posted on the websites of the Bank, visible locations of the project's sites, the Ministry of Transportation as well as the West Java Provincial Government office and Bandung City Government office. Timely disclosure of these documents is crucial to the effectiveness of the stakeholder engagement process and helps protect the Project's reputation. The primary objective of information disclosure is to reach out to all the Project's stakeholders through prioritizing the accuracy of information, project stages, timelines, and potential impacts, and other relevant aspects crucial for the benefits of the Project and the stakeholders themselves.

Table 64. Planned Stakeholder Engagement Prior to and During Construction

Aspects	E&S Related Activities/Documents	Key Responsible Parties for Implementation	Timeline
E&S Mitigation Implementation	Implementation of Grievance Redress Mechanism (GRM)	Governments (national, provincial, city, regency) and the Contractors	Pre-construction, Construction and Operational Phase
	Implementation of mitigation measures – ESMP and UKL/UPL (including Construction Management Plan, noise reduction plan, COVID 19 Response Plan, ANDAL Lalin, GESI-AP, GBV (SEA/SH) Risk Assessment	Governments (national, provincial, city, regency); Implementing Business Entity (IBE)	Pre-construction, Construction and Operational Phase
	Labour Management Plan (LMP)	PIU of BRT-BBMA Project	Pre-construction, Construction and Operational Phase
	Heritage Impact Assessment (HIA)	PIU of BRT-BBMA Project Implemented by contractor	Pre-construction and Construction
	Implementation of LRAP	Governments (national, provincial, city, regency); Consultants	Prior to construction
	SOP of Waste Management Which comprises for waste sanitation and hazardous waste	PIU of BRT-BBMA Project Implemented by contractor and operator	Pre-construction, Construction and Operational Phase
Technical Training	Training on WB E&S standards specifically linked to the MASTRAN project	Target audience: Government (national, provincial, city, regency)	Construction & operational phase; daily/monthly monitoring and annually reporting
	Technical guide on green procurement in the transport sector	Target audience: Government (national, provincial, city, regency)	Inception Phase

Aspects	E&S Related Activities/Documents	Key Responsible Parties for Implementation	Timeline
	Training on Grievance Mechanism	Target audience: Government (national, provincial, city, regency)	Inception Phase
	Training on data monitoring analysis	Target audience: Government	Inception Phase
	Training on environmental and social code of practice as well as guideline for green procurement to construction firms	Target audience: Contractors	Inception Phase
	Training on green initiatives in public transport	Target audience: Government	Inception Phase
	Gender training	Target audience: internal team	Construction phase
	Training on stock assessment	Target audience: internal team	Annually
	GHG emission, air and noise pollution monitoring training	Target audience: Sub-project permanent institution	Annually
	Training capacity building for relevant stakeholders on E&S standards for the MASTRANS project, such as occupational health and safety; and community health and safety This would target main stakeholder groups of sub project locations to provide community monitoring on the implementation and fulfillment of the E&S standards	Contractors Target audience: Community and PAPs near the construction site	Annually

8. GRIEVANCE REDRESS MECHANISM

GRM Procedures. The BRT Project establishes a grievance redress mechanism (GRM) for stakeholders and project-affected people to express their grievances/complaints or request information. The GRM aims to capture, process, and resolve concerns promptly, in an impartial, understandable, and transparent manner tailored to the specific community, at no cost and without retribution to the complainants.

The GRM implementation refers to the handbook titled Operational Guidance on the Grievance Redress Mechanism (GRM) for the Indonesia MASTRAN Project, which is also available in the project's Stakeholder Engagement Plan (SEP). There are three (3) types of risk for project grievance, which are classified based on the level of risk (Category 3/low risk to Category 1/high risk).

Grievances that cannot be resolved immediately by the project authority within the site area (Risk 3) will be escalated to a higher risk level, involving higher-level authorities at the sub-national level (Risk 2) or national levels (Risk 1). All complaints will be processed in accordance with the Project's GRM procedure in a timely manner.

Table 65. Complaints based on Its Risk Level

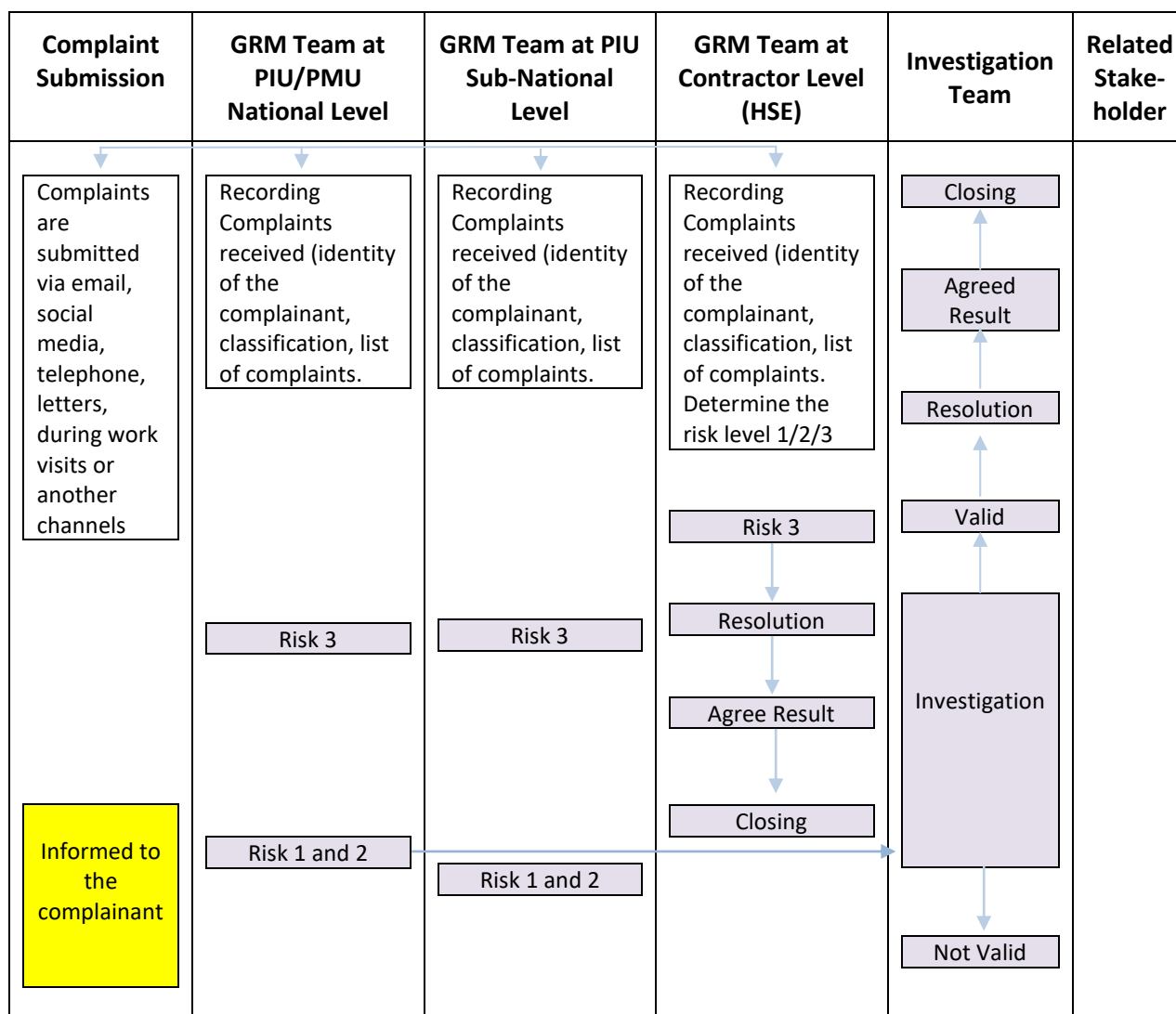
Items	Type of Risks		
	Risk 1 (High)	Risk 2 (Moderate)	Risk 3 (Low)
Risk description	Complaints due to project activities that have significant negative impacts on the complainant, impacts are serious and systematic, cover broader area than the site location, and/or require PIU/PMU level authorities or court involvement to provide a solution/decision, this may include sexual harassment, work accidents resulting in serious injuries or fatalities, relocation and land acquisition issues, etc. In this category, while some grievances can be resolved by the contractor or PIU Sub-national (for instance: a simple relocation issue). However, there are also grievances under this category that cannot be resolved at the contractor level and the PIU at the Sub-national level. In this case, the grievance must be	Complaints that are significant (but not as significant as High Risk), moderately severe, potentially systematic impact, and/or not being able to be resolved at the site level, thus require PIU at the sub-national level authorities to participate in the discussion and to provide a solution, such as a claim over land ownership or a dispute of compensation payment. Generally, these can be resolved at the PIU-sub-national level. <u>Notes:</u> Complaints related to the handling of environmental and social impacts by the local governments as per the working agreement.	Complaints occur within the site location that can be addressed immediately through discussion and solution given at the contractor level, and are generally minor, such as dust and noise causing annoyance to the communities within the proximity of the project's construction sites.

Items	Type of Risks		
	Risk 1 (High)	Risk 2 (Moderate)	Risk 3 (Low)
	resolved at the PIU/PMU and/or through litigation.		
Response period	To be processed within 24 hours after the complaints are received. To be resolved within 5 x 24 hours after being escalated from Risk 2	To be processed within 24 hours after the complaints are received. To be resolved within 5 x 24 hours after being escalated from Risk 3	To be processed within and resolved within 2 x 24 hours-
Data/information collection period	Max. 12 days	Max. 7 days	Max. 2 days
Closing period	30 days	14 days	7 days
Investigation	Yes	Yes	Not necessary
Review	PMU-PIU National	PMU-PIU National	-
Closing	PIU National	PIU National	Contractor

Source: Operational Guidance of Grievance Redress Mechanism for Indonesia MASTRAN Project, 2024

The GRM Procedure is shown in the following figure. Once the contractor is selected, the contractor will be responsible for adopting the GRM described in this chapter and establishing a site-level GRM to receive and respond to grievances and feedback related to the project's environmental and social risks and impacts. As part of the bidding document, the contractor is required to hire a community liaison, whose responsibilities include collecting, processing, addressing, and documenting grievances from affected people.

Figure 39. Grievance Redress Mechanism



GRM Channel to Receive Complaints. To increase accessibility and ensure communities have options to report grievances, GRM will offer multiple channels for complaint submission. However, GRM for workers is handled in accordance with the Labor Management Procedure (LMP). At the National Level, LAPOR! is an existing GRM portal that could be promoted as a mechanism to be adjusted and adopted for the sub-project grievance-handling process. Alternatively, the Labor! The process can be followed if the complaint is not considered a matter for the PIU. Labor! (literally means 'report') It is managed by the Ministry of Administrative Reform and Bureaucracy Reform (PANRB).

Aside from LAPOR above, to increase accessibility and reach, CPMU will also provide other channels for receiving/capturing grievances, including:

- Email: humas_hubdat@dephub.go.id
- Phone: 021) 3456919, 3811308; Ext. 1102, 1350
- Social media: Instagram and Twitter @ditjen_hubdat

- Office address: Direktorat Jenderal Perhubungan Darat, Kementerian Perhubungan Republik Indonesia, Jalan Merdeka Barat No. 8, Jakarta, DKI Jakarta. 10110. Indonesia.

At the Sub-national level, GRM can use the official website of the local Government that puts LAPOR! Portal. However, at each subnational level, additional channels must be provided to increase accessibility for project-affected parties and the general public to lodge complaints.

Role and Responsibilities for GRM Implementation. The following table describes the roles and responsibilities of each party and institution involved in the BRT project related to GRM implementation. The Project provides GRM Focal Points/Officers to coordinate with the provided grievance channels at the subnational and national levels. At the subnational level, GRM focal points have been appointed, as substantiated by an Appointment Decree (SK). These GRM Focal Points will sort and receive project-related grievances and channel them to the appropriate project team authorities for resolution.

Table 66. Roles and Responsibilities on GRM

Institution	Role and Responsibility
Contractor	▪ Receive and record complaints ▪ Identify and assess the risk type of each grievance: - RISK 3 grievance is for PIU to send it to the Contractor to be resolved. - RISK 2 grievance is for the PIU at the Subnational government to resolve it - RISK 1 grievance is to be forwarded to PIU/CPMU at the national level (i.e., MoT) to resolve it ▪ Contractor prepares regular records/reports of complaints to be submitted to PIU ▪ Day-to-day implementation of GRM
PIU at the Subnational level/Local governments (GRM Focal Points/ Officer)	▪ Receive and record complaints ▪ Identify and assess the type of each grievance as above for subsequent resolution ▪ Submit the report on GRM cases, handling, and resolution to PIU/CPMU at the national level regularly ▪ Day-to-day implementation of GRM
PIU/CPMU at National Level – Ministry of Transportation (GRM Focal Point/ Officer)	▪ Receive and record complaints ▪ Identify and assess the type of each grievance as above for subsequent resolution ▪ Submit the report on GRM cases, handling, and resolution to PIU/CPMU at the national level regularly ▪ Day-to-day implementation of GRM

Source: Operational Guidance of Grievance Redress Mechanism for Indonesia MASTRAN Project, 2024

In the Operational Stage, grievances will be treated the same as customer complaints due to concerns about BRT operational services. The unit responsible for GRM will be under the Crisis Centre at the headquarters office of the BRT.

9. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

9.1. Mitigation Measures and Monitoring Plans

As an overall approach, the design of the project should avoid or prevent impacts; for impacts that are anticipated or that result from project activities, there are formal steps and substantive actions outlined in this section to manage and mitigate such risks. In addition to this impact prevention approach through project design of beneficial activities, mitigating the potentially significant adverse impacts arising from project activities could be done through a range of mitigation measures and monitoring plans.

The Environmental and Social Management Plan (ESMP) is the main mechanism for E&S management and mitigation during the construction and operation of the BRT project. Upon contract award, the contractor should prepare a project- and site-specific construction environmental and social management plan (CESMP) to be submitted to the PIU for review and endorsement prior to commencement of construction activities.

The ESMP requires the development of specific, stand-alone management plans as part of project construction and operation including, among others:

- *Construction Environmental and Social Management Plan (CESMP)* which is an overarching project-specific E&S risk mitigation measures and monitoring requirements that should be implemented by the contractors and is also applicable for the sub-contractors and respective primary suppliers.
- *Traffic Management Plan (TMP)* which is a detailed plan describing mitigation measures, monitoring and agencies coordination required to manage the existing traffic congestion and disturbance to public transportation services road users during construction of the BRT project.
- *Labor Management Plan (LMP)* which details labor and working conditions including health and safety requirements for project workers that should be provided by the project. The LMP would include code of conducts for preventing sexual exploitation and abuse/sexual harassment as well as gender-based violence.
- *Heritage Impact Assessment (HIA)* that would include assessment of the integrity and existing damages of the cultural heritage building within the dedicated BRT corridors and define mitigation measures to be implemented.
- *A Chance Find Procedure (CFP)* will need to be develop as precautionary measure if cultural heritage objects unexpectedly found during excavation and construction activities.
- *Standard Operating Procedure (SOP)* for managing hazardous and non-hazardous wastes as well as construction wastes including its disposal to ensure compliant with prevailing laws and regulations.

Table 67. Environmental and Social Management and Monitoring Plan**A. PRE-CONSTRUCTION PHASE**

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
Livelihood and access restriction due to relocation of affected kiosks and street vendors	- Disseminate LARAP including the entitlement for PAPs - Implement the LARAP including its Livelihood Restoration Program in a transparent and timely manner. - Conduct periodic stakeholder engagement with PAPs and other relevant parties, following the project's Stakeholder Engagement Plan (SEP). - Establish an accessible/functional Grievance Redress Mechanism (GRM) to address complaints from PAP and other interest shareholders and facilitate its resolutions. (The GRM is described in detail in the LARAP.)	- Monitor transparency in the provision of compensation for project-affected communities, including ensuring that compensation is provided in a fair and transparent manner in accordance with identified rights. - Monitor increases or decreases in employment due to the project, including new sectors that emerge such as trade or services supporting the project. - Monitor the livelihood of existing tenants, street vendors and parking attendants and the extent of losses resulted from the project. - Monitor the impact of the project on access restriction after land acquisition. - Periodically reports on the results of monitoring economic and livelihood impacts of PAPs.	- Mitigation measures are implemented prior to/during LARAP implementation. - Monitoring is conducted/reported monthly or more frequently depending on the needs.	The locations where the project-affected person (PAP) live and working.	The sub-national governments (i.e., Bandung Municipality) including related agencies.
Marginalization of vulnerable groups and gender-based violence	- As recommended in LARAP, provide specific measures to support the identified vulnerable individuals and ensure that their living standards are maintained or improved. - Prioritize the vulnerable groups in the livelihood restoration programs and relocation opportunities. - Establish an accessible and functional, project-level GRM to address concerns, expectations, and inputs. The GRM should be tailored to ensure its accessibility by the vulnerable individuals. - Socialize and ensure the acknowledgement of workers with the GBV prevention code of conducts and its violation sanctions. - Establish and implement a dedicated GRM for GBV cases that ensure the confidential handling of information related to GBV incidents that may occur during the project implementation	- Periodically monitor and evaluate the effectiveness of the implementation of LARAP, SEP and GRM and the level of community satisfaction with the solutions provided. - Monitor the number of vulnerable individuals participating in the project, compare it with the data identified in the LARAP. - Monitor the distribution of Project Information Brochures (PIBs) in local and national languages and evaluate community understanding of the information provided through surveys and interviews. - Evaluate the effectiveness of the implementation of empowerment programs for vulnerable groups, including job skills training and business opportunities for communities around the project. - Monitor transparency in the provision of compensation for project-affected communities, including ensuring that compensation is provided in a fair and transparent manner in accordance with identified rights. - Track the number of women who receive clear and transparent information on land acquisition and compensation processes. - Evaluate the effectiveness of the grievance mechanism (GRM) in handling complaints related to discrimination of vulnerable individuals, including tracking the number of complaints received and resolved. - Monitor the GBV cases reported through the dedicated GBV-GRM channel, ensure that each case is treated in a	- Mitigation measures are implemented during pre-construction phase. - Monitoring actions are conducted quarterly or semi-annual basis as appropriate.	The location where the project-affected persons (PAPs) live and working.	- PIUs assisted by the Design and Supervision Consultant - The sub-national governments including related agencies of BBMA.

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
		confidential manner, with the consent of the victim/survivor, and in coordination with experienced external service providers for the required handling.			

B. CONSTRUCTION PHASE

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
Increased airborne particulates (dust) and fugitive gaseous emissions into the local watershed	- Conduct air pollutant dispersion modelling before the commencement of the construction phase. This modelling is required to assess the significance of impact from fugitive gaseous emissions generated by the project's construction activities. - Perform land clearing, demolition, and earthwork activities within designated construction zones as needed. - Install temporary fence (e.g. usually made of zinc-alum sheet) of approximately 3-m high at construction sites. - Ensure that vehicles and trucks transporting soil or other construction materials are not overloaded, and cover all loads properly with tarpaulin. - Use only designated roads suitable for the vehicle's tonnage, and maintain speeds within the allowed limits. - Schedule material mobilization activities during night-time hours (22:00–05:00 WIB) instead of daytime, where practicable - Conduct regular water spraying once per day at minimum or more frequently particularly during dry seasons. - Prohibit any open burning of construction or solid waste at construction sites and supporting facilities. - During demolition activities, if asbestos-containing materials (ACM) are identified, immediately notify and coordinate with the PIU, and ensure that all ACM are handled, contained, transported, and disposed of in full compliance with applicable health, safety, and environmental regulations. - Engage only licensed asbestos-removal contractors and certified disposal facilities to prevent worker exposure and environmental contamination.	- Verify the validity of all operating and driving licenses as well as maintenance records for trucks and heavy equipment. Ensure that any vehicle or equipment without complete documentation is not allowed to operate on-site. - Conduct regular inspection on the implementation of water spraying on roads and construction sites. Ensure no visible dust leaves the site boundary through direct observation. - Conduct regular air quality monitoring (e.g., quarterly) at construction sites and in areas with sensitive receptors such as residential zones and public facilities. Analyze the results against the Indonesian Government and WHO guideline values. - Use the accredited laboratory to collect and analyze air quality samples.	- Mitigation measures are conducted on a weekly or monthly basis as appropriate. - Air quality monitoring is conducted as follows: - Once prior to commencement of construction activities. - Quarterly during construction activities. - Once within three months after completion of construction activities.	- Conduct air quality monitoring at baseline sampling locations, while ensure that selected sites are representative of sensitive receptor areas (e.g., community settlements, environmentally sensitive sites). - Other mitigation and monitoring measures are conducted at: - active construction sites, - access roads used for construction activities. - the operation of auxiliary facilities	- The contractors, including their sub-contractors and primary suppliers. - PIU (under DG Road Transportation) assisted by the Design and Supervision Consultants is responsible for supervising the civil work including CESMP implementation.
Elevated noise and vibration levels at construction sites and sensitive areas/ receptors above the baseline level.	- Conduct noise dispersion modelling before the commencement of the construction phase. This modelling is required to assess the significance of noise impact due to project construction activities. - Carry out construction activities near community settlements and sensitive receptors (e.g., schools, healthcare facilities, places of worship) only during daylight hours (e.g., 06:00–18:00), and - Apply strict noise and vibration-control practices when using loud machinery. - Locate the basecamp and worker accommodation at a sufficient distance from local communities, public	- Conduct site inspection to ensure noise mitigation measures are properly implemented (e.g., through field observation, daily logs, maintenance records, PPE audit, etc.). - Conduct regular (at least quarterly) noise and vibration monitoring at construction sites, supporting facilities, and nearby sensitive receptors - Compare noise and vibration monitoring results with Government of Indonesia (GoI) standards (the Minister of Environment Decree No. 48 of 1996 on Noise Level Standards and Decree No. 49 of 1996 on Vibration level	- Mitigation measures are conducted on a weekly or monthly basis as appropriate. - Noise monitoring is conducted as follows: - Once prior to commencement of construction activities. - Quarterly or semi-annually during	Conduct noise and vibration monitoring at baseline sampling locations, while ensure that selected sites are representative of sensitive receptor areas (e.g., community settlements, environmentally sensitive sites).	- The contractors, including their sub-contractors and primary suppliers. - PIU (under DG Road Transportation) assisted by the Design and Supervision Consultants is responsible for supervising the civil

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
	facilities, and other sensitive areas to minimize potential noise and disturbance. • Install a temporary fence around construction sites, particularly those adjacent to residential areas or other sensitive locations. • Undertake periodic maintenance of equipment and machinery during construction phase. • Provide project workers working near noisy equipment and machinery with silencers or mufflers.	Standards) to verify the effectiveness of control measures and inspections • Use the accredited laboratory to collect and analyze noise and vibration samples	construction activities. - Once within three months after completion of construction activities.	• Other mitigation and monitoring measures are conducted at: - active construction sites, - access roads used for construction activities. - the operation of auxiliary facilities.	work including CESMP implementation.
Release of GHG emissions due to project's construction activities	• Implement the prescribed air-quality mitigation measures to reduce GHG emissions from equipment, machinery, and vehicle operations. • Conduct regular GHG inventories during the construction phase, focusing on fuel use and electricity consumption • Strictly prohibit open burning of construction waste and solid waste at all construction sites and supporting facilities. • Maintain and service all machinery and equipment according to the manufacturer's schedule and specifications throughout construction. • Use energy-efficient appliances and vehicles, and plan the most efficient routes for project vehicles to avoid unnecessary fuel and electricity use.	• The contractor shall conduct regular monitoring and recording of fuel and electricity consumption at the construction sites and its supporting facilities on a regular/monthly basis. • This monitoring can be used as activity data for calculating construction-related GHG emissions. The findings should be compared against applicable standards and documented to verify the effectiveness of implemented control measures and inspections.	• Mitigation measures are conducted on a weekly or monthly basis as appropriate. • GHG monitoring is conducted on a monthly basis based on fuel and electricity consumption.	• Active construction sites. • The operation of auxiliary facilities.	• The contractors, including their sub-contractors and primary suppliers. • PIU (under DG Road Transportation) assisted by the Design and Supervision Consultants is responsible for supervising the civil work including CESMP implementation.
Water pool/flooding and siltation on existing road drainages due to uncontrolled stormwater runoff discharges	• Develop and implement a site and stormwater control system, including practical measures to prevent stormwater runoff from entering nearby drainage channels. This includes installing a temporary settling pond during terminal and depot construction to collect runoff, allow sediment to settle, and ensure the pond is cleaned regularly. • Coordinate with local communities and relevant government agencies before construction to secure approval for directed stormwater discharge. • Ensure that appropriate culverts and drainage structures are included in the BRT Project's DED, based on the need to upgrade existing drainage channels along Jl. Rajawali Timur, Jl. Kebonjati, Jl. Naripan, Jl. Simpang Lima–Jl. Asia Afrika, Jl. Simpang Lima–Jl. Ahmad Yani, Jl. Sudirman, Jl. Kiaracandon/Jl. Ibrahim Adjie, Jl. Otista, Jl. Pungkur, and Jl. Moh. Toha	• Conduct quarterly (at minimum) surface water quality monitoring at the nearest water bodies adjacent to the construction sites. Compare the results with the Indonesian Water Quality Standards (Government Regulation No. 22/2021, Appendix VI – Class II). • Use the accredited laboratory to collect and analyze water quality samples. • Conduct regular site inspection and document any findings to verify the effectiveness of control measures. • Monitor construction sites, equipment and machinery by using simple checklists and forms completed with photos	• Mitigation measures are conducted on a weekly or monthly basis as appropriate. • Water monitoring: - Monitoring is conducted once prior to construction. - Quarterly or semi-annually during construction activities. - Once within three months after completion of construction activities	• Active construction sites. • Water monitoring is conducted if drainage or runoff from construction sites enter nearby water courses. Monitoring locations should be placed at upstream and downstream locations from the discharge points.	• The contractors including their sub-contractors and primary suppliers. • PIU (under DG Road Transportation) assisted by the Design and Supervision Consultants is responsible for supervising the civil work including CESMP implementation.
Potential for soil and ground water	• Conduct soil and groundwater investigations before construction begins, particularly at the Cicaheum and Leuwipanjang Terminal sites, to identify any contamination from previous and on-going activities.	• Conduct soil and groundwater sampling and analysis at the Cicaheum and Leuwipanjang terminals and depots to determine whether contamination from past or ongoing activities is present. The method to conduct	• Mitigation measures are conducted on a weekly or monthly basis as appropriate.	• Active construction sites. • Workers' basecamp	• The contractors, including their sub-contractors and primary suppliers.

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
contamination at future BRT depots	- Conduct Asbestos Containing Materials (ACM) investigation prior to demolishing existing structures at Cicaheum and Leuwipanjang terminal sites. If ACM is identified, immediately notify and coordinate with the PIU, and engage with licensed contractors and certified disposal facilities to ensure safe handling, removal, and disposal. - Develop and implement an Emergency Preparedness and Response Plan (EPRP) that includes procedures for preventing and managing oil or chemical spills, ensures the availability of spill-response equipment, and covers other risks such as fire and natural hazards. - Manage sewage and wastewater from worker accommodation using a modular biofilter (wastewater treatment) system with a filtered seepage system. - Carry out land clearing in stages, limiting it to areas needed for immediate construction activities. - Rehabilitate and landscape disturbed or exposed areas promptly once they are no longer required for construction, rather than waiting for the entire corridor or facilities to be completed. - Store oil, fuel, and hazardous substances in separate, bunded, and secure storage areas equipped with waterproof flooring, overhead cover, restricted access, and a drainage system connected to an oil–water separator. - Manage hazardous and non-hazardous waste separately, including handling, storage, and disposal, in compliance with Government Regulation No. 22/2021 and/or good international industry practices. - Repair any leaks from construction vehicles and equipment immediately. - Provide dedicated storage shelters for hazardous substances and hazardous waste, and establish SOPs for handling and disposal.	these sampling and contamination should adopt good international industry practices and be undertaken by a competent third party that has proven track records in this service. - Conduct regular inspection to ensure the implementation of EPRP is properly maintained. This includes leak detection and equipment monitoring, spill kits, stormwater and drainage monitoring, and incident reports/logbook. - Monitor hazardous material and hazardous waste handling and storage using simple checklists and photo-supported forms. Ensure hazardous waste manifests, temporary storage duration limits, and transfer records to licensed collectors are properly maintained and documented.	Soil and groundwater sampling and contamination assessment at Cicaheum and Leuwipanjang terminals and depots is conducted once prior to the commencement of construction activities; and subsequent sampling as required.	Cicaheum and Leuwipanjang terminals and depots	PIU (under DG Road Transportation) assisted by the Design and Supervision Consultants is responsible for supervising the civil work including CESMP implementation.
Road traffic disruption and pressure on road infrastructure along BRT on-corridor as well as off-corridor	- Implement the Traffic Management Plan and traffic engineering measures during construction in accordance with the approved ANDALALIN or other required project plans. - Close work areas located in the middle or left side of the road as required for construction. - Install warning signs or notifications to advise road users to avoid sections where BBMA BRT bus stop construction is taking place.	- Monitor and report on the implementation of the TMP on a regular basis (e.g., quarterly) to ensure compliance and effectiveness of traffic management measures. - Conduct traffic counts to monitor traffic volumes and assess potential impacts of construction activities. Traffic counting locations should, at a minimum, correspond to baseline sampling points to enable meaningful comparison and trend analysis. Based on baseline conditions, traffic counting was carried out at 48 points at 14 roads along BRT on-corridor. This	- Mitigation measures are conducted on a weekly or monthly basis as appropriate. - Traffic monitoring or counting is conducted on a quarterly basis as appropriate.	- Active construction sites. - BBMA areas and roads used for the project. - Cicaheum and Leuwipanjang Terminals and depots	- The contractors, including their sub-contractors and primary suppliers. - PIU (under DG Road Transportation) assisted by the Design and Supervision Consultants is responsible for

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
	• Refresh or clarify existing road markings to improve traffic order and safety. • Provide signs indicating alternative routes for areas where construction activities will occupy road space. • Provide safe pedestrian access and temporary facilities for walking around construction sites. • Control street vendors operating on sidewalks to ensure pedestrian paths remain clear. • Adjust and reset traffic signals at intersections to improve intersection performance. • Allow heavy vehicles to operate only during agreed low traffic periods, such as late evenings or early mornings, as approved by relevant agencies. • Impose strict sanctions on vehicles that violate traffic signs and road markings.	monitoring framework may be expanded, as appropriate, to also cover off-corridor areas. • Perform regular inspection on road condition along on- and off-corridors, pedestrian access, and the effectiveness of signage placement, as well as complaints related to traffic congestion, access disruption, or road damage through the Project's GRM.			supervising the civil work including CESMP implementation.
Affected trees and pedestrian landscape during construction	• Establish and implement a Landscape Management Plan to guide the establishment, and maintenance of green spaces, while ensuring ecological sustainability, visual quality, and enhanced air quality • Coordinate with the relevant Bandung Municipality agency responsible for trees and landscaping to obtain approval before cutting or replanting any trees. • Compensate every tree removed due to construction at a ratio of 1:5—one tree felled replaced with five new trees—subject to final agreement with Bandung Municipality regarding the ratio and species to be planted. • Prepare a tree inventory map showing all trees to be cut or replanted, including locations and photos, with special attention to mature trees. • Install clear demarcation or barriers around trees that must not be disturbed during construction\. • Preserve Angsana (<i>Pterocarpus indicus</i>) and Cinnamon (<i>Cinnamomum spp.</i>) trees in situ whenever possible, and relocate or replace them only with proper care and close supervision if removal is unavoidable. • Maintain and monitor vegetation, including newly planted trees and relocated trees, in accordance with the civil works contract requirements	• Verify the number of trees removed and new trees planted. • Monitor the implementation of tree cutting and replanting plan and report the results (such as watering, soil condition, and tree health) on a regular basis..	Mitigation measures are conducted on a weekly or monthly basis as appropriate.	• Active construction sites. • BBMA areas and roads used by the project. • Cicaheum and Leuwipanjang Terminals and depots	• The contractors, including their sub-contractors and primary suppliers. • PIU (under DG Road Transportation) assisted by the Design and Supervision Consultants is responsible for supervising the civil work including CESMP implementation.
Potential local economy development surrounding BRT BBMA areas.	• Communicate employment and business opportunities, including requirements and qualifications, to local communities and vendors in a transparent, timely, and easy-to-understand manner.	• Monitor changes in employment attributed to the project, including both increases and decreases, as well as any new sectors that emerge (e.g., trade or services supporting project activities).	• Mitigation measures are implemented during pre-construction phase.	• The location where the project-affected persons (PAPs), particularly small business owners,	• PIU (under DG Road Transportation) assisted by the Design

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
	- Coordinate with local government offices on workforce needs and ensure equal opportunity and non-discrimination for poor households, disadvantaged groups, and women. - Prioritize hiring local workers and engaging local entrepreneurs and small- and medium-sized enterprises (SMEs) to supply goods and services, as long as they meet the specified criteria. - Implement the SEP and GRM effectively, ensuring timely disclosure of project information and responsive handling of community inquiries and complaints	- Monitor the transparency and fairness of the livelihood restoration process for affected business owners, street vendors, and street parking operators, ensuring that implementation aligns with their identified rights. - Periodically assess the effectiveness of LARAP and GRM implementation, including community satisfaction with the solutions provided. - Monitor the number of affected small business owners, street vendors, and street parking lots participating in the project, compare it with the data identified in LARAP. - Monitor the distribution of Project Information Brochures (PIBs) in local and national languages and evaluate their understanding of the information provided through surveys and interviews.	Monitoring actions are conducted quarterly or semi-annual basis as appropriate.	street vendors and street parking lots, are working.	and Supervision Consultant The sub-national governments (Bandung municipality) including related agencies of BBMA.
Access restriction and increased traffic congestion primarily within the BRT on-corridor	- Develop a site-specific Traffic Management Plan (TMP) and obtain approval from the Implementing Agency. The TMP should outline measures to manage and monitor traffic impacts during mobilization, demobilization, and construction, in line with the Traffic Impact Assessment (ANDALALIN). - Conduct socialization to potentially affected parties (angkot, adjacent road users, and business owners) prior to any construction activities that may result in livelihood impairments, access restrictions, and traffic disruptions - Analyze concerns from affected parties, such as business owners, street vendors, and angkot operators, through perception surveys and media monitoring to identify access issues and traffic congestion caused by construction activities. - Provide temporary public access routes to areas affected by partial road closures or construction barriers to maintain mobility for communities and businesses. - Implement a functional Grievance Redress Mechanism (GRM) with clear procedures, timelines, and assigned responsibilities to ensure timely and effective resolution of traffic- and access-related complaints.	- Conduct surveys with business owners, street vendors, angkot operators, and nearby residents regarding their perception of project-related congestion and access disruption. - Inspect regularly about the effectiveness of traffic control measures (signage, flaggers, barriers, lighting, and temporary access provisions) - Check and verify the effectiveness of GRM functionality (GRM channel, records, and reporting).	- Mitigation measures are implemented during the construction phase. - Monitoring actions are conducted on a monthly or quarterly basis and the results are reported monthly, quarterly and semi-annually as appropriate.	- Active construction sites - PAP affected areas within the BRT corridors and service routes - Cicaheum and Leuwipanjang terminals and depots	- The contractors, including their sub-contractors and primary suppliers. - PIUs (under DG Road Transportation) assisted by the Design and Supervision Consultants is responsible for supervising the civil work including CESMP implementation.
Marginalization of vulnerable groups of people, including gender-based violence risk	Prepare a Contractor Environmental and Social Management Plan (CESMP) that includes a Code of Conduct (CoC) with clear rules and sanctions for preventing and addressing gender-based violence,	- In the presence of vulnerable workers, monitor the implementation of mitigation measures as described in the C-ESMP - Monitor and data collection in pertaining to grievance/feedback received through worker GRM, particularly for issue of vulnerable workers and	- Mitigation measures are implemented during the construction phase. - Monitoring actions are conducted on a	- Active construction sites - PAP affected areas within the BRT	The contractors, including their subcontractors, are responsible for implementing the CESMP.

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
	including SEA/SH, involving workers and nearby communities. - Conduct mandatory induction and refresher training to project workers regarding CoC and GBV/SEA/SH prevention, including clear communication of sanctions and contract termination for violations. - Provide accessible and inclusive facilities for vulnerable workers (e.g., universal access in accommodation, sanitation, and work areas, separated women facilities with sufficient lighting, etc.) in coordination with the contractor. - Establish a survivor-centered GBV/SEA/SH grievance system ensuring confidential and safe reporting and referral to licensed service providers. This specified GRM should separate from the project-wide GRM and include clear timelines, confidential reporting channels, and defined responsibilities. - Establish coordination with external service providers experienced in GBV incident mitigation as referral for GBV case handling - Ensure worker living conditions meet national minimum standards, including access to sanitation, clean water, and social protection services - Promote increased representation of women in decision-making and supervisory roles within the project. - Conduct appropriate background checks on all project workers, especially those in supervisory or community-facing positions. - Foster a supportive, non-retaliatory work environment to encourage safe reporting of grievances and misconduct.	GBV/SEAH, ensure that the grievance/feedback is being timely and sufficiently addressed and documented. - Monitor the GBV cases reported through the dedicated GBV-GRM channel, ensure that each case is treated in a confidential manner, with the consent of the victim/survivor, and in coordination with experienced external service providers for the required handling. - Interview to some workers especially female worker regarding their working condition - Presented and reporting periodically labor monitoring activity. - Observation at nearby locations regarding the possibility of GBV/SEAH cases which may involve the project workers	monthly or quarterly basis and the results are reported monthly, quarterly and semi-annually as appropriate.	corridors and service routes - Workers' basecamp - Cicaheum and Leuwipanjang terminals and depots	PIUs (under DG Road Transportation) assisted by the Design and Supervision Consultants is responsible for supervising the civil work including CESMP implementation.
Disturbance on cultural heritage objects including unaesthetic impacts	- Conduct a Heritage Impact Assessment (HIA) before construction begins to assess the condition of historic buildings, evaluate potential project impacts, and recommend avoidance or mitigation strategies. - Implement all HIA-recommended mitigation measures when carrying out construction activities near heritage structures. - Carry out regular visual inspections and photographic documentation before, during, and after construction to detect early signs of structural stress, cracking, or surface damage. - Clearly demarcate and secure construction areas to prevent accidental disturbance to known or unknown cultural heritage features	- Monitor implementation of the mitigation measures and recommendation in the HIA through regular inspections and monitoring report. - Daily checks by project supervisors to ensure that the construction activities are suspended (for the interim) if unexpected cultural objects are identified. - Conduct site inspections to verify the installation of fences and warning signs in the unexpected object discovery. - Check for complete documentation of the chance find procedures competed by photos and notes.	- Mitigation measures are implemented during the construction phase. - Monitoring actions are conducted on a monthly or quarterly basis and the results are reported monthly, quarterly and semi-annually as appropriate.	- Within the BRT on-corridors where the cultural heritage buildings are located - Other BRT corridors where cultural heritage may be identified.	- The contractors, including their subcontractors, are responsible for implementing the CESMP. - PIUs (under DG Road Transportation) assisted by the Design and Supervision Consultants is responsible for supervising the civil

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
	- Develop and disseminate a Chance Find Procedure to all workers and contractors to ensure proper handling of any cultural resources discovered during excavation. - Immediately report any cultural heritage findings to the project supervisor and implementing agencies, and halt construction activities in the affected area until clearance is granted. - Use low-vibration construction methods and restrict heavy equipment movement near sensitive heritage buildings to minimize vibration, dust, and physical stress.				work including CESMP implementation.
Poor labor and working conditions including unmitigated exposure to health and safety risks	- Establish an Occupational Health and Safety (OHS) management system and appoint a qualified Construction OHS Expert - Adopt and implement Labor Management Procedure (LMP) developed by MASTRAN into the C-ESMP - Promote local employment opportunities, including construction workers and BRT operations staff (e.g., drivers, maintenance, and management employees), applying fair hiring principles and strict age verification to ensure compliance with labor standards. - Develop and implement contractors' Occupational Health and Safety (OHS) Management Plans in compliance with the Labor Management Procedures (LMP) and align with the World Bank Group (WBG) General EHS and Infrastructure Sector Guidelines. This management plan should include: - Training for all workers on relevant aspects such as emergency preparedness, working at height, and safe handling of hazardous materials - Risk Hazard Assessments (RHA) and development of hazard maps within the BRT corridor. - Ensure safe working and living conditions for workers, including: - Safe and secure access to construction sites with proper signage and barriers - Adequate basecamp facilities with free access to clean water, proper ventilation, and comfortable resting areas - Provide workers with written contract with clear terms of employment, ensuring reasonable working hours, adequate rest days and insurance coverage - A functional and accessible Grievance Redress Mechanism (GRM) for workers should be provided and monitored.	- Supervise the workers and assess their compliance with the LMP, including conducting disciplinary checks and supervision through internal audits. - Monitor the recruitment process transparently and ensure that the number of workers required, criteria set, and selection methods are followed, including monitoring the implementation of fair selection. - Monitor the implementation of working conditions and obligation clauses in tender documents, including minimum age requirements. Verify through employment contracts as well. - Monitor safety and security procedures (K3, LOTO, JSA, use of PPE), worker age verification and possibility of forced labor. - Monitor delivery of OHS and emergency preparedness training, keeping records of frequency, attendance, and effectiveness - Inspect construction sites and basecamps regularly to ensure safe access, clean water, sanitation, proper ventilation, housekeeping, and designated smoking areas. - Verify workers' insurance coverage through policy records and random worker checks; monitor accident reports and claims. - Monitor functionality and accessibility of the GRM through review of complaint records, resolution timelines, visibility of information, and worker awareness. - Monitor and document any occupational incidents and near-miss occurrences among workforce	- Mitigation measures are implemented during the construction phase. - Monitoring actions are conducted on a monthly or quarterly basis and the results are reported monthly, quarterly and semi-annually as appropriate.	- Active construction sites - Workers' basecamp - Cicaheum and Leuwipanjang terminals and depots	- The contractors, including their subcontractors, are responsible for implementing the CESMP. - PIUs (under DG Road Transportation) assisted by the Design and Supervision Consultants is responsible for supervising the civil work including CESMP implementation.

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
Disturbance to community health and safety	• Provide CESMP prior to construction activity which includes community health and safety mitigation strategies. • Socialize GBV prevention Code of Conduct (CoC) to all project workers, ensure all workers understand and acknowledge • Provide and prioritize job opportunities for local laborers to minimize impacts from labor influx • Provide adequate sanitation facilities and maintain a healthy working environment, including conducting mosquito eradication activities to prevent vector-borne diseases. • Provide community awareness programs on construction hazards and temporary access restrictions. • Install safety barriers, signage, and fencing to protect public areas. • Implement Traffic Management Plan (TMP) for construction zones. • Apply mitigation measures to control air emissions, noise, and surface water pollution as outlined above • Coordinate with local authorities to manage temporary utility disruptions. • Establish an accessible and functional Grievance Redress Mechanism (GRM) to address concerns, expectations, and inputs from affected communities	• Conduct regular inspection and monitor the quality of sanitation infrastructure, vector control measures, and overall hygiene management • Monitor functionality and accessibility of the community GRM through review of complaint records, resolution timelines, visibility of information, and community awareness. • Evaluate the effectiveness and adequacy of traffic management strategies and pedestrian safety provisions within and adjacent to construction zones. • Monitor air emissions, noise, and surface water pollution as outlined above	• Mitigation measures are implemented during the construction phase. • Monitoring actions are conducted on a monthly or quarterly basis and the results are reported monthly, quarterly and semi-annually as appropriate.	• Surrounding community areas affected by construction zones • Roads and pedestrian areas near construction zones • Workers' basecamp	• The contractors, including their subcontractors, are responsible for implementing the CESMP. • PIUs (under DG Road Transportation) assisted by the Design and Supervision Consultants is responsible for supervising the civil work including CESMP implementation.

C. OPERATION PHASE

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
Air quality impacts from the operation of internal combustion engine (ICE) buses	• Ensure all internal combustion engine (ICE) buses comply with stringent emissions standards, preferably Euro IV or higher. • Maintain all vehicles, especially engines, fuel systems, and exhaust systems, in good mechanical condition through scheduled servicing and preventive maintenance. • Implement and enforce anti-idling policies at terminals, depots, and major stations to reduce localized pollutant buildup. • Prioritize the deployment of electric buses in densely populated areas, near schools or hospitals, and along narrow road segments where pollutants can accumulate more easily. • Install adequate ventilation and emissions control systems in bus depots to ensure proper air circulation and minimize indoor air pollution. • Integrate the BRT with feeder services and progressively reorganize informal paratransit (angkot) to reduce overall vehicle volume and maximize emission-reduction benefits on the corridor. • Conduct regular ambient air quality monitoring at critical locations, especially around terminals and segments with vulnerable populations.	• Conduct a periodic air quality monitoring using the methodology stipulated in the Government Regulation No. 22 Year 2021 – Appendix VII: Ambient Air Quality Standard; and • Use the accredited laboratory to collect and analyze the air samples. • Conduct regular inspections and verify the validity of all driving licenses as well as maintenance records for buses • Conduct annual review on the operational BRT system, including related to the implementation of bus idling and scheduling efficiency.	• Mitigation measures are conducted on a monthly or quarterly basis as appropriate. • Air quality monitoring is conducted on a quarterly basis, and reported on a semi-annual basis as appropriate	• Conduct air quality at baseline sampling locations, while ensure that selected sites are representative of sensitive receptor areas (e.g., community settlements, environmentally sensitive sites). • Other mitigation and monitoring measures are conducted at: - Terminals and depots, - BRT on- and off-corridors, including bus stops and bus shelters.	PIU (under DG Road Transportation) and BBMA BRT operations team
Overall reduction in noise impacts	• Design stations to minimize sound reflection, avoiding hard surfaces that amplify noise • Enhance landscaping buffers using vegetation or trees around terminals and depots • Maintain buses' conditions regularly, including lubrication, brake inspections, tire pressure checks, and exhaust systems • Install low-noise tires on all BRT buses to reduce rolling noise • Enforce speed limits in sensitive areas (e.g., 30 km/h near schools, hospitals, and residential zones). • Optimize bus scheduling to prevent long idling and overlapping arrivals • Train drivers in eco-driving and noise-reduction practices. • Monitor noise levels regularly to identify hotspots and trigger timely mitigation actions.	• Conduct a periodic noise monitoring using the methodology stipulated in the Minister of Environment Decree No. 48 of 1996 concerning noise level standards • Use the accredited laboratory to collect and analyze the noise levels. • Conduct regular inspections and verify the validity of all driving licenses as well as maintenance records for buses • Conduct annual review on the operational BRT system, including related to the implementation of bus idling and scheduling efficiency, driving adherence to noise-reducing practices, landscaping buffer conditions, etc.	• Mitigation measures are conducted on a monthly or quarterly basis as appropriate. • Noise monitoring is conducted on a quarterly basis, and reported on a semi-annual basis as appropriate	• Conduct noise monitoring at baseline sampling locations, while ensure that selected sites are representative of sensitive receptor areas (e.g., community settlements, environmentally sensitive sites). • Other mitigation and monitoring measures are conducted at: - Terminals and depots, - BRT on- and off-corridors,	PIU (under DG Road Transportation) and BBMA BRT operations team

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
				including bus stops and bus shelters.	
Direct GHG emissions from the operation of BRT buses, depots, charging stations, etc	• Maintain and optimize all air conditioning systems in buses, terminals, depots, and offices using regular servicing and low-GWP refrigerants. • Maximize energy efficiency in depots, terminals, and offices through LED lighting, smart controls, proper insulation, and operating air-conditioners at optimal temperatures. • If possible, prioritize clean electricity sources via rooftop solar PV or other renewable energy options for depots and terminals. • Ensure proper wastewater management at depots and terminals to prevent methane and nitrous oxide emissions. • Implement a GHG inventory and monitoring plan to track energy consumption, refrigerant leaks, and wastewater management practices.	• Monitor and record consumption of fuel, refrigerants, and electricity, categorized by type (e.g., diesel, pertamax, R134a, R410A, etc.), on a monthly basis • Conduct regular inspections of lighting, smart controls, and insulation performance to ensure optimal energy efficiency, with findings documented and corrective actions implemented promptly	• GHG monitoring is conducted on a monthly basis based on fuel, refrigerant/air cooling, and electricity consumption. • Other mitigation measures are conducted on a monthly or quarterly basis as appropriate.	• BRT terminals and depots, including office operations • BRT bus stations	PIU (under DG Road Transportation) and BBMA BRT operations team
Flooding and inundation due to stormwater runoff, and surface water pollution due to domestic wastewater from terminals and depots area	• Ensure drainage systems at terminals and depots have sufficient capacity to manage stormwater during heavy rainfall and prevent flooding or operational disruptions • Install oil separators at bus depots and washing areas to capture hydrocarbons and lubricants from runoff during rainfall. • Use permeable paving or green buffers around BRT infrastructure to increase infiltration and reduce runoff. • Conduct bus washing and maintenance only in contained areas with wastewater treatment systems to prevent contaminants from entering drains. • Ensure bus depot wastewater is properly collected in storage tanks and treated via dedicated bus-washing WWTPs and collector basins before discharge into the municipal sewer network • Clean platforms, parking areas, and tracks regularly to minimize pollutant accumulation and runoff during rainfall • Establish and implement waste management procedure by ensuring that hazardous and non-hazardous waste generation are managed properly. Non-hazardous solid waste should be placed in properly covered and segregated containers, while hazardous waste is stored	• Perform routine inspections, maintenance, and performance checks of drainage systems as well as WWTPs at Leuwipanjang and Cicaheum depots to ensure consistent treatment efficiency and compliance with regulatory standards. • Conduct a periodic monitoring of treated effluent quality prior to discharge to nearby water courses. Use the accredited laboratory to collect and analyze the effluent samples. • Conduct regular inspections to ensure cleanliness and proper housekeeping, including reviewing the waste management logbooks to verify proper waste segregation, storage, and disposal practices.	• Mitigation measures are conducted on a monthly or quarterly basis as appropriate. • Wastewater effluent monitoring is conducted on a quarterly basis, and reported on a semi-annual basis as appropriate	• Conduct wastewater effluent monitoring at designated discharge points where BRT WWTP is located • Other mitigation and monitoring measures are conducted terminals and depots	PIU (under DG Road Transportation) and BBMA BRT operations team

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
	in designated, covered, and impermeable containment areas.				
Groundwater abstraction to meet water supply demand for the operation of BRT systems	• Install low-flow fixtures, efficient washing systems, and conduct routing leak detection to ensure optimal water efficiency • Implement rainwater harvesting where feasible for non-potable uses (e.g., vehicle washing, surface cleaning) to reduce groundwater reliance. • Restrict groundwater extraction to licensed volumes and ensure regular monitoring and reporting. • Establish groundwater monitoring wells at or near depots to track levels and enable early operational adjustments.	• Monitor water consumption and compare it with historical usage to identify abnormal patterns and potential water saving/efficiency measures • Monitor groundwater abstraction volumes against licensed limits through regular meter readings and reporting • Conduct regular water quality sampling of extracted groundwater to assess compliance with regulatory standards and ensure suitability for operational use	• Mitigation measures are conducted on a monthly or quarterly basis as appropriate. • Groundwater quality monitoring is conducted on a quarterly basis, and reported on a semi-annual basis as appropriate	• Groundwater quality monitoring at all BRT groundwater well locations • Other mitigation and monitoring measures are conducted terminals and depots	PIU (under DG Road Transportation) and BBMA BRT operations team
Remaining localized traffic congestion at certain road sections during peak hours due to the operation of BRT	• Implement ANDALALIN recommendations to optimize traffic circulation and ensure efficient BRT operations. • Enforce strict parking and stopping prohibitions within stations and BRT corridors to maintain unobstructed bus lanes and traffic flow. • Regulate and manage street vendors occupying sidewalks to minimize obstruction and preserve pedestrian accessibility • Monitor and control roadside obstructions, including illegal parking and unauthorized vendors, especially at intersections, to maintain optimal traffic flow • Coordinate with traffic police and local authorities to enforce traffic rules and respond to congestion hotspots. • Conduct awareness campaigns targeting passengers, pedestrians, and drivers to promote responsible behavior near BRT corridors. • Apply strict penalties and corrective measures for violations of traffic regulations. • Implement Transportation Demand Management (TDM) initiatives to encourage public adoption of communal transport, including electric BRT buses.	• Record and analyze all traffic violations and apply sanctions to non-compliant vehicles. • Conduct regular inspection on sidewalks and intersections to ensure removal of obstacles and maintain clear access • Monitor public participation in Transportation Demand Management (TDM) initiatives and track increases in public transit ridership • Assess and verify the implementation and effectiveness of traffic management measures following recommendations in the ANDAL Lalin and Traffic Management Plan.	• Mitigation measures are conducted on a monthly basis as appropriate. • Monitoring is conducted on a quarterly basis, and reported on a semi-annual basis as appropriate	• Key road intersections • BRT corridors • Sidewalks along BRT corridor • Cicaheum and Leuwipanjang Terminals/depots	PIU (under DG Road Transportation) and BBMA BRT operations team
Labor and working condition issue which including occupational health and safety	• Provide good work conditions and environments to workers, including adequate sanitation, ventilation and/or air conditioning system, procedures and good housekeeping practices and dedicated smoking area/room • Establish work procedures incorporating a comprehensive Health, Safety, and Environmental (HSE)	• Maintain and review records of HSE system procedures and training implementation. • Track and report worker incidents/accidents and near-misses. • Conduct audits and inspections for compliance with PPE use and safe work practices. • Periodically verify and update hazard maps.	• Mitigation measures are conducted on a monthly or quarterly basis as appropriate. • Monitoring actions are conducted on a monthly or quarterly basis and the results	• Cicaheum and Leuwipanjang terminals and depots • BRT corridors	PIUs and related government agencies such as Transportation Agencies of BBMA

Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
	management system to ensure all workers are systematically protected from occupational hazards • Provide workers with appropriate terms and conditions of employment, equal opportunities, fair benefits, insurance coverage, etc., following the prevailing regulations • Provide vulnerable workers with adequate accommodating facilities that can address their specific needs, such as universal access, separated sanitation facilities, minimized high working hours for female workers, etc. • Conduct a thorough Risk Hazard Assessment (RHA) and develop a detailed hazard mapping framework along the entire BRT corridor, ensuring that structural designs incorporate earthquake resilience measures and do not impede or redirect natural flood flows, while facilitating effective stormwater drainage. • Provide and socialize hazard and emergency warning system, safety barriers, signage and emergency exits and scenarios. • Prepare and implement an Occupational Health and Safety (OHS) management training for all workers, including emergency response training • Implement fair and equitable hiring practice, overseen by the Project Manager, to prevent the engagement of unqualified personnel. • Establish an accessible and functional worker Grievance Redress Mechanism (GRM) separate from the community GRM to address concerns, expectations, and inputs from workers.	• Monitor completion, attendance, and effectiveness of worker training programs. • Regularly verify age documentation and hiring compliance. • Inspect structural designs and drainage systems for adherence to safety standards. Track worker complaints via GRM.	are reported monthly, quarterly and semi-annually as appropriate.		
Community health and safety issues (e.g., traffic accidents) during operational activity	• Enhance lighting and security features at bus stops and terminals, as well as coordinate with local police in provision of contact number for response or guard, especially if there is a heightened risk of security. • Implement good housekeeping and good sanitation practice at BRT facilities and service areas. • Establish and socialize functional and accessible GRM channels for all passengers and adjacent communities • Conduct a risk hazard assessment (RHA) and develop a detailed hazard map within the BRT corridor. Ensure that structural designs mitigate seismic risks, avoid obstruction or diversion of flood flows, and enhance drainage efficiency. • Prepare and implement an OHS management plan and training for all workers, including on emergency	• Record and report number of safety and security incidents at bus stops and terminals • Monitor the cleanliness of BRT facilities and service areas • Conduct regular inspection to check functionality and adequacy of lighting and security measures, sanitation, and emergency response facilities • Evaluate and update regularly RHA and hazard maps • Document training completion records and emergency drill • Track complaints via GRM	• Mitigation measures are conducted on a monthly and quarterly basis as appropriate. • Monitoring is conducted on a quarterly basis, and reported on a semi-annual basis as appropriate	• Cicaheum and Leuwipanjang terminals and depots • Ledeng and Antapani terminals • Roads along BRT corridors • Bus stations and bus stops	PIUs and related government agencies such as Transportation Agencies of BBMA

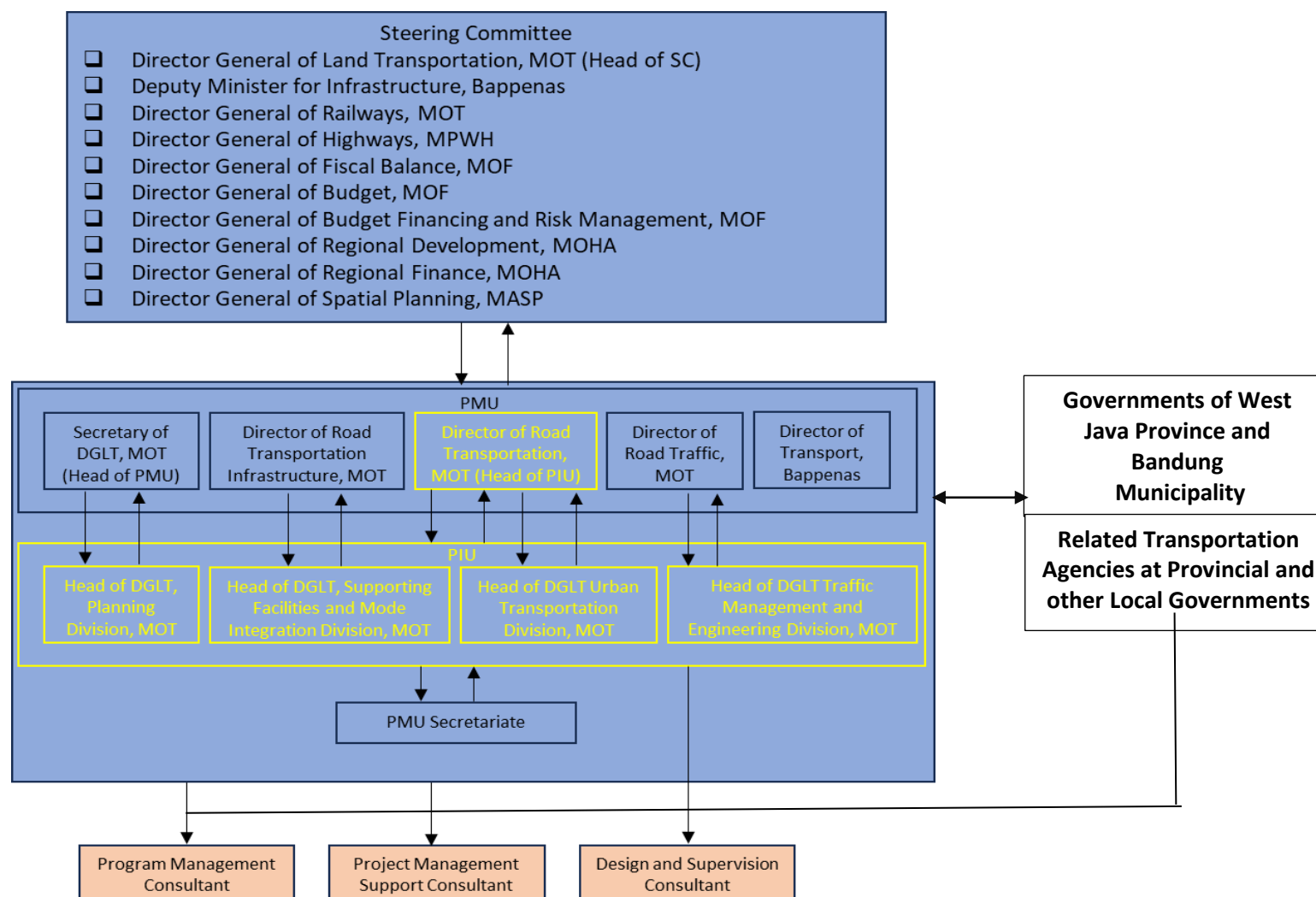
Anticipated Impacts	Mitigation Measures	Monitoring Action/Indicator	Schedule/Monitoring Frequency	Mitigation/Monitoring Area	Main Responsibility
	scenarios and evacuation procedures and provide contact numbers for emergency response. • Provide officers stationed at the entry/exit of the bus stop and terminal that will also conduct routine inspection and patrol to monitor safe and secure condition of buses and passengers traffic.				
Reduced or Loss of Incomes and livelihoods of Angkot Operators	Pending to the result of study for angkot drivers, the following are considered options for mitigation measures: • Gradual Angkot Reform Option - Inviting operators of all angkot routes which are impacted by the project to become BRT operators by establishing consortium or other business entities within five to seven years' time frame (gradually). A such, the angkot drivers can be employed by the consortium to be the feeder operator as part of the BRT system. • BRT Feeder Operator Option - Inviting all affected angkot operators to become BRT feeder operators (provide services from and to BRT stations) and provide employment opportunities for angkot drivers. The detailed mitigation measures will be presented in a separate project-level angkot integration plan/ public transport reform, which is part of the project's sub-component 1.C on 'Angkot Reorganization' of the overall MASTRAN project. This document shall include details on the establishment of the subnational- public service enterprise (Badan Layanan Usaha Daerah or BLUD) to govern and manage the BRT operations and action plans to mitigate negative impacts on the affected angkot drivers in Bandung Basin Metropolitan Area (BBMA).	Pending to the result of study for angkot drivers, the following mitigation strategies to be adapted with the selected option for livelihood restoration of angkot drivers: • Monitor the number of angkot operators affected by the project and/or switch job due to the presence of the BRT operations • Conduct regular audit to ensure compliance with TMP measures (signage, road diversion, pedestrian safety). • Document stakeholder consultation records and feedback from affected operators.	• Mitigation measures are conducted on a monthly and quarterly basis as appropriate. • Monitoring is conducted on a quarterly basis, and reported on a semi-annual basis as appropriate	• Affected angkot routes along BRT corridor area	PIUs and related government agencies such as Transportation Agencies of BBMA

9.2. Institutional Roles and Responsibilities

As shown in the following figure, the Ministry of Transportation (MOT) is the implementing agency for the project (at national level) and responsible for overall project implementation, including the ESMP of BBMA. The MOT will provide technical assistance to sub-national governments related to project preparation and implementation of the Indonesia Mass Transit. A Project Steering Committee (PSC) and a Project Management Unit (PMU) have been established under the Directorate General of Land Transportation (DGLT) of the MOT. The project steering committee, chaired by Director General of Land Transportation of MOT. The PMU led by the Secretary of DGLT is responsible for carrying out day-to-day management, implementation and coordination of the project and supported by the Director of Road Transportation of MOT as coordinator.

The PMU will be supported by a Program Management Consultant (ProgMC) to assist DGLT in implementing the institutional and capacity development meanwhile the Project Management Consultant (PMC) already onboard to assist the PMU in day-to-day management of the BRT project implementation. The DGLT is also responsible for the development of BRT infrastructure and system and supported by a project implementation Unit (PIU) has also been established under Directorate of Road Transportation of DGLT.

The PIU will be led by the Director of Road Transportation of MOT and responsible for managing contracts related to the development of the BRT. The PIU will be supported by Detailed Engineering Design and Supervision (DEDS) Consultant to design the BRT systems and supervise the implementation of civil and other physical works until completion. Sub-national governments, including West Java Province and related local/sub-national government at BBMA level will be responsible in implementing LARAP and other obligations in the ESMP.

Figure 40. Organization of BBMA – BRT Project

9.3. Monitoring, Capacity Building and Budgeting

Adequate budget, safeguard, biodiversity and other specialists required, as well as budget items for ESMP implementation, monitoring and reporting should be made by the PIU in the bidding and contract documents. These include the budgets and resources for training the workers of contractors including sub-contractors and primary suppliers. on E&S implementation, monitoring, and reporting. The PIU through its PMC and/or Design and Supervision Consultants would develop fit-for-purpose training materials on E&S safeguards and provide required trainings to the workers and project personnel responsible for implementing and monitoring the implementation of CESMP including associated management plans. The training is anticipated to consist of two levels, including:

- E&S awareness/induction targeted for all workers; and
- Specific E&S training in technical subjects and interests targeted for technical experts, supervisors, staff, and managerial level and above. These subjects and interests may include, among others: The Bank's ESSs 1, 2, and 3 including its key requirements; E&S safeguard documents and its obligations; Grievance redress mechanisms; and implementation of the project's CESMP, LARAP, SEP, LMP, HIA including monitoring and reporting requirements.
- Regular monitoring will need to be undertaken throughout the project lifecycle. Monitoring results of environmental components such as air quality, noise and vibration, surface water quality, groundwater quality shall be assessed against applicable national and international quality standards. The frequency of monitoring and reporting for the required environmental and social components is proposed vary from a monthly, quarterly, and semi-annually basis as defined in this ESMP as well as CESMP to be developed by the contractors.
- Semi-annual E&S monitoring report and other safeguard reporting requirements will be prepared by the PMU during the construction phase for submission to the Bank, incorporating the semi-annual CESMP implementation (monitoring) reports. This semi-annual monitoring report of the Project will be prepared for the period of January – June and July – December and submitted to the Bank no later than 30 calendar days after the end of each semester. In addition, the summary of CESMP implementation and monitoring should be included as integral section of the Project's progress reports prepared by the contractor on quarterly basis. In terms of meeting government requirements, the Project will also need to prepare the RKL-RPL (Indonesian EMP) monitoring report for submission to respective environmental agencies, both national and sub-national level as appropriate.
- In the event of any design changes that may cause significant E&S impacts or unanticipated E&S impacts not covered in this ESIA, the PIU and/or PMU are required to inform the Bank of an amendment that may be required to the E&S safeguard documents.
- The ESMP will be implemented and reported during the 12 to 18-month construction schedule including commissioning of the BRT project, and this implementation schedule would continue in the event of contract timeline extension is granted. Cost items and budget of EHS and social aspects to be included in the bidding documents and proposed

by the bidder is indicatively listed in the following table. The estimated cost of the CESMP implementation for the BBMA BRT project is approximately USD 940,000 but this figure is subject to change and evaluation, depending upon the work method and quality of specialist and services to be proposed by each contractor. Indicative cost items for the CESMP implementation are presented in the following table.

Table 68. Indicative Cost Items for CESMP Implementation and Capacity Building

EHS and Social Aspects	Cost Items to be Included in the Bidding and Contract Documents (Indicative)
Subject matter experts	H&S construction specialist including his assistance Environmental specialist Paramedic and/or Medical Doctor Road traffic coordinator Structural engineer Mechanical and Electrical engineer Social specialist Stakeholder engagement specialist
Development of project-specific management plans and monitoring reports	CESMP LMP Code of Conduct Building Heritage Impact Assessment Health and Safety Management Plan
Induction, training, and monitoring	EHS and Social induction Safety toolbox talks Training on mitigation of high-risk activities and environmental impacts OHS monitoring
Personnel protective equipment and fire safety	Safety net Identity card for project workers Safety helmet Safety shoes with steel toe cap Goggles Earmuff/plug Gloves Fire extinguishers
Occupational health	First aider and facilities Fogging equipment HIV check and drugs
Environmental	Handling and disposal of hazardous and non-hazardous wastes including construction wastes Portable toilets at construction sites and contractor's basecamps Air quality and water sampling Noise measurement

EHS and Social Aspects	Cost Items to be Included in the Bidding and Contract Documents (Indicative)
	Water spraying for dust suppression Installation of automatic air quality and noise level monitoring stations
Social related aspects	Stakeholder engagement, socialization, and information disclosure events Provision of GRM channels for stakeholders, workers, and for GBV incidents Coordination with third party provider for GBV case handling GBV prevention, HIV/AIDS and communicable diseases awareness campaign Perception survey
Others	BPJS accident insurance Ambulance Signage, poster, etc., for health & safety warning and campaigns

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